N60028_002721
TREASURE ISLAND
SSIC NO. 5090.3.A

FINAL REPORT
SCOPING SURVEY OF WASTEWATER LINES DOWNSTREAM FROM FORMER BUILDING 233
Former Naval Station Treasure Island
San Francisco, California

Contract Number N62473-10-D-0808
Task Order Number 0006
Document Control Number: ITSI-0808-0006-0043

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June 2016

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ABBREVIATIONS AND ACRONYMS

cm	centimeter
cm^2	square centimeter
cpm	counts per minute
DoD	United States Department of Defense
DOE	United States Department of Energy
DQO	data quality objective
dpm	disintegrations per minute
EML	Environmental Measurements Laboratory
EPA	United States Environmental Protection Agency
g	gram
Gilbane	Gilbane Federal
HRASTM	Historical Radiological Assessment – Supplemental Technical Memorandum
in	inch, inches
m	meter(s)
m^2	square meter(s)
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
mg	milligram
min	minute
N/A	not applicable
NaI(Tl)	sodium iodide (thallium activated)
Navy	United States Department of the Navy
NIST	National Institute of Standards and Technology
NSTI	Naval Station Treasure Island
pCi	picocuries
Ra-226	radium-226
RMP	Radiological Management Plan
sec	second(s)
TSP	Task-Specific Plan
ZnS(Ag)	silver-activated zinc sulfide

EXECUTIVE SUMMARY

This report presents the results of the radiological scoping survey performed on wastewater lines downstream from the former (now demolished) Building 233 at the former Naval Station Treasure Island (NSTI), San Francisco, California (Figure 1-1). The radiological scoping survey was conducted from December 2013 to October 2014 for the United States Department of the Navy (Navy) Base Realignment and Closure Program Management Office West by Gilbane Federal (Gilbane).

The *Historical Radiological Assessment – Supplemental Technical Memorandum, Naval Station Treasure Island, San Francisco, California* (HRASTM) identified the former Building 233 sewer drain and the Avenue M storm sewer line downstream from the former Building 233 as radiologically impacted (TriEco-Tt, 2014).

The radionuclide of concern is radium-226 (Ra-226). No previous radiological investigations have been performed. The radiological scoping survey objective was to collect data from the wastewater lines and determine if radioactivity is present that exceeds the radiological screening criteria of:

- 1.0 picocurie per gram (pCi/g) of volumetric radioactivity above background
- 100 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) of total surface radioactivity above background

The wastewater lines downstream from Building 233 were classified into survey units based on the history of the radiological operations conducted by the Navy, the conceptual site model, and professional judgment. The classification determined the level of survey effort. Wastewater lines downstream of Building 233 were designated as Class 1or Class 3 survey units based on their potential for residual radioactivity above the radiological screening criteria.

The following survey data were collected and analyzed:

- Field data: Gross gamma scans and alpha/beta static measurements
- Laboratory data: Volumetric samples submitted for analysis

Radiological scan data were reviewed qualitatively to determine whether further investigation(s) were necessary, and static measurement and laboratory data were analyzed quantitatively for direct comparison to the radiological screening criteria.

Radiological survey data results were below the screening criteria, and there were no indications of radioactive contamination based on field observations. Field and laboratory data demonstrate the wastewater lines downstream from Building 233 are suitable for radiological clearance. No further action is recommended.

1.0 INTRODUCTION

This report presents the results of the radiological scoping survey performed on wastewater lines downstream from the former (now demolished) Building 233 at the former Naval Station Treasure Island (NSTI), San Francisco, California (Figure 1-1). The radiological scoping survey was conducted from December 2013 to October 2014 for the United States Department of the Navy (Navy) Base Realignment and Closure Program Management Office West by Gilbane Federal (Gilbane). The work was performed as Contract Task Order 0006 under the Radiological Environmental Multiple Award Contract N62473-10-D-0808 with the Naval Facilities Engineering Command Southwest.

The radiological scoping survey was performed in accordance with the procedures and methodologies detailed in the *Radiological Management Plan, Naval Station Treasure Island, San Francisco, California* (RMP)) and the *Task-Specific Plan for the Radiological Survey of Building 3 and Impacted Wastewater Drains, Naval Station Treasure Island, San Francisco, California* (Wastewater Drains TSP) (ITSI Gilbane, 2013a and 2013b, respectively).

1.1 OBJECTIVE AND SCOPE

The objective of the radiological scoping survey was to collect data from the wastewater lines to determine if radioactivity is present that exceeds the radiological screening criteria. The scope of work included the collection of field data (radiological scans and static measurements) and laboratory-analyzed volumetric samples for comparison to radiological screening criteria.

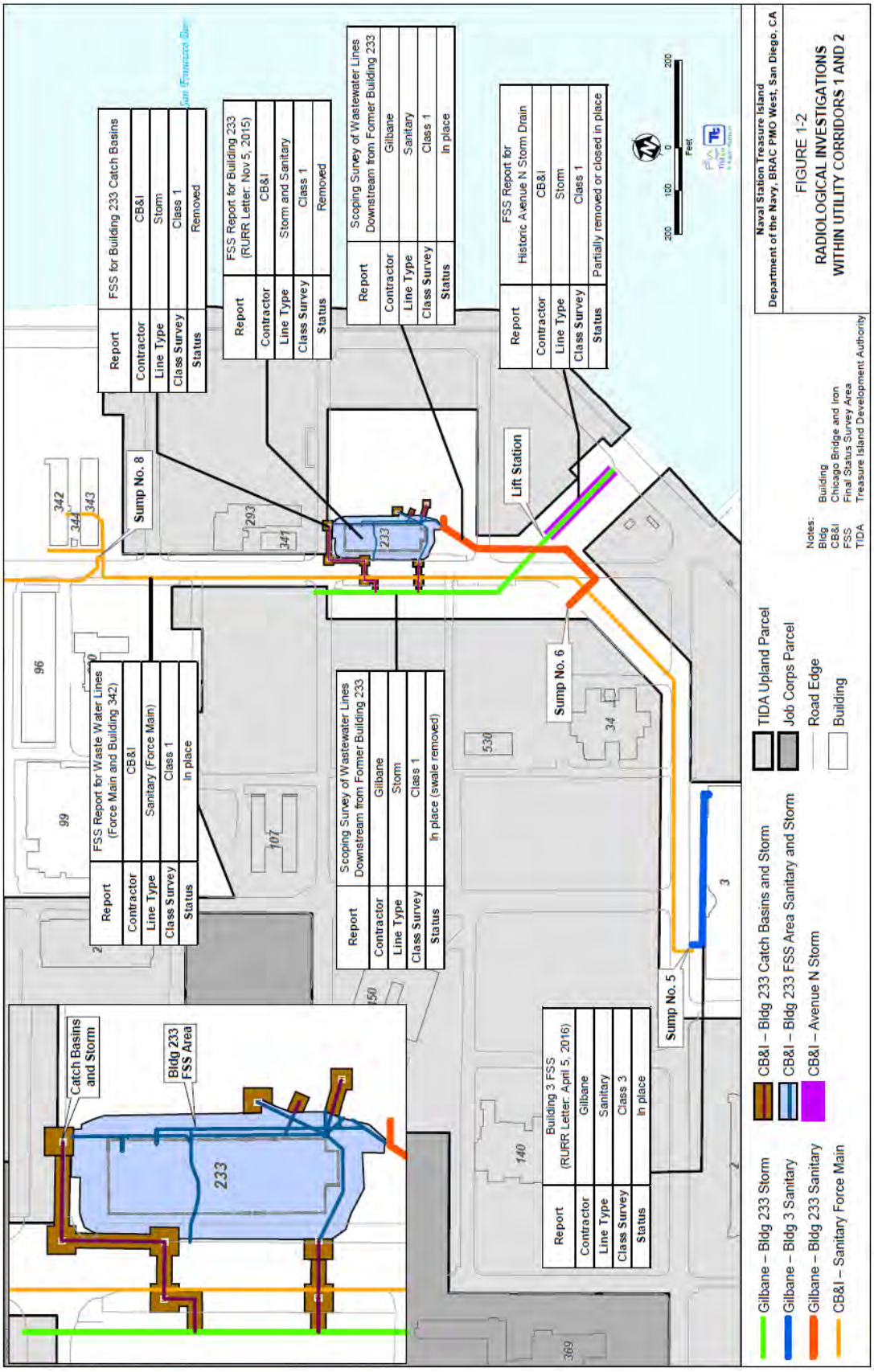
1.2 SITE DESCRIPTION AND BACKGROUND

The former Building 233 was located in the southeastern corner of the former NSTI (Figure 1-1). In 1950, a significant radium spill occurred in Building 233; additionally, contamination was discovered in the wastewater lines. The Navy demolished Building 233 and remediated an area around the building that likely would have been established as a radiologically controlled area boundary during the clean-up of the 1950 spill. The area included a storm drain inlet that was found to be contaminated as well as sanitary sewer and storm drain lines leading from the building. That work was performed earlier by a separate Navy contractor. Figure 1-2 shows the radiological investigations that have been performed in and around the Building 233 footprint in addition to this work scope.

Radiological Scoping Surveys
Department of the Navy
Naval Station Treasure Island
San Francisco, California

Figure 1-1
Impacted Wastewater Lines

G:\ArcGIS\Navy\Treasure_Island\PROJECTS\TI_Rad_Web\Site32\Impacted_Wastewater_Lines.mxd 12/7/2015 AZHUK, Gilbane


Naval Station Treasure Island
Department of the Navy, BRAC PMO West, San Diego, CA
FIGURE 1-2
RADIOLOGICAL INVESTIGATIONS
WITHIN UTILITY CORRIDORS 1 AND 2
Report | FSS for Building 233 Catch Basins
Contractor | CB&I
Line Type | Storm
Class Survey | Class 1
Status | Removed
Report | FSS Report for Building 233 (RURR Letter: Nov 5, 2015)
Contractor | CB&I
Line Type | Storm and Sanitary
Class Survey | Class 1
Status | Removed
Report | Scoping Survey of Wastewater Lines Downstream from Former Building 233
Contractor | Gilbane
Line Type | Sanitary
Class Survey | Class 1
Status | In place
Report | FSS Report for Historic Avenue N Storm Drain
Contractor | CB&I
Line Type | Storm
Class Survey | Class 1
Status | Partially removed or closed in place
Report | FSS Report for Waste Water Lines (Force Main and Building 342)
Contractor | CB&I
Line Type | Sanitary (Force Main)
Class Survey | Class 1
Status | In place
Report | Scoping Survey of Wastewater Lines Downstream from Former Building 233
Contractor | Gilbane
Line Type | Storm
Class Survey | Class 1
Status | In place (swale removed)
Report | Building 3 FSS (RURR Letter: April 5, 2016)
Contractor | Gilbane
Line Type | Sanitary
Class Survey | Class 3
Status | In place
Sump No. 8
Sump No. 6
Sump No. 5
Lift Station
Catch Basins and Storm
Bldg 233 FSS Area
233
342
343
344
293
341
96
99
107
530
34
140
369
150
3
2
200
100
0
200
Feet
Notes:
Bldg Building
CB&I Chicago Bridge and Iron
FSS Final Status Survey Area
TIDA Treasure Island Development Authority
TIDA Upland Parcel
Job Corps Parcel
Road Edge
Building
CB&I – Bldg 233 Catch Basins and Storm
CB&I – Bldg 233 FSS Area Sanitary and Storm
CB&I – Avenue N Storm
CB&I – Sanitary Force Main
Gilbane – Bldg 233 Storm
Gilbane – Bldg 3 Sanitary
Gilbane – Bldg 233 Sanitary

The *Historical Radiological Assessment – Supplemental Technical Memorandum, Naval Station Treasure Island, San Francisco, California* (HRASTM) identified the former Building 233 sewer drain and the Avenue M storm sewer line downstream from the former Building 233 as radiologically impacted since radioactive material may have been discarded or otherwise entered the downstream lines (TriEco-Tt, 2014). The radionuclide of concern is radium-226 (Ra-226). No previous radiological investigations have been performed.

1.3 RADIONUCLIDE OF CONCERN

The radionuclide of concern for the wastewater lines downstream from Building 233 is radium-226 (Ra-226). There are no chemicals of concern.

1.4 RADIOLOGICAL SCREENING CRITERIA

The radiological screening criteria for the wastewater lines downstream from Building 233 are listed in Table 1-1. The release criteria are given in units of disintegrations per minute per 100 square centimeters (dpm/100 cm^2) for total surface radioactivity and in units of picocurie per gram (pCi/g) of volumetric radioactivity.

Table 1-1 Radiological Screening Criteria[a]

Radionuclide of Concern	Total Surface Radioactivity (dpm/100 cm^2)[b,c]	Soil (or Volumetric) Radioactivity (pCi/g)
Ra-226	100	1.0[d]

Notes
[a] Source: RMP Table 3.1 (ITSI Gilbane, 2013a).
[b] Values are net (i.e., above instrument background – see Section 3.1.2) concentrations, in disintegrations per minute per 100 square centimeters (dpm/100 cm^2).
[c] An arbitrary value of 20% of the radiological screening criteria was used to compare smear sample results; for conservative simplicity in execution, alpha activity was assumed to be Ra-226.
[d] Value is concentration above background in picocuries per gram (pCi/g).

1.5 DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) for the radiological clearance of areas, buildings, and structures at the former NSTI are provided in the RMP (ITSI Gilbane, 2013a). Specific DQOs developed for the radiological scoping survey of the wastewater lines downstream from Building 233 are presented below.

1.5.1 Step 1 – Statement of the Problem

The Navy's objective is to obtain radiological clearance of the wastewater lines downstream from Building 233. Radiological contamination may have occurred as a result of the 1950 spill of Ra-226 that occurred in Building 233. Radiological data were needed to determine if radioactivity exceed the radiological screening criteria. Radiological data below the screening criteria provide a technical basis for radiological clearance of the wastewater lines.

1.5.2 Step 2 – Decision Statement

The principal study question was: "Is radioactivity present that exceeds the radiological screening criteria?" Total surface radioactivity measurements and volumetric sample analytical results were used to answer the question quantitatively.

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

- If the levels of radioactivity do not exceed the radiological screening criteria, then the wastewater lines downstream from Building 233 are suitable for radiological clearance.
- If the levels of radioactivity exceed the radiological screening criteria, then the wastewater lines downstream from Building 233 may not be suitable for radiological clearance and will require additional characterization and/or remediation based on consultation with the Navy.

Based on the principal study question and the alternative actions listed above, the decision statement was: "Determine whether the levels of radioactivity exceed the radiological screening criteria."

1.5.3 Step 3 – Inputs to the Decision

Ra-226 is the radionuclide of concern. The impacted media are materials are clay and concrete (piping materials) and surrounding soil where breakage in the pipe may have occurred. For surfaces, alpha/beta static measurements were used as quantitative inputs. Alpha/beta scans and samples of removable surface radioactivity (smears) analyzed for gross alpha/beta radioactivity were used as qualitative inputs. For material such as concrete or soil, volumetric samples analyzed by gamma and/or alpha spectroscopy were used as quantitative inputs for comparison to screening criteria. Gross gamma scans were used as qualitative inputs to access if further investigation(s) were warranted.

1.5.4 Step 4 – Boundaries of the Study

The target population was surface and volumetric radioactivity concentrations of Ra-226 on and/or in the impacted media. The spatial boundaries constitute the potential radiologically impacted media in and around the wastewater lines downstream from Building 233. (described in Sections 5.0 and 6.0).

Decisions were made on three fundamental criteria:

- Localized areas: A decision to collect additional data was determined for discrete areas with radiological measurements that exceeded the screening criteria.
- Survey unit: A decision for each survey unit was determined as to its suitability for radiological clearance for unrestricted use or its need for additional characterization and/or remediation. The wastewater lines were divided into survey units based on similar physical characteristics and potential for residual radioactivity.
- Downstream wastewater lines: Survey data were evaluated in total and used to support decisions for radiological clearance.

1.5.5 Step 5 – Decision Rules

Decision rules were used to collect data (Table 1-2).

Table 1-2 Decision Rules

Parameter of Interest	IF	THEN
Static Measurements	Measurement exceeds radiological screening criteria	Investigate to determine the area of elevated radioactivity, remediate, and resurvey (or consult the Navy)
Volumetric Samples	Sample concentration exceeds radiological screening criteria	Investigate to determine the area of elevated radioactivity, remediate, and resurvey (or consult the Navy)

1.5.6 Step 6 - Limits on Decision Errors

To ensure data quality, data were reviewed, verified, and validated in accordance with the Sampling and Analysis Plan of the RMP (Appendix B; ITSI Gilbane, 2013a). To ensure the usability of laboratory data, laboratory methods were selected to provide the necessary laboratory detection limits.

1.5.7 Step 7 - Optimizing the Survey Design

Steps 1 through 6 of the DQO process and the Sampling and Analysis Plan describe a resource-effective design for collecting sufficient data to fulfill the study objectives of the RMP (Appendix B; ITSI Gilbane, 2013).

2.0 SURVEY DESIGN

A survey design for data collection was developed from the DQO process and guidance from the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM; United States Department of Defense [DoD] et al, 2000). The survey design integrated both probability-based (random-start/systematic) and judgmental (biased) data collection methods to achieve the project DQOs.

2.1 SURVEY UNITS

Wastewater lines downstream from Building 233 were divided into survey units based on the history of the radiological operations conducted by the Navy, the conceptual site model, and professional judgment. The classification determined the level of survey effort. The wastewater lines downstream from Building 233 were designated as Class 1 or Class 3 survey units based on their potential for residual radioactivity above the radiological screening criteria (see Section 1.2) (Table 2-1). Class 1 indicates the highest potential for residual radioactivity above the radiological screening criteria, while Class 3 indicates the lowest potential. MARSSIM does not suggest size limitations on Class 3 survey units (DoD et al, 2000).

Table 2-1 Number and Classification of Survey Units

Wastewater Line	Class 1	Class 3	Total
Avenue M Storm Sewer Line	---	2	2
Building 233 Sewer Drain	1	---	1

Data analysis was performed and a separate decision was made for each survey unit to determine its suitability for radiological clearance for unrestricted use as described in Sections 5.0 and 6.0.

2.2 SCANS

A gross gamma scan was performed to locate radiation anomalies (i.e., irregularities) that may identify areas warranting further investigation. The level of scanning effort was designed to be proportional to the potential for finding areas of elevated radioactivity. The scan method is described in Section 3.2.1.

2.3 STATIC MEASUREMENTS

Static measurements were collected from accessible and suitable locations. The static measurements provide a quantitative measure of the radioactivity present for comparison to the radiological screening criteria. Only alpha/beta static measurements were performed. The static measurement method is described in Section 3.2.2.

2.3.1 Number of Measurements

A minimum of 20 static measurements were collected per survey unit. This number of static measurements were developed using the MARSSIM process and is based on the design goals and constraints listed in Attachment 1 of the RMP (ITSI Gilbane, 2013a).

2.3.2 Measurement Locations

A random-start systematic pattern was applied in a linear manner. Individual measurement locations were randomly selected linearly along the survey unit to avoid clustering.

2.4 VOLUMETRIC SAMPLES

Volumetric samples (soil and sediment) were collected for laboratory analysis where residual radioactivity may have been present and/or additional qualitative data (form and/or isotopic composition) was desired. Volumetric sample locations were selected based on static measurement data and/or professional judgement. The volumetric sampling method is described in Section 3.2.3.

3.0 DATA COLLECTION

Survey data were collected in accordance with the procedures and methodologies detailed in the RMP and the Wastewater Drains TSP (ITSI Gilbane, 2013a and 2013b, respectively). The Wastewater Drains TSP is included as Attachment 1. Deviations were documented as a field change request; field change requests are provided in Appendix A. Radiation work instructions (RWIs) for operating the Radiation Solutions' RS-700 gamma scintillation detector and for handling radioactive commodities were developed to supplement guidance provided in the RMP (ITSI Gilbane, 2013a); however, neither were used for the survey of the wastewater lines downstream of Building 233.

3.1 SURVEY INSTRUMENTATION

Commercially available radiation detection and measurement instruments were selected based on reliable operation, detection sensitivity, operating characteristics, and expected performance in the field (Table 3-1). Survey instrumentation data are provided in Appendix B.

Table 3-1 Survey Instrumentation

Measurement Type	Detector Type	Effective Detector Area and Window Density	Instrument Model	Detector Model
Gross gamma scan	NaI(Tl) scintillation	5.1 cm diameter/length (2x2-in) N/A	Ludlum 2221	Ludlum 44-10
Alpha/beta scan/static	Dual phosphor scintillation	100 cm^2 1.2 mg/cm^2 aluminized Mylar	Ludlum 2360	Ludlum 43-93
Alpha/beta smears	Dual phosphor scintillation	5.1 cm diameter 0.4 mg/cm^2	Ludlum 2929	Ludlum 43-10-1

Notes
cm^2 = square centimeter
cm = centimeter
in = inch
mg/cm^2 = milligrams per square centimeter
NaI(Tl) = sodium iodide (thallium activated)
N/A = not applicable

3.1.1 Instrument Calibration and Maintenance

Survey instruments were calibrated prior to use. Radioactive sources used for calibration purposes were traceable to the National Institute of Standards and Technology (NIST). Instruments were inspected prior to each use to ensure proper working condition and were properly protected against inclement weather conditions during the operation.

3.1.2 Instrument Response

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

Prior to initial instrument use, 10 to 20 measurements were taken using a source representative of the radiation types and energies of interest. The same number of measurements were also taken with the source removed to determine the instrument's expected response to ambient background. Background was monitored qualitatively to assess daily variations that may have impacted instrument minimum detectable concentrations (MDCs).

3.1.3 Detection Sensitivity

No assessment of gamma scan detection sensitivity was made since the sole purpose of the gross gamma scan was to locate radiation anomalies that may indicate areas that warrant further investigation.

Alpha/beta detection sensitivities of survey instrumentation used are shown in Table 3-2. The results shown are based on actual count times, background counts, and total efficiencies. Multiple values indicate the range across the instruments that were used in the scoping surveys. Instrument-specific values based on actual field conditions were used to establish *a priori* MDCs before the instruments were used to ensure the instrument's capability of detecting radiation at or below the radiological screening criteria. The MDC values were calculated in accordance with the RMP (ITSI Gilbane, 2013a).

The instrument efficiency (the ratio between the net count rate of the instrument and the 2π surface emission rate of a radiation source) was determined by counting the source with the detector in a fixed position from the source (reproducible geometry). A jig was used to create the reproducible geometry and a source-to-detector distance of 0.5 centimeter (cm) was used. A surface efficiency of 0.5 was used for beta-emitting radiations. A value of 0.25 was used for alpha-emitting radiations. These values were established based on surface geometry

considerations. The surface efficiency is the ratio between the number of radiation particles emerging from the measurement surface of the area being surveyed (the source) and the total number of radiation particles being released within that source per unit time.

Table 3-2 Detection Sensitivities

Detector Model	Radiation of Interest	Count Time (min)	Back-ground (cpm)	Total Efficiency[a] (cpm/dpm)	Scan MDC[b] (dpm/100 cm^2)	Static MDC[c] (dpm/100 cm^2)
Ludlum 43-93	Alpha	1	0-1	0.08-0.10	---	48-92
Ludlum 43-93	Beta	1	93-162	0.08-0.15	882-1,472	384-615
Ludlum 43-10-1	Alpha	2	0-1	0.19-0.20	---	15-17
Ludlum 43-10-1	Beta	2	39-41	0.16-0.22	---	101-141

Notes
[a] Total efficiency equals instrument efficiency multiplied by surface efficiency; alpha = 0.25, beta = 0.5.
[b] Scan MDC is calculated per MARSSIM (DoD, 2000) Equation 6-10 and assumes a surveyor efficiency of 0.5, an observation interval of 1.8 seconds (which results from a scan speed of 5 cm/sec), and a value of 1.38 for acceptable false indications.
[c] Static MDC is calculated per MARSSIM (DoD, 2000) Equation 6-7.

cm^2 – square centimeter(s)
cpm – counts per minute
dpm – disintegrations per minute
min – minute

3.2 MEASUREMENT METHODS

Survey data were collected using three primary types of measurement methods: gross gamma scans, alpha/beta statics, and volumetric samples. Table 3-3 summarizes the data collected using each method.

Table 3-3 Types of Measurement Methods Used and Data Collected

Wastewater Line	Gross Gamma Scans		Alpha/Beta Statics	Volumetric Samples
	Surface	Piping		
Building 233 Sewer Drain	---	100%[a]	---	9
Avenue M Storm Sewer Line	100%	100%	22	---

Notes
[a] limited to manhole surfaces accessible from the ground surface and piping segments retrieved from the trench by backhoe bucket

3.2.1 Gross Gamma Scans

Gross gamma scans inside the Avenue M below ground storm sewer line were performed using a Ludlum Model 44-10 2-inch by 2-inch (5.1 cm) NaI(Tl) gamma scintillation detector with a Ludlum 2221 rate meter/scaler detector. The detector was moved through the piping at a speed of 0.5 m/s or less. No attempt was made to orient the detector relative to the inside of the pipe. Moving the detector through the pipe along the bottom where residual radioactivity is more likely to accumulate conservatively biases the scan results high.

3.2.2 Alpha/Beta Static Measurements

Alpha/beta static measurements collected along the Avenue M storm sewer line aboveground drainage ditch were performed using a Ludlum Model 43-93 100-cm^2 silver-activated zinc sulfide [ZnS(Ag)] dual phosphor scintillation detector with a Ludlum Model 2360 alpha/beta data logger. Static measurements were performed by placing the detector on or near the surface to be measured (i.e., dry concrete surface free of debris), taking a two-minute scaler count, and recording the reading.

Swipe samples were collected at static measurement locations to detect removable radioactivity. Samples were collected over approximately 100 cm^2 and analyzed for alpha/beta radioactivity using a Ludlum Model 43-10-1 ZnS(Ag) dual phosphor alpha/beta scintillation detector with a Ludlum Model 2929 alpha/beta scaler. Samples were counted for two minutes.

3.2.3 Volumetric Samples

Volumetric samples of soil and sediment were collected at locations along the Building 233 sewer drain. Approximately 1,000 grams of material was collected per sample, if available. Visually identifiable foreign objects and debris were separated manually in the field. Sampling equipment (e.g., hand and power tools, mixing utensils, and homogenizing bowls) were decontaminated (using dry methods) after each sample collection to prevent cross-contamination of the sample media.

Samples were double bagged in one-gallon resealable plastic bags, numbered, logged, and sent for laboratory analysis. Each sample was labeled and assigned a unique sample identification number. A chain-of-custody record accompanied the samples to the laboratory for tracking

purposes. Any special handling requirements of the laboratory were documented on the sample chain-of-custody record. Samples were packed to ensure safe arrival at the laboratory.

Samples were analyzed by TestAmerica Laboratories, Inc., in St. Louis, Missouri (TestAmerica St. Louis). TestAmerica St. Louis is accredited under the DoD Environmental Laboratory Accreditation Program. Samples were analyzed in accordance with the Environmental Measurements Laboratory (EML) Procedures Manual (United States Department of Energy [DOE], 1997). Analysis for Ra-226 was performed using United States Environmental Protection Agency (EPA) Method 901.1MOD/DOE EML Health and Safety Laboratory-300 Method GA-01-R (DOE, 1997). The activity concentration of Ra-226 was inferred from bismuth-214 after a sufficient in-growth period to achieve secular equilibrium. Samples were packaged in hermetically sealed containers prior to initiating the in-growth period to avoid radon-222 losses.

4.0 DATA ANALYSIS

The survey data were collected in accordance to the project DQOs and are both quantitative and qualitative (Sections 5.0 and 6.0). Static measurement and volumetric sample data from a laboratory were analyzed quantitatively for direct comparison to the radiological screening criteria, and radiological scan data were analyzed qualitatively to determine whether further investigation was necessary.

4.1 DATA VALIDATION AND VERIFICATION

Survey data were reviewed for authenticity, appropriate documentation, and technical defensibility. Review criteria for data acceptability were as follows:

- The instruments used to collect the quantitative data were capable of detecting the radiation types and energies of interest at or below the radiological screening criteria.
- Instrument calibration source(s) were current and traceable to NIST.
- Instrument response was checked before use each day.
- The MDCs, and the assumptions used to develop them, were appropriate for the instruments and the survey methods used to collect the data.
- The survey methods were appropriate for the media and type(s) of radiation.
- The laboratory sample chain-of-custodies were tracked from the time of collection until the final results were reported.

If one or more of the criteria were not met, the discrepancy was reviewed and the reasons for acceptability of the data or the corrective actions taken to restore data acceptability were documented.

4.2 DATA REVIEW

Alpha/beta static measurements and volumetric samples were compared to the radiological screening criteria. Static measurements were graphed to identify patterns, relationships, or potential anomalies in the data.

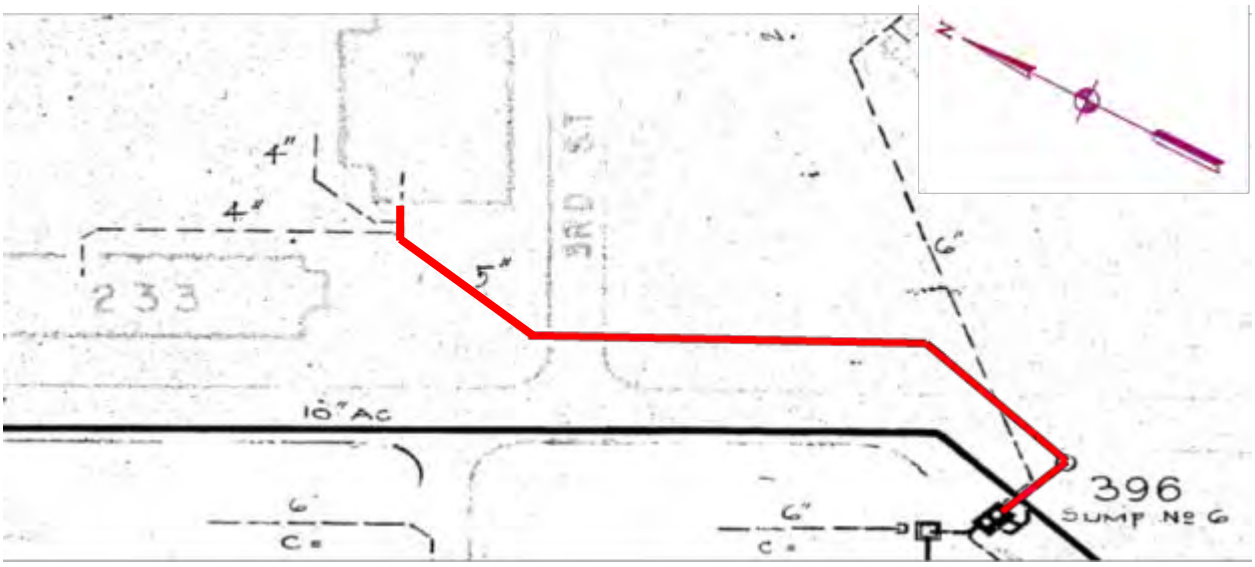
5.0 BUILDING 233 SEWER DRAIN

The HRASTM identified the sewer drain downstream from Building 233 as radiologically impacted as the sanitary drains from the sinks, washbasins, and lavatories in Building 233 may have carried radioactive contamination.

5.1 SURVEY UNIT

The sewer drains downstream from former Building 233 drain by gravity to Sump No. 6 (Figure 5-1). The Building 233 sewer drain was treated as a single survey unit as described in Table 5-1. The potentially impacted media are vitreous clay, PVC, and the surrounding soil or building material.

Figure 5-1 Building 233 Sewer Drain Map



(Source: Drawing No. T.I. SE-121; piping within scope denoted in red)

Table 5-1 Building 233 Sewer Drain Survey Unit

Survey Unit Description	Pipe Diameter (inches)	Linear Length (m)	No. of Manholes Accessed	Pipe Material
Gravity-fed wastewater line (below grade) and associated manholes draining former (demolished) Building 233 to Pump Station 6	5-6	120	3	vitreous clay, PVC

5.2 DATA COLLECTION

Two primary types of data were collected from the Building 233 sewer drain: gross gamma scans and volumetric sample results. The gross gamma scan data are provided in Appendix C. The sample analytical results are provided in Appendix D.

The Wastewater Drains TSP planned for a surveyor entering the excavation and performing radiation measurements and collecting samples of material in and around the exposed drain piping. The Building 233 sewer drain was discovered to be deeper (1.2 to 1.8 m) than expected which made trench entry by a surveyor impractical due to the health and safety concerns. Based on this survey constraint, a modified approach was developed to collect data without a surveyor entering the excavation. Where manholes or other access points were not available, an opening (i.e., pothole) was excavated to obtain access to the line (Figure 5-2). Since the Building 233 sewer drain is no longer in service, the backhoe bucket was used to remove a small segment of intact pipe at an access point in lieu of the surveyor entering the excavation. A field change request was prepared to document this modified approach (Field Change Request 03, dated 28 April 2014; Appendix A).

Figure 5-2 Building 233 Sewer Drain Access

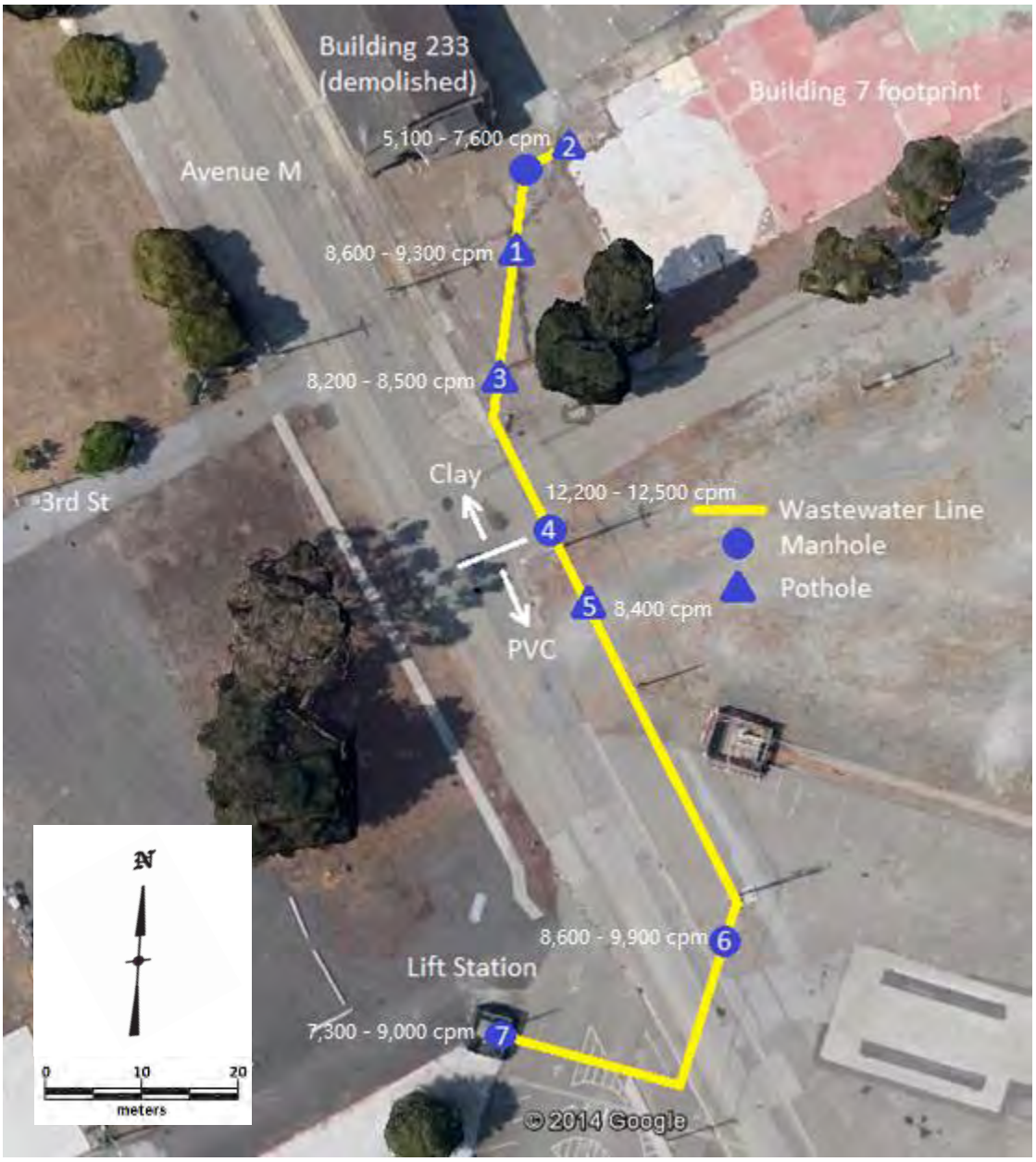
Sewer Drain Accessed via Manhole

Sewer Drain Exposed and Accessed via Backhoe

A combination of visual inspection, gross gamma scans, and samples of residual material inside the pipe and soil surrounding the pipe were collected to determine the radiological condition of the sewer drain and the surrounding soil.

A series of three manholes and four potholes was used to gain access to the pipe and soil surrounding the Building 233 sewer drain. The access points are shown on Figure 5-3.

Figure 5-3 Building 233 Sewer Drain Access Points with Gamma Scan Results



5.3 GROSS GAMMA SCANS

Gross gamma scans were performed at each access point and are summarized in Table 5-2. Measurement locations and corresponding values are shown in Figure 5-3. The gross gamma scan data demonstrate the continuity of radiation levels along the length of the sewer line.

Table 5-2 Building 233 Sewer Drain Gross Gamma Data Summary

Access Point	Type of Access	Readings (gross cpm)[a]	
		Inside Pipe	Under Pipe
1	pothole	8,600	9,300
2	pothole	5,100	7,600
3	pothole	8,200	8,500
4	manhole[b]	12,500[c]	12,200[d]
5	pothole	n/a	8,400
6	manhole[e]	9,900[c]	8,600[d]
7	manhole[e]	7,300[c]	9,000[d]

Notes
[a] Readings were taken with Ludlum Model 44-2 1x1 gamma scintillation detector; as a reference point, daily instrument background = 953 cpm.
[b] Brick manhole
[c] Reading was taken in manhole approximately 0.6 m above floor.
[d] Reading was taken in manhole adjacent to pipe.
[e] Concrete manhole

Readings through the sewer line were consistent with the exception of the brick manhole where the readings were 2,000 to 3,000 cpm higher. The pipe and brick manhole readings were approximately 7 to 10 times the instrument background; these readings are reasonably due to naturally occurring radioactivity in clay pipe and brick and the 360-degree geometry in which the detector was placed. Readings from the two other non-brick (concrete) manholes are consistent with sewer line readings. Figure 5-4 illustrates the construction of the concrete manholes.

Figure 5-4 Photos of Concrete Manholes Along Building 233 Sewer Drain

The radioactivity in clay pipe, brick, and concrete is a function of the amount of naturally occurring uranium, thorium, and potassium in the material used to construct them. The variations in radiation levels among the clay pipe, the brick manhole, and the concrete manholes, which are relatively small, can readily be explained based on the different types of building materials made at different times in different locations using different constituent materials.

5.4 VOLUMETRIC SAMPLING

A large area swipe of the pipe retrieved using the backhoe bucket was performed and field counted to identify any removable radioactivity; none was identified. Approximately two-thirds of the sewer line was observed to be PVC pipe which had been installed to replace the original vitreous clay piping (see Figure 5-3). No attempt was made to breach the PVC pipe and collect samples of material inside that portion of the sewer line for the following reasons. The contaminating event(s) occurred prior to the PVC pipe installation, and any contaminated piping and surrounding soil would have been removed. There was no evidence of contamination in the original vitreous clay pipe upstream of the replacement PVC pipe. Samples of material inside the pipe (or manhole) and of soil surrounding the pipe were collected. Laboratory analytical results are summarized in Table 5-3. Ra-226 concentrations ranged from 0.16 to 0.78 pCi/g which are below the radiological screening criteria and consistent with background concentrations.

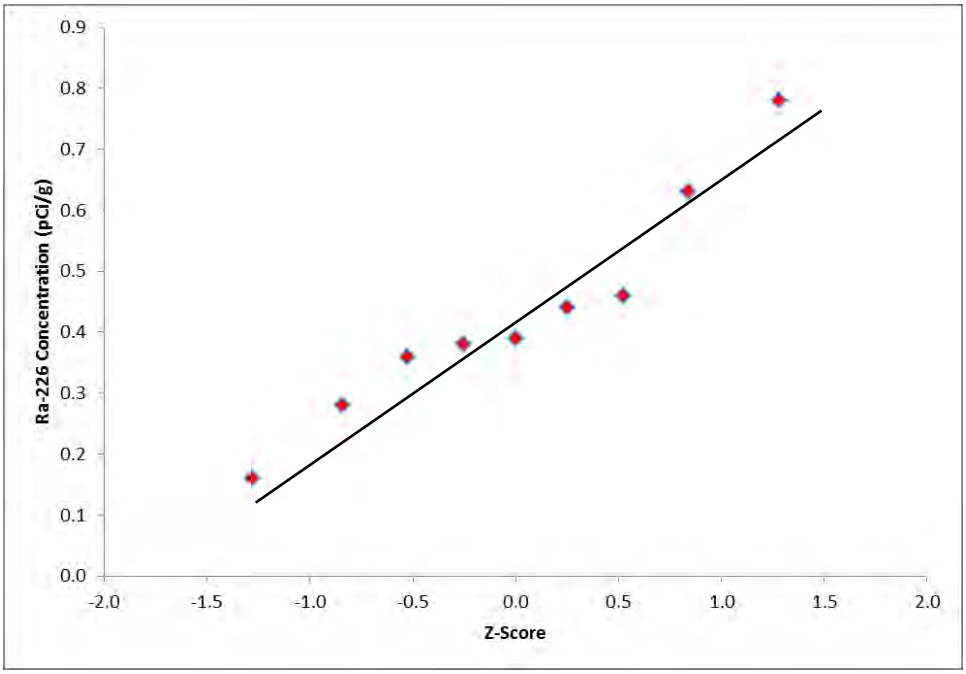
Table 5-3 Building 233 Sewer Drain Sample Data Summary

Access Point	Sample Results (pCi/g)[a]			
	Inside Pipe		Under Pipe	
	Sample ID	Ra-226	Sample ID	Ra-226
1	B233PH001	0.63	B233PH002	0.78
2	B233PH003	0.16	B233PH004	0.36
3	B233PH006	0.46	B233PH005	0.28
4	B233PH007[b]	0.38	N/A[b]	---
5	N/A[c,d]	---	B233PH008	0.44
6	B233PH009[b]	0.39	N/A[b]	---
7	N/A[c,e]	---	N/A[b]	---

Notes
[a] Reported to two significant figures.
[b] Sample was collected from sediment inside the manhole.
[c] No sample collected.
[d] Pipe (PVC) was not breached at that location for sample collection.
[e] Suitable sample material was not available.

The Ra-226 sample results were plotted on a cumulative frequency diagram to provide information on the general shape of the data distribution and to identify data distribution anomalies (Figure 5-5). The diagram was constructed assuming normally distributed data that form a straight line when plotted. A sharp bend in the plotted data indicates the possibility of multiple distributions, and outliers plot as individual points separate from the rest of the distribution. Such anomalies indicate dissimilarity in the data as would be present with radioactive contamination. The data set, though small, appears to be normally distributed. There are no appearances of multiple populations or distinct outliers suggesting radioactive contamination.

Figure 5-5 Cumulative Frequency Diagram: Building 233 Sewer Drain Sample Results



5.5 DATA ASSESSMENT

The radiological scoping survey consisted of Building 233 sewer drain running from the site of the former Building 233 to the lift station. A series of manholes and excavated potholes were used to gain access to the pipe and surrounding soil. Gross gamma scans were performed at each access point. The gross gamma scan data through the line and non-brick (concrete) manholes were consistent except for the brick manhole which were 2,000 to 3,000 cpm higher. The pipe and manhole readings were approximately 7 to 10 times the instrument background readings;

these data are reasonable as variations in naturally occurring radioactivity is found in clay pipe, brick, and concrete. A large area swipe of the pipe was performed at each access point and field counted to identify any removable radioactivity: none was identified. Regardless of the gross gamma scan readings, samples of material collected from inside the pipe (or manhole) and soil surrounding the pipe reported Ra-226 concentrations ranged from 0.16 to 0.78 pCi/g which are below the radiological screening criteria.

Data results from the Building 233 sewer drain were below the radiological screening criteria, and no evidence of radiological contamination was observed.

6.0 AVENUE M STORM SEWER LINE

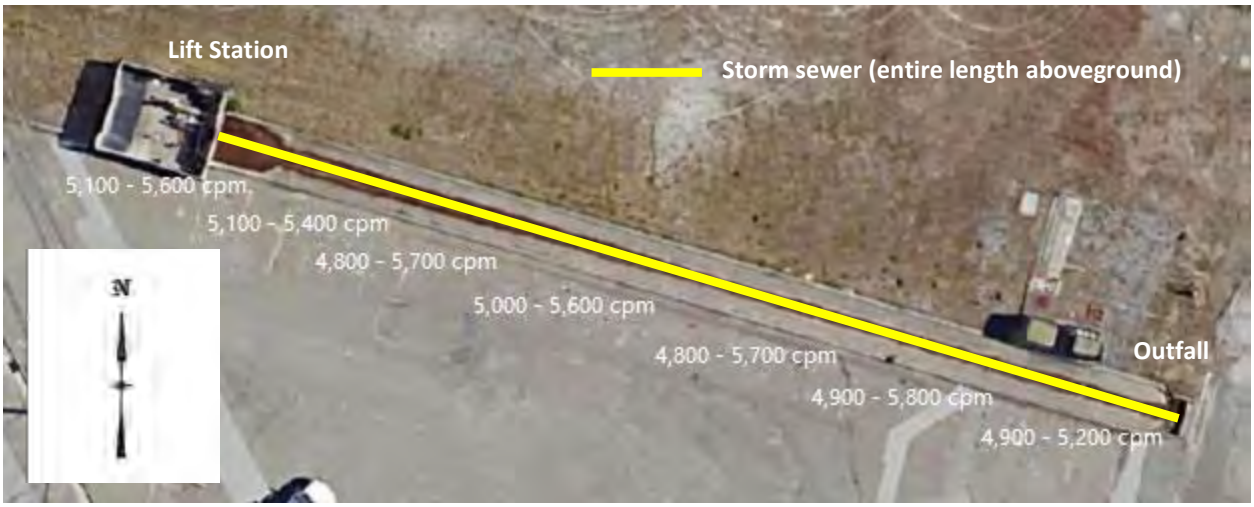
The HRASTM identified the Avenue M storm sewer line downstream from Building 233 as radiologically impacted due to the clean-up of the 1950 spill of Ra-226 that occurred in Building 233 (Figure 6-1).

6.1 SURVEY UNITS

The storm sewer running along Avenue M next to Building 233 drains north to south from 4th Street (immediately north of Building 233) to the lift station and is underground. At the lift station, the sewer acts as an above-ground drainage ditch that runs to the outfall. The in-ground and above-ground segments of the storm sewer line are shown in Figures 6-1 and 6-2, respectively.

Figure 6-1 Avenue M Storm Sewer In-Ground Segments with Gamma Scan Results

Figure 6-2 Avenue M Storm Sewer Above-Ground Segment with Gamma Scan Results



The Avenue M storm sewer line downstream from Building 233 was treated as two survey units as described in Table 6-1. The potentially impacted medium is concrete and the surrounding soil or building material in the event a leak occurred.

Table 6-1 Avenue M Storm Sewer Line Survey Units

Survey Unit Description	Pipe Diameter (inches)	Linear Length (m)	No. of Manholes Accessed	Pipe Material
Storm sewer draining north to south along Avenue M from 4th Street to pump station	21-24	160	5	concrete
Drainage ditch running east southeast from lift station to outfall	N/A	37	N/A	concrete

6.2 DATA COLLECTION

Two primary types of data were collected from the Avenue M storm sewer line: gross gamma scans and alpha/beta static measurements. Scan and static measurement data are provided in Appendix E and summarized in Tables 6-2 and 6-3.

Surveys were performed starting at the upstream end of the storm sewer line and working toward the downstream terminus. A combination of video inspection, gross gamma scans, and alpha/beta static measurements were collected to determine the radiological condition of the storm sewer line. Data were collected in six survey segments from five access points along the

length of the Avenue M storm sewer line (Figure 6-1). Data were collected along a seventh segment running the entire aboveground length from the lift station to the outfall (Figure 6-2).

A visual inspection of the in-ground pipe internals was performed by running a video camera mounted on a crawler through the pipe to identify sediment, debris, and/or cracked or broken piping where leakage may have occurred (see Figure 6-3). A Ludlum Model 44-10 gamma scintillation detector mounted to the crawler was used to perform a gross gamma scan between access points. No sediment was readily available inside the pipe for sample collection. The video inspection revealed points of root intrusion into the pipe at pipe joints. No soil samples adjacent to and/or beneath the drain piping were collected as the video inspection and scan survey revealed a pipe in good condition with no suspect integrity or contamination issues.

Figure 6-3 Avenue M Storm Sewer Line Inspection

Preparing Pipe Crawler for Video Inspection and Gross Gamma Scan

6.3 GROSS GAMMA SCANS

Gross gamma readings through the line ranged from 8,000 to 10,500 cpm (Table 6-2). Measurement locations and corresponding values are shown in Figure 6-1. These reading are approximately two times instrument background which are likely due to the subsurface location inside the concrete pipe. A drop in radiation levels inside the pipe (6,500 cpm) occurred where water was encountered. This is likely the result of the attenuating effects of water on radiation levels. The lower readings along the drainage ditch, ranging from 4,800 to 5,800 cpm, are roughly equal to the instrument background and reflect the difference in source-to-detector geometry between a pipe and plane source. Measurement locations and corresponding values are

shown in Figure 6-2. Gross gamma readings were consistent along the length of the drainage ditch.

Table 6-2 Avenue M Storm Sewer Gross Gamma Scan Data Summary

Survey Segment				Readings (gross cpm)[a]	
No.	**Length (m)**	**Start**	**Stop**	**Low**	**High**
1	13.7	Manhole #2	Blockage[b]	8,000	8,000
2	7.6	Manhole #1	Blockage[c]	9,500	10,500
3	52.4	Manhole #2	Manhole #3	10,000	10,000
4	31.1	Manhole #3	Manhole #4	8,000	9,700
5	26.2	Manhole #4	Manhole #5	8,600	9,500
6	21.9	Manhole #5	Lift Station	6,500[d]	8,600
7[e]	36.7	Lift Station	Outfall	4,800	5,800

Notes

[a] Readings were taken with Ludlum Model 44-10 2x2 gamma scintillation detector; as a reference point, the daily instrument background = 4,600 – 5,200 cpm.

[b] Survey performed in upstream direction (toward Manhole #1). Pipe blocked with debris and survey abandoned 13.7 m into pipe.

[c] Survey performed in downstream direction (toward Manhole #2). Pipe blocked with debris and survey abandoned 7.6 m into pipe, leaving approximately 6.1 m between blockages that was not surveyed (total length between Manholes #1 and #2 is 27.4 m)

[d] Presence of water noted approximately 33.7 m into the pipe, at which point gross gamma readings dropped from 8,600 cpm to 6,500 cpm.

[e] Segment consists of above-ground storm sewer drainage ditch running from lift station to outfall; lower readings reflect a difference in geometry between pipe and plane source.

6.4 ALPHA/BETA STATIC MEASUREMENTS

Alpha/beta static measurements were collected in systematic pattern across the aboveground drainage ditch. Static and removable activity measurement data are summarized in Table 6-3.

Table 6-3 Avenue M Storm Sewer Above-Ground Static Measurement Data Summary

Parameter	Static (Total Activity)		Removable Activity	
	Alpha	**Beta**	**Alpha**	**Beta**
Random-Start/Systematic Measurements				
Count	22	22	22	22
MDC (dpm/100 cm^2)	53	477	15	15
Measurements ≥ MDC	6	20	0	0
Measurements ≥ screening criterion	0	0	0	0
Minimum (dpm/100 cm^2)	< MDC	< MDC	< MDC	< MDC
Maximum (dpm/100 cm^2)	94	905	< MDC	< MDC

Note

[a] A second instrument was used to collect 10 of the 22 random-start/systematic static measurements. Static MDCs were 92 dpm/100 cm^2 alpha and 484 dpm/100 cm^2 beta.

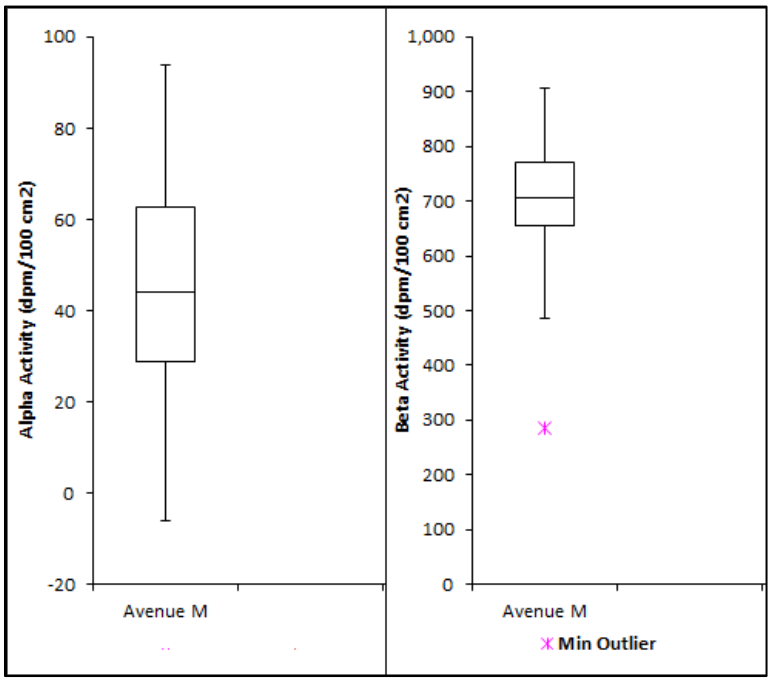
The alpha and beta static measurements are graphed on Figures 6-4, 6-5, and 6-6. The alpha static measurements are below the radiological screening criteria. There are no radiological screening criteria for beta static measurements.

The storm sewer lines carrying potentially contaminated water from Building 233 activities are the surfaces of interest, and not the manholes. Consequently, no static measurements of the manholes were collected; only measurements of the sewer lines accessed through the manholes were collected.

6.4.1 Box and Whisker Plot

Box and whisker plots provide insight into the location, shape, and spread of the data. These plots identify the outlier on the lower end of the beta static measurement data distribution (Figure 6-4). The bottom and top of the box represent the first and third quartiles, and the line inside the box represents the second quartile (the median). The whiskers ends represent the minimum and maximum values of the data which are within 1.5 times the interquartile range (i.e., the difference between the first and third quartiles). Maximum or minimum values outside that range are shown as outliers. While there may be multiple outliers, only the outlier representing the maximum or minimum value is plotted.

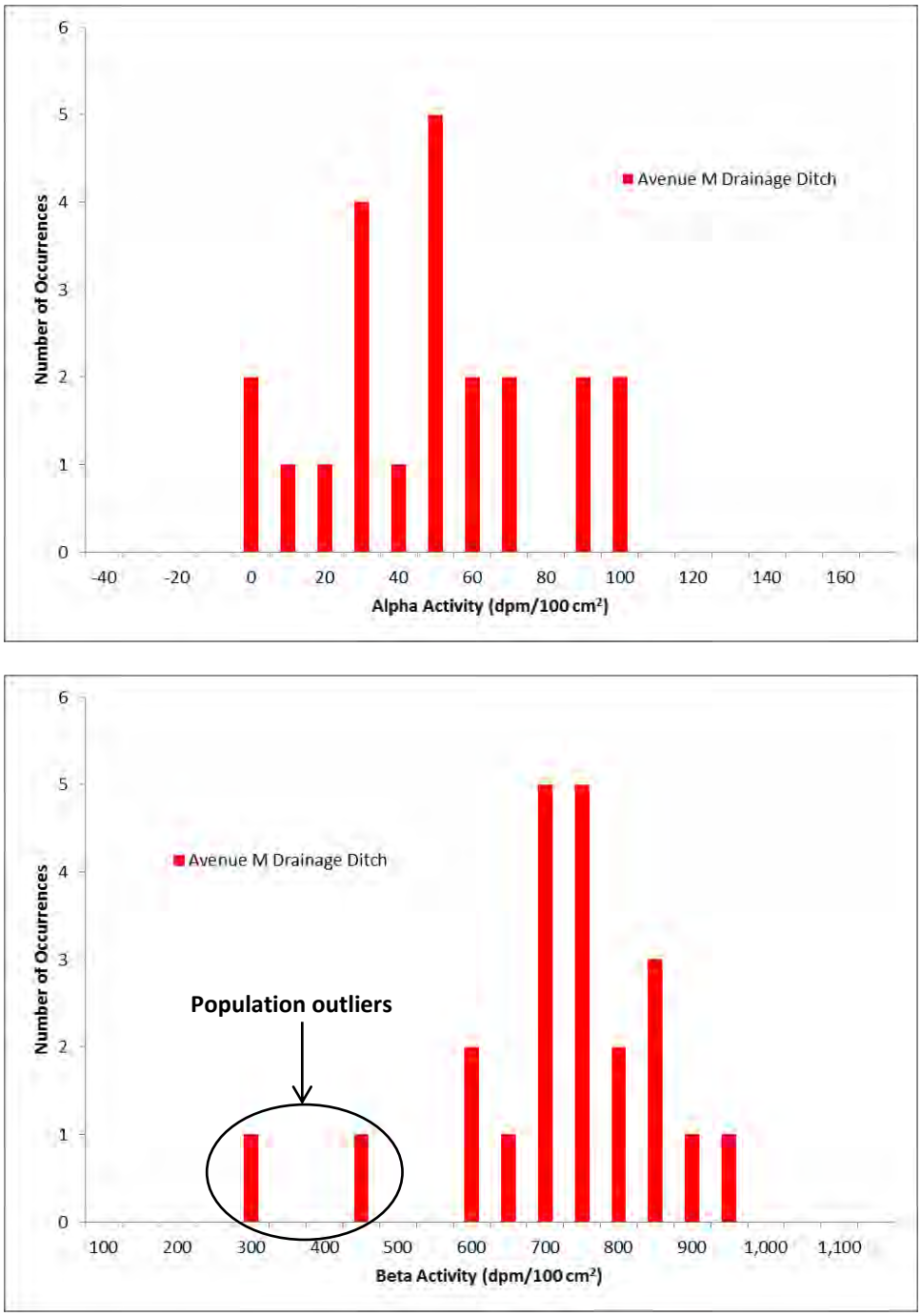
Figure 6-4 Box and Whisker Plots: Avenue M Drainage Ditch Alpha/Beta Statics



6.4.2 Frequency Plot

Frequency plots were used to examine the general shape of the data distribution (Figure 6-5). The frequency plot for the beta static measurements shows the lower end outliers as discussed above.

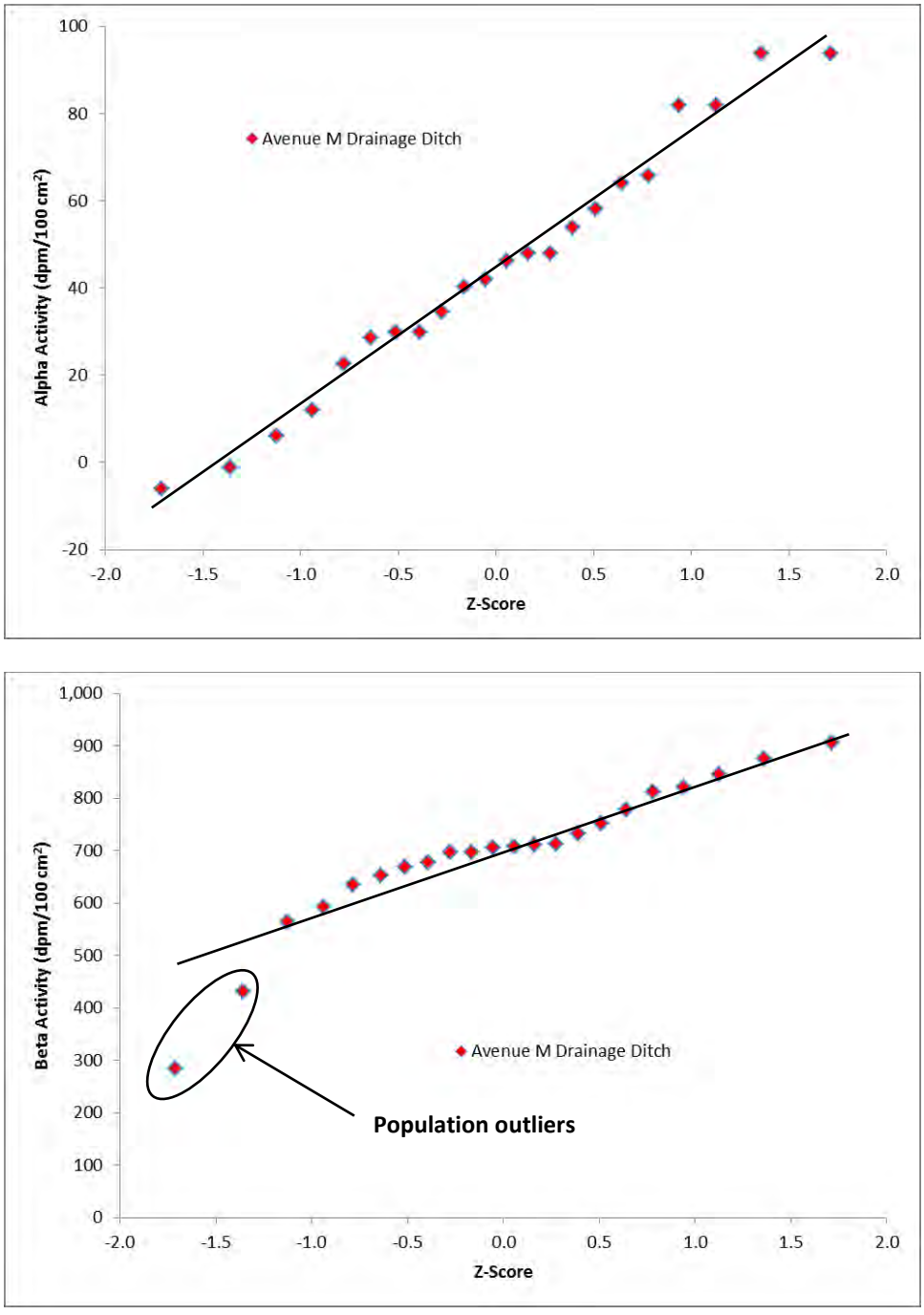
Figure 6-5 Frequency Plots: Avenue M Drainage Ditch Alpha/Beta Statics



6.4.3 Cumulative Frequency Diagram

Cumulative frequency diagrams were used to provide information on the general shape of the data distribution and to identify data distribution anomalies (Figure 6-6).

Figure 6-6 Cumulative Frequency Diagrams: Avenue M Drainage Ditch Alpha/Beta Statics



Both the alpha and beta data sets exhibit a high degree of normality. There were no appearances of multiple populations suggesting radioactive contamination. The distinct outliers observed on the alpha and beta plots correspond to the data point outliers identified by the frequency plots. While elevated measurements may indicate the presence of radioactive contamination, the lower-end outliers are of no particular interest due to their low numerical values.

6.5 DATA ASSESSMENT

The radiological scoping survey consisted of the storm sewer draining north to south running along Avenue M next to Building 233 from 4th Street to lift station and the drainage ditch running from the lift station to the outfall.

A visual inspection of the pipe internal surfaces was performed by running a video camera mounted on a crawler through the pipe to identify sediment, debris, and cracked or broken piping where leakage may have occurred. No sediment was available inside the pipe for sample collection. No soil samples adjacent to and/or beneath the drain piping were collected as visual inspection indicated no leakage had occurred. Based on the video inspection, the pipe appeared to be in good condition with no visible signs of damage. A gross gamma scan was performed on both the belowground storm sewer line and the aboveground drainage ditch. The gross gamma scan data were consistent throughout the storm sewer line.

Alpha/beta static measurements were collected in systematic grid pattern across the drainage ditch. Swipe samples were collected at each static measurement location. Static measurements reported total surface radioactivity less than the radiological screening criteria. No indications of removable radioactivity were observed.

Graphical review of the alpha/beta static measurement data revealed statistical outliers in the beta data set; however, these data do not indicate contamination due to their low numerical values relative to the radiological screening criteria.

Data results of the Avenue M storm sewer line were below the radiological screening criteria, and no evidence of radiological contamination was observed.

7.0 SUMMARY AND RECOMMENDATIONS

Radiological scoping survey data from the wastewater lines downstream from Building 233 were below the radiological screening criteria. Additionally, no evidence of radioactive contamination were observed. These data indicate the wastewater lines downstream from Building 233 are recommended as suitable for radiological clearance. No further action is recommended.

8.0 REFERENCES

DoD, 2000. Department of Energy, Nuclear Regulatory Commission, and U.S. Environmental Protection Agency. *Multi-Agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Revision 1. August.

DOE, 1997. EML Procedures Manual, Environmental Measurements Laboratory, HASL-300, Volume I, 28th Edition, Revision 0, available online at http://www.nbl.doe.gov/htm/EML_Legacy_Website/ProcMan/Start.htm, Procedure Ga-01-R Mode, New York, New York, February.

ITSI Gilbane, 2013a. *Radiological Management Plan, Naval Station Treasure Island, San Francisco, California.* Final. August.

ITSI Gilbane, 2013b. *Task-Specific Plan for the Radiological Survey of Building 3 and Impacted Wastewater Drains, Naval Station Treasure Island, San Francisco, California.* Final. October.

Navy, 1972. *Treasure Island Sanitary Sewer System*, Drawing No. T.I. SE-121. August.

TriEco-Tt, 2014. *Historical Radiological Assessment – Supplemental Technical Memorandum, Naval Station Treasure Island, San Francisco, California*. Final. July.

APPENDICES

Appendix A Field Change Request
Appendix B Survey Instrumentation Data
Appendix C Building 233 Sewer Drain Survey Data
Appendix D Volumetric Sample Analytical Results
Appendix E Avenue M Storm Sewer Line Survey Data
Appendix F Response to Comments

APPENDIX A

Field Change Request

Field Change Request

Project Name: Radiological Scoping Surveys	Page 1 of 2
Project No./Task Code: 07204.0006	Field Change No.: 03

Part 1 – Proposed Change

Applicable Document(s):	Document Date:
1. Final Task-Specific Plan, Radiological Survey of Building 3 and Impacted Wastewater Drains, Former Naval Station Treasure Island, San Francisco, California (TSP)	October 2013
2. Final Radiological Management Plan, Former Naval Station Treasure Island, San Francisco, California (RMP)	July 2013

Problem Description:

The TSP, Section 3.3 describes the manner in which the wastewater drain surveys are conducted. It relies on a surveyor entering the excavation and performing radiation measurements and collecting samples of material in and around the exposed drain piping. Drain piping was anticipated to be between 2 to 4 ft in depth. Bldg 233 drain piping was found to be 4-6 ft in depth. Bldg 3 drain piping was discovered to be 6-8 ft in depth. Trenching at those depths requires permitting, a competent person, installation of protective systems, and daily inspections. These elements are not part of the proposed scope of work. In addition, the Bldg 3 drain line was discovered to be in use as an active sanitary sewer and found to be adjacent to several other active utility lines next to Bldg 3, making accessing the line and removing it from service difficult.

Recommended Solution:

The drain piping downstream of Bldg 233 is no longer in service. It is recommended that potholing be performed as called for in the TSP (approximately every 50 ft). The surveyor will measure radiation levels in and around the hole. To eliminate having the surveyor enter the excavation, the backhoe bucket will be used to remove intact, if possible, a small segment of pipe. The pipe will be frisked and smeared. A sample of any material inside the pipe will be collected. A sample of soil from around the pipe will also be collected.

The drain piping downstream of Bldg 3 is in active service. To eliminate the difficulties in trying to access the buried section of pipe, removing it from service, and having the surveyor enter the excavation, it is recommended that the piping upstream, i.e., vertical drain lines accessible from the roof and/or within the building, be surveyed and a sediment sample be collected at the downstream manhole next to the lift station.

Clarification: ☐ Minor Change: ☑ Major Change: ☐

Impact on Present and Completed Work:

The recommended solution provides for data collection without requiring a surveyor to enter the excavation, or attempting excavation in an obstructed utility corridor to gain access, or removing an active sanitary sewer line from service. While visual inspections of the pipe internals will not be performed and gross gamma surface scan measurements will not be taken inside the pipe, sediment samples inside and beneath drain piping and total and removable alpha/beta radiation measurement data will still be collected. The level of effort to collect the data is consistent with the technology, cost, and operational requirements of a radiological scoping survey.

Requested by:	Title:	Date:
Jerry Cooper	Project RSO	28 Apr 2014

Field Change Request

Project Name: Radiological Scoping Surveys	Page 2 of 2
Project No./Task Code: 07204.0006	Field Change No.: 03

Part 2 – Technical and Management Review/Approval

Gilbane Technical Reviewer

Approved: ☐ Rejected: ☐

Comments:

Name (print) and Signature:	Date:
Jeff Hess	28 Apr 2014

Gilbane Project Manager

Approved: ☐ Rejected: ☐

Is **client** approval required? Yes ☐ No ☐ If yes, Part 3 should be completed

Is this a change to **field efforts**? Yes ☐ No ☐ If yes, Part 5 should be completed.

Comments:

Name (print) and Signature:	Date:
John Baur John E. Baur Digitally signed by John E. Baur DN: cn=John E. Baur, o=Gilbane, ou=Environmental, email=jbaur@itsi.com, c=US Date: 2016.03.04 12:55:59 -08'00'	28 Apr 2014

Part 3 – Client Approval (required if marked above)

Approved: ☐ Rejected: ☐

Comments:

Name (print) and Signature:	Date:

Part 4 – Final Resolution (completed by requestor)

Description of Implemented Solution:

Name (print) and Signature:	Date:

Part 5 – Verification That Approved Changes Have Been Implemented (for field efforts only)

Gilbane Field Team Lead or Project QC Manager

Comments:

Name (print) and Signature:	Date:

APPENDIX B

Survey Instrumentation Data

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Gamma (Coiled Cord)** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006				
Instrument / SN:	2221 / 127231	**Cal. Due:**	27-Jul-14	**Setup Date:**	28-Aug-13
Probe Type / SN:	44-10 / RN19765	**Cal. Due:**	27-Jul-14	**Source Cert. Date:**	08-Aug-13
Technician:	P. Wells			**Source SN:**	808131
Location:	Trailer			**Surface Emission Rate:**	2,100,120 particles/min
				Source Type:	Cs-137
				HV Check/Setting:	900

1. Total Background Counts observed:

Chi-squared Calculations

1	5,089
2	4,966
3	4,836
4	5,172
5	4,883
6	5,070
7	5,118
8	4,943
9	4,925
10	5,022
11	5,061
12	5,071
13	4,960
14	5,092
15	5,052
16	5,034
17	5,140
18	4,648
19	5,245
20	5,177

Background Count Time: 1 minutes

Source/Sample Count Time: 1 minutes

Average Counts = 5,025.2 counts

Average Count Rate = 5,025.2 cpm

2. Total Source Counts observed:

Chi-squared Calculations

1	269,728
2	269,097
3	270,087
4	272,218
5	272,806
6	271,474
7	272,891
8	272,035
9	272,337
10	273,309
11	271,886
12	272,384
13	272,395
14	272,664
15	272,825
16	272,532
17	271,834
18	272,223
19	273,397
20	273,124

Average Counts = 272,062 counts

Average Count Rate = 272,062 cpm

Bkg count range	4,020	to	6,030	(± 20%)
Source count range	217,650	to	326,475	(± 20%)

Jim C Cooper 4 Sep 2013

Technical Reviewer — Date

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER **ENVIRACHEM, INC.** ORDER NO. 20226876/394640

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 129231

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. RN4065

Cal. Date 27-Jul-13 Cal Due Date 27-Jul-14 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 33 % Alt 699.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

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

☑ HV Readout (2 points) Ref./Inst. 500 / 504 V Ref./Inst. 2000 / 2003 V

COMMENTS:

	Peak settings	Gross(Coiled)	Gross(20')
High Voltage:	674 V	900 V	1050 V
Threshold dial:	642	100(10mv)	100(10mV)
Window dial:	40	n/a	n/a
Window Position:	"IN"	"OUT"	"OUT"
Resolution for Cs137:	≈8.91%	n/a	n/a

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

Firmware: 261027

OL checked but not set. Calibrated with coiled cable.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

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

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	400K cpm	400K cpm
	40kcpm	40K	40K
	4kcpm	4K	4K
	400cpm	400	400
	40cpm	40	40

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale	500kcpm	500K cpm	500K cpm
	50kcpm	50K	50K
	5kcpm	5K	5K
	500cpm	500	500
	50cpm	50	50

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

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 63893 ☐ Oscilloscope S/N ☑ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson Date 27-July-13

Reviewed By: Rod H. Date 29 Jul 13

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AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. BN19765

Customer **ENVIRACHEM, INC.** Order #. 20226876/394640

Counter 2221 Serial No. 127231 Counter Input Sensitivity 10 mV

Count Time 6 Seconds Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am241 Size 20. Mpci	Isotope Size	Isotope Size	Isotope Size
800	931	10453			
850	933	11499			
* 900	881	11795			
950	879	12339			
1000	898	11956			
1050	762	12007			
1100	811	11467			
1150	827	11585			
1200	773	11945			
1250	1164	11829			

Signature Jeremy Thompson Date 27 July 13

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Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. RN19765

Customer ENVIRACHEM, INC. Order #. 20226876/394640

Counter 2221 Serial No. 127231 Counter Input Sensitivity 10 mV

Count Time 6 seconds Distance Source to Detector Surface

Other Plateau performed with 20' cable

High Voltage	Background	Isotope Am241 Size ~0.77mCi	Isotope ____ Size ____	Isotope ____ Size ____	Isotope ____ Size ____
950	683	111458			
1000	716	111705			
X 1050	702	111618			
1100	761	111773			
1150	1138	112151			

Signature Jeremy Thompson Date 22 July 13

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SPECTECH

SPECTRUM TECHNIQUES, L.L.C.
106 Union Valley Road
Oak Ridge, TN 37830
Tel: (865) 482-9937 Fax: (865) 483-0473
Email: sales@spectrumtechniques.com
Web: www.spectrumtechniques.com

Certificate of Calibration

Radioactive material, Limited Quantity NOS UN2910,
Exempt Quantity 10CFR30.18, BS 5288/C11111

This source has been calibrated using a HPGe detector whose efficiency was established with the NIST traceable mixed nuclide standard SRS: 80899-854. The stated activity is the weighted average of the measured gamma lines with an estimated uncertainty of 5%. The source is of sealed construction and wipe tested.

Radionuclide: Cs-137

Half-Life: 30.07 years

Decay Constant: 0.02305

Serial Number: 808131

Calibration Date: August 8, 2013 **Activity:** 0.946 **uCi.** 35,002 **Bq.**

Photon Energy (keV)	Intensity (%)	Emission Rate (sec-1)
661.66	**85.1**	29,787

Certified by: *Roger K. Stevens* **Date:** August 8, 2013

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Gamma (20' Cord)** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	28-Aug-13
Instrument / SN:	2221 / 127231	**Cal. Due:**	27-Jul-14	**Source Cert. Date:**	08-Aug-13
Probe Type / SN:	44-10 / RN19765	**Cal. Due:**	27-Jul-14	**Source SN:**	808131
Technician:	P. Wells			**Surface Emission Rate:**	2,100,120 particles/min
Location:	Trailer			**Source Type:**	Cs-137
				HV Check/Setting:	1050

1. Total Background Counts observed:

Chi-squared Calculations

1	4,318
2	4,275
3	4,309
4	4,436
5	4,248
6	4,374
7	4,327
8	4,265
9	4,324
10	4,331
11	4,228
12	4,223
13	4,329
14	4,292
15	4,214
16	4,279
17	4,431
18	4,248
19	4,251
20	4,319

Background Count Time: 1 minutes

Source/Sample Count Time: 1 minutes

Average Counts = 4301.1 counts

Average Count Rate = 4301.1 cpm

2. Total Source Counts observed:

Chi-squared Calculations

1	263,853
2	264,158
3	264,049
4	263,939
5	264,008
6	263,305
7	264,708
8	264,101
9	264,730
10	264,532
11	263,851
12	263,642
13	264,274
14	264,736
15	264,504
16	263,759
17	264,163
18	264,569
19	265,460
20	263,562

Average Counts = 264,195 counts

Average Count Rate = 264,195 cpm

Bkg count range	3,441	to	5,161	(± 20%)
Source count range	211,356	to	317,034	(± 20%)

Technical Reviewer — Date: 4 Sep 2013

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX. 79556, U.S.A.
☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER **ENVIRACHEM, INC.** ORDER NO. 20226876/394640

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 129231

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. RN4465

Cal. Date 27-Jul-13 Cal Due Date 27-Jul-14 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 33 % Alt 699.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

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

☑ HV Readout (2 points) Ref./Inst. 500 / 504 V Ref./Inst. 2000 / 2003 V

COMMENTS:

	Peak settings	Gross(Coiled)	Gross(20')
High Voltage:	674 V	900 V	1050 V
Threshold dial:	642	100(10mv)	100(10mV)
Window dial:	40	n/a	n/a
Window Position:	"IN"	"OUT"	"OUT"
Resolution for Cs137:	≈8.91%	n/a	n/a

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

Firmware: 261027

OL checked but not set. Calibrated with coiled cable.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

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

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	400 (3) cpm	400 (3) cpm
	40kcpm	400	400
	4kcpm	400	400
	400cpm	40	40
	40cpm	4	4
Log Scale	500kcpm	500 kcpm	500 kcpm
	50kcpm	50	50
	5kcpm	5	5
	500cpm	500	500
	50cpm	50	50

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

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 63893 ☐ Oscilloscope S/N ☑ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson Date 27-July-13

Reviewed By: Tod H. Date 29 Jul 13

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AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
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LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556; U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. BN19765

Customer **ENVIRACHEM, INC.** Order #. 20226876/394640

Counter 2221 Serial No. 127231 Counter Input Sensitivity 10 mV

Count Time 6 Seconds Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am241 Size 20 Mpci	Isotope Size	Isotope Size	Isotope Size
800	931	10453			
850	933	11499			
* 900	881	11795			
950	879	12339			
1000	898	11956			
1050	762	12007			
1100	811	11467			
1150	827	11585			
1200	773	11945			
1250	1164	11829			

Signature Jeremy Thompson Date 27-July-13

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☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. RN19765

Customer ENVIRACHEM, INC. Order #. 20226876/394640

Counter 2221 Serial No. 127231 Counter Input Sensitivity 10 mV

Count Time 6 seconds Distance Source to Detector Surface

Other Plateau performed with 20' cable

High Voltage	Background	Isotope Am241 Size 20.77nCi	Isotope Size	Isotope Size	Isotope Size
950	683	114458			
1000	716	117105			
*1050	702	116118			
1100	761	114173			
1150	1138	121151			

Signature Jeremy Thompson Date 27 July 13

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SPECTECH

SPECTRUM TECHNIQUES, L.L.C.
106 Union Valley Road
Oak Ridge, TN 37830
Tel: (865) 482-9937 Fax: (865) 483-0473
Email: sales@spectrumtechniques.com
Web: www.spectrumtechniques.com

Certificate of Calibration

Radioactive material, Limited Quantity NOS UN2910,
Exempt Quantity 10CFR30.18, BS 5288/C11111

This source has been calibrated using a HPGe detector whose efficiency was established with the NIST traceable mixed nuclide standard SRS: 80899-854. The stated activity is the weighted average of the measured gamma lines with an estimated uncertainty of 5%. The source is of sealed construction and wipe tested.

Radionuclide: Cs-137

Half-Life: 30.07 years

Decay Constant: 0.02305

Serial Number: 808131

Calibration Date: August 8, 2013 **Activity:** 0.946 **uCi.** 35,002 **Bq.**

Photon Energy (keV)	Intensity (%)	Emission Rate (sec-1)
661.66	**85.1**	29,787

Certified by: *Roger K. Stevens* **Date:** August 8, 2013

ITSI Gudane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 127231 Setup Date: 28-Aug-13
Cal. Date: July 27, 2014 Source Type: Cs-137
Probe #: 44-10 / RN19765 Source SN: 808131

Ranges Background: 4,020 cpm to 6,030 cpm using ± 20%
Source: 217,650 cpm to 326,475 cpm using ± 20% High Voltage (if applicable): 900

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	263,042	5,811	900	5.9	Sat	Sat	N/A	P.W.	
9/10/2013	264,977	5,292	899	5.8	↓	Sat	↓	P.W.	
9/11/2013	269,321	4,730	899	5.8	↓	Sat	↓	P.W.	
9/12/2013	264,504	5,045	899	5.8	↓	Sat	↓	P.W.	
9/16/2013	267442	4472	899	5.8	↓	Sat	↓	P.W.	
9/17/2013	266474	4854	900	5.8	↓	Sat	↓	P.W.	
9/18/2013	264719	5133	899	5.8	↓	Sat	↓	P.W.	
9/19/2013	264943	5126	899	5.7	↓	Sat	↓	P.W.	
9/23/2013	261167	4525	900	5.7	↓	Sat	↓	P.W.	
9/24/2013	264409	4762	900	5.8	↓	Sat	↓	P.W.	
9/25/2013	263849	4713	900	5.7	↓	Sat	↓	P.W.	
9/26/2013	261243	4955	900	5.7	↓	Sat	↓	P.W.	
9/27/2013	271683	5195	900	5.6	↓	Sat	↓	P.W.	
9/30/2013	263010	4317	898	5.6	↓	Sat	↓	P.W.	
				N/A					N/A

Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: Jay Chapman Date: 1 Oct 2013

ITSI Cabane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 127231	Setup Date:	28-Aug-13
Cal. Date:	July 27, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19765	Source SN:	808131

Ranges Background: 4,020 cpm to 6,030 cpm using ± 20%
Source: 217,650 cpm to 326,475 cpm using ± 20%
High Voltage (if applicable): 900

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/2013	2607592	4775	899	5.5	Sat	Sat	N/A	P.W.	
10/2/13	262513	4723	900	5.5	Sat	Sat	NA	DAO	
10/3/13	2604039	5079	900	5.5.	"	"	"	P.W.	
10/7/13	2620168	5391	900	5.5.	"	"	"	P.W.	
10/8/13	2604310	4787	900	5.5.	"	"	"	P.W.	
10/9/13	2624416	4300	901	6.2	"	"	"	P.W.	
10/10/13	2603005	4796	901	6.0	"	"	"	P.W.	
10/15/13	2607845	5373	901	5.9	"	"	"	P.W.	
10/16/13	2616336	5191	901	5.8	"	"	"	P.W.	
10/17/13	2604807	4933	901	5.7	"	"	"	P.W.	
10/18/13	273453	50326	901	5.7	"	"	"	P.W.	
10/21/13	263114	4815	902	5.6	"	"	"	P.W.	
10/22/13	2616887	5031	903	5.6	"	"	"	P.W.	
10/23/13	2608233	4963	901	5.5	"	"	"	P.W.	
10/24/13	2647561	5211	902	5.5	"	"	"	P.W.	
10/28/13	2657608	5331	902	5.9	"	"	"	PW	N A
10/29/13	2621662	53816	902	6.0	"	"	"	PW.	
10/30/13	2655585	5279	902	5.8	"	"	"	P.W.	
10/31/13	252594	5428	901	5.7	"	"	"	P.W.	
				N	A				

Completed By: [signature] Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 127231 Setup Date: 28-Aug-13
Cal. Date: July 27, 2014 Source Type: Cs-137
Probe #: 44-10 / RN19765 Source SN: 808131

Ranges Background: 4,020 cpm to 6,030 cpm using ± 20%
Source: 217,650 cpm to 326,475 cpm using ± 20% High Voltage (if applicable): 900

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	268,225	4,833	901	5.7	SAT	Sat	N / A	PW	
11/5/13	270334	5339	902	5.6	↓	↓	↓	P.W.	
11/6/13	261708	5160	901	5.6	↓	↓	↓	P.W.	
11/7/13	266339	5016	901	5.5	↓	↓	↓	P.W.	
11/8/13	264511	4781	901	6.0	↓	↓	↓	P.W.	
11/11/13	265168	4672	902	5.9	↓	↓	↓	P.W.	
11/12/13	269274	5321	901	6.2	↓	↓	↓	P.W.	
11/13/13	260312	4940	901	5.9	↓	↓	↓	P.W.	
11/14/13	265011	5213	901	5.8	↓	↓	↓	PW	
11/15/13	254102	4788	901	5.7	↓	↓	↓	PW	
11/18/13	264556	4677	901	5.7	↓	↓	↓	P.W	
11/19/13	261551	4611	901	5.6	↓	↓	↓	P.W	
11/20/13	265172	5052	901	6.2	↓	↓	↓	P.W.	
11/21/13	263471	4764	901	6.1	↓	↓	↓	P.W.	
11/22/13	267522	4897	901	5.9	↓	↓	↓	P.W.	
11/23/13	264070	5123	901	5.9	↓	↓	↓	P.W.	
11/25/13	258216	5002	900	5.8	↓	↓	↓	P.W.	
11/26/13	267116	5178	902	5.7	↓	↓	↓	PW	N/A
				N	A				

Completed By: Pam Wells Date: 11/26/13
Reviewed By: [signature] Date: 12/16/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 127231	Setup Date:	28-Aug-13
Cal. Date:	July 27, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19765	Source SN:	808131

Ranges Background: 4,020 cpm to 6,030 cpm using ± 20%
Source: 217,650 cpm to 326,475 cpm using ± 20% High Voltage (if applicable): 900

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	2601313	4934	900	5.7	Sat	Sat	N/A	P.W.	
12/3/13	2603398	4957	900	5.7	"	"	"	P.W.	
12/4/13	2601061	4698	900	5.7	"	"	"	P.W.	
12/5/13	2632160	5302	902	5.7	"	"	"	P.W.	
12/9/13	2700911	4789	900	5.7	"	"	"	P.W.	
12/10/13	2851685	4909	901	5.7	"	"	"	P.W.	
12/11/13	2603892	5095	901	5.7	"	"	"	P.W.	
12/12/13	2605887	5579	900	5.7	"	"	"	P.W.	
12/13/13	2601592	48603	900	5.7	"	"	"	P.W.	
12/16/13	2602037	5053	902	Lo.3	"	"	"	P.W.	
12/17/13	2598520	55600	903	Lo.1	"	"	"	P.W.	
				N/A	N/A				N/A

Completed By: Pam Wells Date: 1/2/14
Reviewed By: [signature] Date: 1/19/14

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 127231	Setup Date:	28-Aug-13
Cal. Date:	July 27, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19765	Source SN:	808131

Ranges Background: 4,020 cpm to 6,030 cpm using ± 20%
Source: 217,650 cpm to 326,475 cpm using ± 20%
High Voltage (if applicable): 900

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	253,986	4,530	Sat	Sat	Sat	Sat	N / A	JEW	
2/19/2014	261,548	4,240	✓	✓	✓	Sat	✓	P.W.	
2/20/2014	254098	4643	902	Lo. 1	✓	✓	✓	P.W	
2/21/2014	255207	4634	901	Lo. 1	✓	✓	✓	P.W.	
									N / A
				N / A					

Completed By: Pam Wells Date: 3/24/14
Reviewed By: Jerry Coopens Date: 24 Mar 2014

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 127231 Setup Date: 28-Aug-13
Cal. Date: July 27, 2014 Source Type: Cs-137
Probe #: 44-10 / RN19765 Source SN: 808131

Ranges Background: 4,020 cpm to 6,030 cpm using ± 20%
Source: 217,650 cpm to 326,475 cpm using ± 20%
High Voltage (if applicable): 900

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	250,340	4,933	900	6	Sat	Sat	N / A	P.W.	
3/25/2014	250032	4223	901	6	✓	✓	✓	P.W.	
3/26/2014	254254	4352	901	6.9	✓	✓	✓	P.W.	
3/27/2014	250090	4177	901	6.9	✓	✓	✓	P.W.	
3/31/2014	240828	4259	900	6	✓	✓	✓	P.W.	
					N/A	N/A			N/A

Completed By: Paula Wells 4/1/2014
Reviewed By: [signature] 4/3/14

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 127231 Setup Date: 28-Aug-13
Cal. Date: July 27, 2014 Source Type: Cs-137
Probe #: 44-10 / RN19765 Source SN: 808131

Ranges Background: 4,020 cpm to 6,030 cpm using ± 20%
Source: 217,650 cpm to 326,475 cpm using ± 20% High Voltage (if applicable): 900

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
4/1/2014	257712	4290	898	5.9	Sat	Sat	N/A	P.W.	
4/2/2014	262815	4150	898	5.9	↓	↓	↓	P.W.	
4/3/2014	248306	4273	899	5.9	↓	↓	↓	P.W.	
4/7/2014	248747	4267	900	5.9	↓	↓	↓	P.W.	
4/8/2014	253964	4440	900	5.9	↓	↓	↓	P.W.	
					N	A			N A

Completed By: Pam Wells Date: 4/22/2014
Reviewed By: Jay Cooper Date: 4/22/14

Gilbane

RATE METER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

CPM

{Blue cells for input}

Instrument / SN:	2221/144971	**Cal. Due:**	13-Oct-14	**Setup Date:**	08-Oct-14
Probe Type / SN:	44-10/RN21186	**Cal. Due:**	13-Oct-14	**Source Cert. Date:**	08-Aug-13
Technician:	K. Gordon			**Source SN:**	0808132
Location:	Treasure Island			**Source Activity:**	1,949,160 dpm
				Source Type:	Cs-137
				HV Check/Setting:	1050

1. Total Background CPM observed:

1	4,328
2	4,289
3	4,299
4	4,331
5	4,378
6	4,461
7	4,458
8	4,388
9	4,342
10	4,419

Average CPM= 4,369

2. Total Source CPM observed:

1	290,655
2	290,257
3	291,492
4	291,107
5	291,530
6	291,271
7	290,338
8	290,010
9	291,085
10	289,880

Average CPM= 290,763

Bkg count range	3,495	to	5,243	counts (± 20%)
Source count range	232,610	to	348,915	counts (± 20%)

Jim Cooper — 8 Oct 2014

Technical Reviewer — Date

Gilbane

DAILY RESPONSE CHECK SHEET

Contract Number/Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Instrument #: 2221/144971
Cal. Due: October 13, 2014
Probe #: 44-10/RN21186

Setup Date: 8-Oct-14
Source ID: 0808132
Source Type: Cs-137

High Voltage: 1050

Ranges
Background: 3,495 counts to 5,243 counts using ± 20%
Source: 232,610 counts to 348,915 counts using ± 20%

Date	Source CPM	Background CPM	HV	BAT	SPKR	Sat/ Unsat	Technician Initials		Additional Comments
10/8/2014	294,574	4,441	1050	ok	ok	Sat	JP		Pre-check
10/8/2014	287,479	4,089	1050	ok	ok	Sat	JP		Post-check

Completed By: [signature] Date 8- OCT- 2014
Reviewed By: [signature] Date 8 Oct 2014

SPECTECH

SPECTRUM TECHNIQUES, L.L.C.
106 Union Valley Road
Oak Ridge, TN 37830
Tel: (865) 482-9937 Fax: (865) 483-0473
Email: sales@spectrumtechniques.com
Web: www.spectrumtechniques.com

Certificate of Calibration

Radioactive material, Limited Quantity NOS UN2910,
Exempt Quantity 10CFR30.18, BS 5288/C11111

This source has been calibrated using a HPGe detector whose efficiency was established with the NIST traceable mixed nuclide standard SRS: 80899-854. The stated activity is the weighted average of the measured gamma lines with an estimated uncertainty of 5%. The source is of sealed construction and wipe tested.

Radionuclide: Cs-137

Half-Life: 30.07 years

Decay Constant: 0.02305

Serial Number: 808132

Calibration Date: August 8, 2013 **Activity:** 0.878 **uCi.** 32,486 **Bq.**

Photon Energy (keV)	Intensity (%)	Emission Rate (sec-1)
661.66	**85.1**	27,646

Certified by: *Roger K. Stevens* **Date:** August 8, 2013

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street, 325-235-5494, Sweetwater, TX 79556 U.S.A.
10744 Dutchtown Road, 865-392-4601, Knoxville, TN 37932, U.S.A.

CUSTOMER ITSI GILBANE ORDER NO. 20231349/397387

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 144871

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. RN 21136

Cal. Date 13-Oct-13 Cal Due Date 13-Oct-14 Cal. Interval 1 Year Meterface 202-159

Check mark ✓applies to applicable instr and/or detector IAW mfg. spec. T. 76 °F RH 20 % Alt 703.8 mm Hg

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

✓ Mechanical ck. ✓ Meter Zeroed Background Subtract ✓ Input Sens. Linearity
✓ F/S Resp. ck ✓ Reset ck. ✓ Window Operation ✓ Geotropism
✓ Audio ck. Alarm Setting ck. ✓ Batt. ck. (Min. Volt) 4.4 VDC
✓ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89 Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

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

✓ HV Readout (2 points) Ref./Ins: 500 / 498 V Ref./Inst. 2000 / 1990 V

COMMENTS:

	Peak (Coiled)	Gross(Coiled)	Peak(20')	Gross(20')
High Voltage:	746 V	1050 V	840 V	1150 V
Threshold dial:	642	100(10mv)	642	100 ~~(10mV)~~ 57
Window dial:	40	n/a	40	n/a 13N
Window Position:	"IN"	"OUT"	"IN"	"OUT"
Resolution for Cs137:	≈9.96%	n/a	9.36%	n/a

Firmware: 261027

Model 2221 currently set for gross counts(coiled).
High voltage set with detector connected.
CH checked but not set. Calibrated with coiled cable.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

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

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	400 (97.60)	400 (97.60)
	40kcpm	4001	4001
	4kcpm	400	400
	400cpm	40	40
	40cpm	4	4
Log Scale	500kcpm	500 k cpm	500 k cpm
	50kcpm	50	50
	5kcpm	5	5
	500cpm	500	500
	50cpm	50	50

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

Reference Instruments and/or Sources: 059 280 720 734 781 1131 1616 1696 5105 5717CO 5719CO
60646 70897 73410 E551 E552 G112 M565 S-394 S-1054 T-304 T879 T10081 T10082 Y982

Alpha S/N Beta S/N Other

✓ m 500 S/N 63893 Oscilloscope S/N ✓ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson Date 13-Oct-13

Reviewed By: Rhett H Date 14 Oct 13

This certificate shall not be reproduced except in full without the written approval of Ludlum Measurements, Inc.
FORM C22A 02/26/2013 Page 1 of 3

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. RN21186

Customer ITSI GILBANE Order #. 20231349/397387

Counter 2221 Serial No. 144871 Counter Input Sensitivity 10 mV

Count Time 6 Seconds Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am241 Size :0.1 uCi	Isotope Size	Isotope Size	Isotope Size
950	688	13497			
1000	764	13516			
*1050	787	13554			
1100	731	13571			
1150	795	13573			
1200	863	13520			
1250	810	13574			
1300	1203	13721			

Signature Jeremy Thompson Date 13-OCT-23

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater TX 79556, U.S.A.

10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. RN21186

Customer ITSI GILBANE Order #. 20231349/397387

Counter 2221 Serial No. 144871 Counter Input Sensitivity 13 ~~40~~ 37 mV

Count Time 6 Seconds Distance Source to Detector Surface

Other Plateau performed with 20' cable.

High Voltage	Background	Isotope Am241 Size ~0.03μC	Isotope Size	Isotope Size	Isotope Size
1000	700	12210			
1050	717	12066			
1100	695	13650			
* 1150	714	13502			
1200	730	13622			
1250	714	13540			
1300	749	13546			
1350	856	13744			
14100	1952	14418			

Signature Jeremy Thompson Date 13 Oct 13

• *Serving The Nuclear Industry Since 1962* •

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Gamma (50' Cord)** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	11-Sep-13
Instrument / SN:	2221 / 147502	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	08-Aug-13
Probe Type / SN:	44-10 / PR150787	**Cal. Due:**	29-Aug-14	**Source SN:**	808131
Technician:	P. Wells			**Surface Emission Rate:**	2,100,120 particles/min
Location:	Trailer			**Source Type:**	Cs-137
				HV Check/Setting:	1150

1. Total Background Counts observed:

Chi-squared Calculations

1	4,440
2	4,478
3	4,500
4	4,483
5	4,470
6	4,419
7	4,522
8	4,254
9	4,303
10	4,437
11	4,450
12	4,244
13	4,443
14	4,356
15	4,446
16	4,335
17	4,282
18	4,278
19	4,230
20	4,382

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 4387.6 counts

Average Count Rate = 4387.6 cpm

2. Total Source Counts observed:

Chi-squared Calculations

1	290,674
2	290,459
3	291,451
4	291,085
5	290,972
6	285,201
7	285,553
8	285,953
9	285,785
10	285,444
11	286,250
12	285,921
13	286,360
14	286,703
15	286,956
16	287,015
17	287,859
18	289,246
19	289,217
20	288,249

Average Counts = 287,818 counts

Average Count Rate = 287,818 cpm

Bkg count range	3,510	to	5,265	(± 20%)
Source count range	230,254	to	345,381	(± 20%)

Jan C Cooper — 12 Sep 2013

Technical Reviewer — Date

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER ENVIRACHEM INC. ORDER NO. 20229075/396000

Ludlum Measurements, Inc. Model 2221 Serial No. 147502

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR150787

Cal. Date 29-Aug-13 Cal Due Date 29-Aug-14 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 702.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 5.0 VDC
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

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

☑ HV Readout (2 points) Ref./Inst. 500 / 505 V Ref./Inst. 2000 / 1992 V

COMMENTS:

	Peak settings	Gross Counts
High Voltage:	1337v	1500v
Threshold dial:	642	100(10mv)
Window dial:	40	n/a
Window Position:	"IN"	"OUT"
Resolution for Cs137:	≈1uCi 12%	

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

Firmware:26-10-27

Cal with a 50ft. cable

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 1000	400 Kcpm	400	400
X 1000	100 Kcpm	100	100
X 100	40 Kcpm	400	400
X 100	10 Kcpm	100	100
X 10	4 Kcpm	400	400
X 10	1 Kcpm	100	100
X 1	400 cpm	400	400
X 1	100 cpm	100	100

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

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 K cpm	400.33 (0)	400.33 (0)
	40 K cpm	400.4	400.4
	4 K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Log Scale	500 K cpm	500 k	500k
	50 K cpm	50	50
	5 K cpm	5	5
	500 cpm	500 cpm	500 cpm
	50 cpm	50	50

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 238275 ☐ Oscilloscope S/N ☑ Multimeter S/N 70602489

Calibrated By: Duane Nelson Date 29-Aug-13

Reviewed By: Date 30 Aug 13

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

AC Inst. ☐ Passed Dielectric (Hi-Pot) and Continuity Test

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. PR 150787

Customer ENVIRACHEM INC. Order #. 20229075/396000

Counter 2221 Serial No. 147502 Counter Input Sensitivity 10 mV

Count Time 60sec. Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am-241 Size ~0.69 Ci	Isotope ____ Size ____	Isotope ____ Size ____	Isotope ____ Size ____
1400	636	4078			
1450	710	8534			
* 1500	727	9285			
1550	773	9934			
1600	918	10522			
1650	998	10952			

Signature Daniel Jackson Date 29-Aug-13

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SPECTECH

SPECTRUM TECHNIQUES, L.L.C.
106 Union Valley Road
Oak Ridge, TN 37830
Tel: (865) 482-9937 Fax: (865) 483-0473
Email: sales@spectrumtechniques.com
Web: www.spectrumtechniques.com

Certificate of Calibration

Radioactive material, Limited Quantity NOS UN2910,
Exempt Quantity 10CFR30.18, BS 5288/C11111

This source has been calibrated using a HPGe detector whose efficiency was established with the NIST traceable mixed nuclide standard SRS: 80899-854. The stated activity is the weighted average of the measured gamma lines with an estimated uncertainty of 5%. The source is of sealed construction and wipe tested.

Radionuclide: Cs-137

Half-Life: 30.07 years

Decay Constant: 0.02305

Serial Number: 808131

Calibration Date: August 8, 2013 **Activity:** 0.946 **uCi.** 35,002 **Bq.**

Photon Energy (keV)	Intensity (%)	Emission Rate (sec-1)
661.66	**85.1**	29,787

Certified by: *Roger K. Stevens* **Date:** August 8, 2013

ITSI Cabane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147502	Setup Date:	11-Sep-13
Cal. Date:	August 29, 2014	Source Type:	Cs-137
Probe #:	44-10 / PR150787	Source SN:	808131

Ranges Background: 3,510 cpm to 5,265 cpm using ± 20%
Source: 230,254 cpm to 345,381 cpm using ± 20% High Voltage (if applicable): 1150

Date / Time	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/17/2013	296751	4426	1500	5.9	Sat	Sat	N/A	P.W.	
9/18/2013	290150	4357	1502	5.9	Sat	Sat	N/A	P.W.	
9/19/2013	289384	4359	1502	5.7	Sat	Sat	↓	P.W.	
9/23/2013	252327	4336	1503	5.8	Sat	Sat	↓	P.W.	
9/24/2013	289361	4294	1503	5.8	Sat	Sat	↓	P.W.	
9/25/2013	291957	4282	1504	5.8	Sat	Sat	↓	P.W.	
9/26/2013	284394	4414	1504	5.8	Sat	Sat	↓	P.W.	
9/27/2013	294218	4460	1506	5.8	Sat	Sat	↓	P.W.	
9/30/2013	288580	4425	1503	5.8	↓	Sat	↓	P.W.	

N A

N A

Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: Jay Cooper Date: 1 Oct 2013

ITSI Cabane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 147502 Setup Date: 11-Sep-13
Cal. Date: August 29, 2014 Source Type: Cs-137
Probe #: 44-10 / PR150787 Source SN: 808131

Ranges Background: 3,510 cpm to 5,265 cpm using ± 20%
Source: 230,254 cpm to 345,381 cpm using ± 20% High Voltage (if applicable): 1150

Date / Time	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/2013	291670	4315	1503	5.7	Sat	Sat	N/A	P.W.	
10/2/13	287867	4120	1506	5.8	Sat	Sat	NA	QAO	
10/3/13	288061	4269	1504	5.4	✓	✓	✓	P.W.	
10/7/13	287276	4403	1504	5.6	✓	✓	✓	P.W.	
10/8/13	286786	4438	1506	5.6	✓	✓	✓	P.W.	
10/9/13	287266	4378	1506	5.6	✓	✓	✓	P.W.	
10/10/13	287168	4605	1505	5.6	✓	✓	✓	P.W.	
10/15/13	292915	4809	1505	5.6	✓	✓	✓	P.W.	
10/16/13	290816	4633	1506	5.6	✓	✓	✓	P.W.	
10/17/13	298509	5199	1506	5.6	✓	✓	✓	P.W.	
10/18/13	296592	4634	1506	5.6	✓	✓	✓	P.W.	
10/21/13	281250	4443	1507	5.6	✓	✓	✓	P.W.	
10/22/13	290802	4625	1507	5.6	✓	✓	✓	P.W.	
10/23/13	285963	4881	1507	5.6	✓	✓	✓	P.W.	
10/24/13	287984	4630	1508	5.6	✓	✓	✓	P.W.	N/A
10/28/13	284623	4436	1509	5.6	✓	✓	✓	P.W.	
10/29/13	289592	4594	1507	5.6	✓	✓	✓	P.W.	
10/30/13	288556	4741	1505	5.6	✓	✓	✓	P.W.	
10/31/13	287096	4739	1505	5.6	✓	✓	✓	P.W.	
				N					
					A				

Completed By: [signature] Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 147502 Setup Date: 11-Sep-13
Cal. Date: August 29, 2014 Source Type: Cs-137
Probe #: 44-10 / PR150787 Source SN: 808131

Ranges Background: 3,510 cpm to 5,265 cpm using ± 20%
Source: 230,254 cpm to 345,381 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	287,182	4,514	1505	5.6	SAT	Sat	N / A	PW	
11/5/13	290983	4339	1507	5.6	↓	↓	↓	P.W.	
11/6/13	285399	4987	1507	5.6	↓	↓	↓	P.W.	
11/7/13	283457	4723	1506	5.6	↓	↓	↓	P.W.	
11/8/13	2860576	41516	1507	5.6	↓	↓	↓	P.W.	
11/11/13	281525	4348	1507	5.5	↓	↓	↓	P.W.	
11/12/13	287265	4317	1506	6.1	↓	↓	↓	P.W.	
11/13/13	2816314	41669	1506	6.1	↓	↓	↓	P.W.	
11/14/13	290141	4333	1506	6.1	↓	↓	↓	P.W.	
11/15/13	272481	4093	1507	6.1	↓	↓	↓	P.W.	
11/18/13	2816293	4350	1507	6.1	↓	↓	↓	P.W.	
11/19/13	279495	40716	1506	6.1	↓	↓	↓	P.W.	
11/20/13	288950	4139	1506	6.1	↓	↓	↓	P.W.	
11/21/13	276578	43606	1506	6.1	↓	↓	↓	P.W.	
11/22/13	290980	42360	1506	6.0	↓	↓	↓	P.W.	
11/23/13	284750	4395	1506	6.0	↓	↓	↓	P.W.	
11/25/13	271450	41638	1506	6.0	↓	↓	↓	P.W.	
11/26/13	2855916	47602	1508	6.0	↓	↓	↓	P.W.	N/A
				N/A					

Completed By: Pam Wells Date: 11/26/13
Reviewed By: [signature] Date: 12/19/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147502	Setup Date:	11-Sep-13
Cal. Date:	August 29, 2014	Source Type:	Cs-137
Probe #:	44-10 / PR150787	Source SN:	808131

Ranges Background: 3,510 cpm to 5,265 cpm using ± 20%
Source: 230,254 cpm to 345,381 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	282353	4614	1505	6.0	Sat	Sat	N/A	P.W.	
12/3/13	282576	4309	1502	6.0	"	"	"	P.W.	
12/4/13	280844	4212	1505	6.0	"	"	"	P.W.	
12/5/13	289822	4820	1505	6.0	"	"	"	P.W.	
12/9/13	294054	4578	1505	6.0	"	"	"	P.W.	
12/10/13	276242	4746	1505	5.9	"	"	"	P.W.	
12/11/13	285981	46526	1505	5.9	"	"	"	P.W.	
12/12/13	277971	5106	1505	5.9	"	"	"	P.W.	
12/13/13	280848	4916	1505	5.9	"	"	"	P.W.	
12/16/13	283014	4697	1505	5.9	"	"	"	P.W.	
12/17/13	2603458	5248	1505	5.9	"	"	"	P.W	
12/18/13	2859161	5343	1505	5.9	"	"	"	PW	
12/19/13	290205	45606	1505	5.9	"	"	"	PW	
12/20/13	279609	4620	1506	5.9	"	"	"	PW	
				N/A	N/A				N/A

Completed By: Pam Wells Date: 1/2/14
Reviewed By: Date:

Gilbane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147502	Setup Date:	11-Sep-13
Cal. Date:	August 29, 2014	Source Type:	Cs-137
Probe #:	44-10 / PR150787	Source SN:	808131

Ranges Background: 3,510 cpm to 5,265 cpm using ± 20%
Source: 230,254 cpm to 345,381 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/2/2014	285,601	5,222	1507	5.9	Sat	Sat	N / A	P.W.	

N A

N A

Completed By: Pam Wells Date: 2/21/14
Reviewed By: Jim Cooper Date: 24 Mar 2014

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Gamma (50' Cord)** | ***(Blue cells for input)***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	12-Sep-13
Instrument / SN:	2221 / 147504	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	08-Aug-13
Probe Type / SN:	44-10 / PR125434	**Cal. Due:**	29-Aug-14	**Source SN:**	808131
Technician:	P. Wells			**Surface Emission Rate:**	2,100,120 particles/min
Location:	Trailer			**Source Type:**	Cs-137
				HV Check/Setting:	1150

1. Total Background Counts observed:

Chi-squared Calculations

1	4,786
2	4,793
3	4,813
4	4,848
5	4,789
6	4,907
7	5,060
8	4,759
9	4,787
10	4,723
11	4,756
12	4,642
13	4,800
14	4,663
15	4,665
16	4,813
17	4,710
18	4,755
19	4,751
20	4,726

Background Count Time: 1 minutes

Source/Sample Count Time: 1 minutes

Average Counts = 4777.3 counts

Average Count Rate = 4777.3 cpm

2. Total Source Counts observed:

Chi-squared Calculations

1	237,411
2	238,975
3	240,660
4	240,704
5	240,914
6	242,057
7	242,174
8	242,335
9	241,913
10	241,910
11	242,795
12	242,990
13	239,804
14	242,060
15	241,215
16	241,523
17	242,083
18	241,193
19	242,295
20	242,553

Average Counts = 241,378 counts

Average Count Rate = 241,378 cpm

Bkg count range	3,822	to	5,733	(± 20%)
Source count range	193,103	to	289,654	(± 20%)

Technical Reviewer — Date: 12 Sep 2013

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER ENVIRACHEM INC. ORDER NO. 20229075/396000

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 147504

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. PR 125434

Cal. Date 29-Aug-13 Cal Due Date 29-Aug-14 Cal. Interval 1 Year Meterface 202-159

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 45 % Alt 702.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 5.0 VDC

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

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

☑ HV Readout (2 points) Ref./Inst. 500 / 497 V Ref./Inst. 2000 / 2010 V

COMMENTS:

	Peak settings	Gross Counts
High Voltage:	1080v	1350v
Threshold dial:	642	100(10mv)
Window dial:	40	n/a
Window Position:	"IN"	"OUT"
Resolution for Cs137:	≈1uCi 9.9%	

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

Firmware:26-10-27

Cal with a 50ft. cable

modifications done.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
X 1000	400 Kcpm	400	400
X 1000	100 Kcpm	100	100
X 100	40 Kcpm	400	400
X 100	10 Kcpm	100	100
X 10	4 Kcpm	400	400
X 10	1 Kcpm	100	100
X 1	400 cpm	400	400
X 1	100 cpm	100	100

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

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400 K cpm	40020 (c)	40020 (c)
	40 K cpm	4002	4002
	4 K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4
Log Scale	500 K cpm	500k	500k
	50 K cpm	50	50
	5 K cpm	5	5
	500 cpm	500 cpm	500 cpm
	50 cpm	50	50

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

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 238275 ☐ Oscilloscope S/N ☑ Multimeter S/N 70602489

Calibrated By: Duane Pickton Date 29-Aug-13

Reviewed By: Date 30 Aug 13

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

☐ AC Inst. ☐ Passed Dielectric (Hi Pot) and Continuity Tests

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. PR125434

Customer ENVIRACHEM INC. Order #. 20229075/396000

Counter 2221 Serial No. 147504 Counter Input Sensitivity 10 mV

Count Time 60 sec Distance Source to Detector Surface

Other

High Voltage	Background	Isotope Am-241 Size ~0.69 uCi	Isotope ____ Size ____	Isotope ____ Size ____	Isotope ____ Size ____
1200	662	8571			
1250	702	8833			
1300	704	9679			
* 1350	726	10165			
1400	746	10186			
1450	757	10354			
1500	1010	12170			

Signature Duane Jackson Date 29-Aug 13

Serving The Nuclear Industry Since 1962

SPECTECH

SPECTRUM TECHNIQUES, L.L.C.
106 Union Valley Road
Oak Ridge, TN 37830
Tel: (865) 482-9937 Fax: (865) 483-0473
Email: sales@spectrumtechniques.com
Web: www.spectrumtechniques.com

Certificate of Calibration

Radioactive material, Limited Quantity NOS UN2910,
Exempt Quantity 10CFR30.18, BS 5288/C11111

This source has been calibrated using a HPGe detector whose efficiency was established with the NIST traceable mixed nuclide standard SRS: 80899-854. The stated activity is the weighted average of the measured gamma lines with an estimated uncertainty of 5%. The source is of sealed construction and wipe tested.

Radionuclide: Cs-137

Half-Life: 30.07 years

Decay Constant: 0.02305

Serial Number: 808131

Calibration Date: August 8, 2013 **Activity:** 0.946 **uCi.** 35,002 **Bq.**

Photon Energy (keV)	Intensity (%)	Emission Rate (sec-1)
661.66	**85.1**	29,787

Certified by: *Roger K. Stevens* **Date:** August 8, 2013

ITSI Gilbane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 147504 Setup Date: 12-Sep-13
Cal. Date: August 29, 2014 Source Type: Cs-137
Probe #: 44-10 / PR125434 Source SN: 808131

Ranges Background: 3,822 cpm to 5,733 cpm using ± 20%
Source: 193,103 cpm to 289,654 cpm using ± 20% High Voltage (if applicable): 1150

Date / Time	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/17/2013	242715	5039	1355	5.9	Sat	Sat	N/A	P.W.	
9/18/2013	239481	5059	1353	5.9	Sat	Sat	N/A	P.W.	
9/19/2013	239794	5047	1352	5.7	Sat	Sat	↓	P.W.	
9/23/2013	237710	5194	1355	5.8	Sat	Sat	↓	P.W.	
9/24/2013	239587	4456	1355	5.8	Sat	Sat	↓	P.W.	
9/25/2013	244126	4376	1356	5.8	Sat	Sat	↓	P.W.	
9/26/2013	234199	4679	1356	5.8	Sat	Sat	↓	P.W.	
9/27/2013	242552	4621	1357	5.8	Sat	Sat	↓	P.W.	
9/30/2013	236913	4398	1354	5.8	↓	Sat	↓	P.W.	
				N/A					N/A

Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: Jay Compton Date: 1 Oct 2013

ITSI Shane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 147504 Setup Date: 12-Sep-13
Cal. Date: August 29, 2014 Source Type: Cs-137
Probe #: 44-10 / PR125434 Source SN: 808131

Ranges Background: 3,822 cpm to 5,733 cpm using ± 20%
Source: 193,103 cpm to 289,654 cpm using ± 20% High Voltage (if applicable): 1150

Date / Time	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/2013	243905	4556	1354	5.7	Sat	Sat	N/A	P.W.	
10/2/13	239023	4760	1357	5.8	Sat	Sat	NA	NAD	
10/3/13	238173	4497	1357	5.7	"	"	"	P.W.	
10/7/13	242347	4532	1356	5.8	"	"	"	P.W.	
10/8/13	240748	4561	1357	5.7	"	"	"	P.W.	
10/9/13	238078	4315	1357	5.7	"	"	"	P.W.	
10/10/13	240667	4588	1356	5.7	"	"	"	P.W.	
10/15/13	240323	5061	1357	5.7	"	"	"	P.W.	
10/16/13	239581	5017	1357	5.7	"	"	"	P.W.	
10/17/13	240104	5173	1357	5.7	"	"	"	P.W.	
10/18/13	244739	4577	1357	5.7	"	"	"	P.W.	
10/21/13	237051	4727	1357	5.7	"	"	"	P.W.	
10/22/13	242023	4847	1358	5.7	"	"	"	P.W.	
10/23/13	242453	4842	1358	5.7	"	"	"	P.W.	
10/24/13	239706	4811	1358	5.7	"	"	"	P.W.	
10/28/13	239628	4367	1360	5.7	"	"	"	P.W.	
10/29/13	239354	4813	1358	5.7	"	"	"	P.W.	N A
10/30/13	240373	4922	1358	5.7	"	"	"	P.W.	
10/31/13	239551	5005	1358	5.7	"	"	"	P.W.	
				N	A				

Completed By: [signature] Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 147504 Setup Date: 12-Sep-13
Cal. Date: August 29, 2014 Source Type: Cs-137
Probe #: 44-10 / PR125434 Source SN: 808131

Ranges Background: 3,822 cpm to 5,733 cpm using ± 20%
Source: 193,103 cpm to 289,654 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	239,907	4,569	1358	5.7	SAT	Sat	N / A	PW	
11/5/13	243583	4931	1358	5.7	↓	↓	↓	PW	
11/6/13	238865	5053	1358	5.7	↓	↓	↓	P.W.	
11/7/13	241311	4749	1358	5.7	↓	↓	↓	P.W.	
11/8/13	239851	4433	1358	5.7	↓	↓	↓	P.W.	
11/11/13	237899	4842	1359	5.6	↓	↓	↓	P.W.	
11/12/13	240978	4488	1357	6.1	↓	↓	↓	P.W.	
11/13/13	240608	4814	1358	6.1	↓	↓	↓	P.W.	
11/14/13	241346	4744	1358	6.1	↓	↓	↓	P.W.	
11/15/13	236975	4467	1360	6.1	↓	↓	↓	P.W.	
11/18/13	241124	4448	1360	6.1	↓	↓	↓	P.W.	
11/19/13	239449	4324	1359	6.1	↓	↓	↓	P.W.	
11/20/13	245710	4823	1358	6.1	↓	↓	↓	P.W.	
11/21/13	242111	4400	1358	6.1	↓	↓	↓	P.W.	
11/22/13	245494	4472	1358	6.0	↓	↓	↓	PW	
11/23/13	240938	4849	1358	6.0	↓	↓	↓	PW	
11/25/13	242387	5040	1358	6.0	↓	↓	↓	P.W.	N/A
11/26/13	240635	5219	1359	6.0	↓	↓	↓	P.W.	
				N/A					

Completed By: Dawn Wells Date: 11/26/13
Reviewed By: [signature] Date: 12/14/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147504	Setup Date:	12-Sep-13
Cal. Date:	August 29, 2014	Source Type:	Cs-137
Probe #:	44-10 / PR125434	Source SN:	808131

Ranges Background: 3,822 cpm to 5,733 cpm using ± 20%
Source: 193,103 cpm to 289,654 cpm using ± 20%
High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	242081	4695	1357	6.0	Sat	Sat	N/A	P.W.	
12/3/13	238831	4567	1357	6.0	↓	↓	↓	P.W.	
12/4/13	235333	4150	1357	6.0	↓	↓	↓	P.W.	
12/5/13	243687	4839	1360	6.0	↓	↓	↓	P.W.	
12/9/13	244448	4670	1360	5.9	↓	↓	↓	P.W.	
12/10/13	237063	4698	1359	5.9	↓	↓	↓	P.W.	
12/11/13	237553	5079	1359	5.9	↓	↓	↓	P.W.	
12/12/13	236556	5498	1358	5.9	↓	↓	↓	P.W.	
12/13/13	236450	4940	1358	5.9	↓	↓	↓	P.W.	
12/16/13	232094	5023	1358	5.9	↓	↓	↓	P.W.	
12/17/13	235744	5541	1360	5.9	↓	↓	↓	P.W.	
12/18/13	237263	5428	1360	5.8	↓	↓	↓	P.W.	
12/19/13	239202	4629	1361	5.8	↓	↓	↓	PW	
12/20/13	236303	4727	1362	5.8	↓	↓	↓	PW	
				N/A					N/A

Completed By: Pam Wells Date: 1/2/14
Reviewed By: Date: 1/9/14

Gilbane

Instrument Daily Source Check **Type:** Gamma (50' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147504	Setup Date:	12-Sep-13
Cal. Date:	August 29, 2014	Source Type:	Cs-137
Probe #:	44-10 / PR125434	Source SN:	808131

Ranges Background: 3,822 cpm to 5,733 cpm using ± 20%
Source: 193,103 cpm to 289,654 cpm using ± 20%
High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/2/2014	238,777	5,527	1358	5.8	Sat	Sat	N / A	P.W.	
				N/A					N/A

Completed By: Pam Wells
Reviewed By: Jay Cooper

Date: 2/21/14
Date: 24 Mar 2014

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Gamma (Coiled Cord)** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	28-Aug-13
Instrument / SN:	2221 / 147512	**Cal. Due:**	21-Aug-14	**Source Cert. Date:**	08-Aug-13
Probe Type / SN:	44-10 / RN19768	**Cal. Due:**	21-Aug-14	**Source SN:**	808131
Technician:	J. Wells			**Surface Emission Rate:**	2,100,120 particles/min
Location:	Trailer			**Source Type:**	Cs-137
				HV Check/Setting:	1150

1. Total Background Counts observed:

	Chi-squared Calculations
1	4,540
2	4,553
3	4,668
4	4,889
5	4,741
6	4,734
7	4,730
8	4,686
9	4,569
10	4,488
11	4,257
12	4,204
13	4,619
14	4,323
15	4,478
16	4,405
17	4,464
18	4,464
19	4,500
20	4,323

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 4531.8 counts

Average Count Rate = 4531.8 cpm

2. Total Source Counts observed:

	Chi-squared Calculations
1	297,912
2	298,444
3	298,437
4	298,614
5	298,776
6	297,881
7	298,383
8	298,929
9	299,102
10	298,604
11	299,073
12	298,416
13	298,360
14	298,638
15	298,828
16	299,405
17	298,662
18	299,001
19	298,323
20	299,058

Average Counts = 298,642 counts

Average Count Rate = 298,642 cpm

Bkg count range	3,625	to	5,438	(± 20%)
Source count range	238,914	to	358,371	(± 20%)

Technical Reviewer — Date: 4 Sep 2013

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Gamma (20' Cord)** | ***(Blue cells for Input)***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	28-Aug-13	
Instrument / SN:	2221 / 147512	**Cal. Due:**	21-Aug-14	**Source Cert. Date:**	08-Aug-13	
Probe Type / SN:	44-10 / RN19768	**Cal. Due:**	21-Aug-14	**Source SN:**	808131	
Technician:	J. Wells			**Surface Emission Rate:**	2,100,120	particles/min
Location:	Trailer			**Source Type:**	Cs-137	
				HV Check/Setting:	1150	

1. Total Background Counts observed:

	Chi-squared Calculations
1	4,527
2	4,700
3	4,790
4	4,651
5	4,669
6	4,857
7	4,827
8	4,805
9	4,822
10	4,929
11	5,042
12	4,940
13	5,079
14	4,994
15	4,998
16	5,260
17	5,507
18	5,011
19	5,204
20	5,185

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 4939.9 counts

Average Count Rate = 4939.9 cpm

2. Total Source Counts observed:

	Chi-squared Calculations
1	298,265
2	299,943
3	299,920
4	301,333
5	299,187
6	300,808
7	300,526
8	300,556
9	301,474
10	300,214
11	301,433
12	300,407
13	300,938
14	300,552
15	301,034
16	300,894
17	300,573
18	301,493
19	300,359
20	301,430

Average Counts = 300,567 counts

Average Count Rate = 300,567 cpm

Bkg count range	3,952	to	5,928	(± 20%)
Source count range	240,454	to	360,680	(± 20%)

Jay C Cooper 4 Sep 2013

Technical Reviewer — Date

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER **ENVIRACHEM, INC.** ORDER NO. 20228596/395727

Mfg. Ludlum Measurements, Inc. Model 2221 Serial No. 141513

Mfg. Ludlum Measurements, Inc. Model 44-10 Serial No. RN19768

Cal. Date 21-Aug-13 Cal Due Date 21-Aug-14 Cal. Interval 1 Year Meterface 202-159

Check mark ✓ applies to applicable instr. and/or detector IAW mfg. spec. T. 75 °F RH 34 % Alt 703.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☑ Input Sens. Linearity
☑ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☐ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 4.4 VDC

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

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

☑ HV Readout (2 points) Ref./Inst. 500 / 496 V Ref./Inst. 2000 / 1998 V

COMMENTS:

	Peak(Coiled)	Gross(Coiled)	Peak(20')	Gross(20')	Firmware: 261027
High Voltage:	870 V	1150 V	980 V	1350 V	
Threshold dial:	642	100(10mv)	642	100(13mV)	
Window dial:	40	n/a	40	n/a	
Window Position:	"IN"	"OUT"	"IN"	"OUT"	
Resolution for Cs137:	≈10.57%	n/a	≈11.17%	n/a	

OL checked but not set. Threshold dial 100 = 13 mV with 20' cable.High voltage set with detector connected.Model 2221 currently set for gross counts using coiled cable.Calibrated with coiled cable.

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1K	400kcpm	400	400
x1K	100kcpm	100	100
x100	40kcpm	400	400
x100	10kcpm	100	100
x10	4kcpm	400	400
x10	1kcpm	100	100
x1	400cpm	400	400
x1	100cpm	100	100

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

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	400	400
	40kcpm	40	40
	4kcpm	4	4
	400cpm	400	400
	40cpm	40	40
Log Scale	500kcpm	500 kcpm	500 kcpm
	50kcpm	50	50
	5kcpm	5	5
	500cpm	500	500
	50cpm	50	50

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

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☐ Alpha S/N ☐ Beta S/N ☐ Other

☑ m 500 S/N 63893 ☐ Oscilloscope S/N ☑ Multimeter S/N 93870637

Calibrated By: Jeremy Thompson Date 21-Aug-13

Reviewed By: Rod H Date 21Aug13

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

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4801
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. BN19768

Customer **ENVIRACHEM, INC.** Order #. 20228596/395727

Counter 2221 Serial No. 149512 Counter Input Sensitivity 10 mV

Count Time 6 Seconds Distance Source to Detector surface

Other Plateau performed with coiled cable.

High Voltage	Background	Isotope Am241 Size 30.Mpki	Isotope Size	Isotope Size	Isotope Size
1000	666	81472			
1050	705	94484			
1100	729	10015			
*1150	792	10058			
1200	730	9956			
1250	833	10076			
1300	954	10367			
1350	2046	11580			

Signature Jeremy Thompson Date 21 Aug 13

• *Serving The Nuclear Industry Since 1962* •

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 44-10 Serial No. RN19768

Customer **ENVIRACHEM, INC.** Order #. 20228596/395727

Counter 2221 Serial No. 141512 Counter Input Sensitivity 10 mV

Count Time 6 seconds Distance Source to Detector Surface

Other Platcau performed with 20' cable.

High Voltage	Background	Isotope Am241 Size ~0.1 µCi.	Isotope Size	Isotope Size	Isotope Size
1250	707	10081			
1300	742	10085			
* 1350	670	9993			
1400	645	10460			
1450	2654	12247			

Signature Jeremy Thompson Date 21-Aug-13

• *Serving The Nuclear Industry Since 1962* •

SPECTECH

SPECTRUM TECHNIQUES, L.L.C.
106 Union Valley Road
Oak Ridge, TN 37830
Tel: (865) 482-9937 Fax: (865) 483-0473
Email: sales@spectrumtechniques.com
Web: www.spectrumtechniques.com

Certificate of Calibration

Radioactive material, Limited Quantity NOS UN2910,
Exempt Quantity 10CFR30.18, BS 5288/C11111

This source has been calibrated using a HPGe detector whose efficiency was established with the NIST traceable mixed nuclide standard SRS: 80899-854. The stated activity is the weighted average of the measured gamma lines with an estimated uncertainty of 5%. The source is of sealed construction and wipe tested.

Radionuclide: Cs-137

Half-Life: 30.07 years

Decay Constant: 0.02305

Serial Number: 808131

Calibration Date: August 8, 2013 **Activity:** 0.946 **uCi.** 35,002 **Bq.**

Photon Energy (keV)	Intensity (%)	Emission Rate (sec-1)
661.66	**85.1**	29,787

Certified by: *Roger K. Stevens* **Date:** August 8, 2013

ITSI Cabrane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 147512 Setup Date: 28-Aug-13
Cal. Date: August 21, 2014 Source Type: Cs-137
Probe #: 44-10 / RN19768 Source SN: 808131

Ranges Background: 3,625 cpm to 5,438 cpm using ± 20%
Source: 238,914 cpm to 358,371 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	301,758	5,430	1150	6	Sat	Sat	N/A	P.W.	
9/10/2013	295,769	5,047	1148	6	↓	Sat	↓	P.W.	
9/11/2013	300,630	4,736	1149	6	↓	Sat	↓	P.W.	
9/12/2013	298,837	4,896	1150	6	↓	Sat	↓	P.W.	
9/16/2013	301980	4866	1149	5.9	↓	Sat	↓	P.W.	
9/17/2013	297676	4533	1150	5.9	↓	Sat	↓	P.W.	
9/18/2013	297579	4786	1148	5.9	↓	Sat	↓	P.W.	
9/19/2013	299935	4717	1150	5.8	↓	Sat	↓	P.W.	
9/23/2013	295804	4524	1150	5.9	↓	Sat	↓	P.W.	
9/24/2013	298607	4034	1150	5.9	↓	Sat	↓	P.W.	
9/25/2013	297701	4127	1150	5.9	↓	Sat	↓	P.W.	
9/26/2013	296084	4725	1150	5.8	↓	Sat	↓	P.W.	
9/27/2013	307942	4705	1150	5.7	↓	Sat	↓	P.W.	
9/30/2013	294910	4541	1152	5.7	↓	Sat	↓	P.W.	
				N	A				N A

Completed By: Pam Wells
Reviewed By: Jay Cooper

Date: Oct 1, 2013
Date: 1 Oct 2013

ITSI Shane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2221 / 147512 Setup Date: 28-Aug-13
Cal. Date: August 21, 2014 Source Type: Cs-137
Probe #: 44-10 / RN19768 Source SN: 808131

Ranges Background: 3,625 cpm to 5,438 cpm using ± 20%
Source: 238,914 cpm to 358,371 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/2013	300104	4732	1150	5.7	Sat	Sat	N/A	P.W.	
10/2/13	295296	4730	1152	5.7	Sat	Sat	N/A	DAD	
10/3/13	294967	4655	1153	5.7	↓	↓	↓	P.W.	
10/7/13	298083	4736	1151	5.7	↓	↓	↓	P.W.	
10/8/13	297057	4949	1150	5.6	↓	↓	↓	P.W.	
10/9/13	292798	4178	1151	6.2	↓	↓	↓	P.W.	
10/10/13	293140	4876	1152	6.0	↓	↓	↓	P.W.	
10/15/13	296538	4927	1152	5.9	↓	↓	↓	P.W.	
10/16/13	299319	5131	1149	5.7	↓	↓	↓	P.W.	
10/17/13	294807	4823	1153	5.7	↓	↓	↓	P.W.	
10/18/13	303116	4681	1153	5.6	↓	↓	↓	P.W.	
10/21/13	298887	4804	1153	5.7	↓	↓	↓	P.W.	
10/22/13	303658	4185	1155	5.7	↓	↓	↓	P.W.	
10/23/13	300381	5203	1157	5.7	↓	↓	↓	P.W.	
10/24/13	299904	4850	1158	5.7	↓	↓	↓	P.W.	
10/28/13	299536	4360	1161	6.2	↓	↓	↓	P.W.	
10/29/13	298495	4724	1157	6.0	↓	↓	↓	P.W.	
10/30/13	295718	4913	1161	5.9	↓	↓	↓	P.W.	
10/31/13	294730	4827	1157	5.8	↓	↓	↓	P.W.	
				N	A				N A

Completed By: Pam Wells Date: 10/31/13
Reviewed By: Date: 11/5/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147512	Setup Date:	28-Aug-13
Cal. Date:	August 21, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19768	Source SN:	808131

Ranges Background: 3,625 cpm to 5,438 cpm using ± 20%
Source: 238,914 cpm to 358,371 cpm using ± 20%
High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/1/2013	299,315	5,193	1161	5.8	SAT	Sat	N / A	TC	
11/4/2013	295,978	4,834	1153	5.8	↓	Sat	↓	PW	
11/5/13	299812	5024	1158	5.7	↓	↓	↓	P.W.	
11/6/13	295363	5285	1157	5.6	↓	↓	↓	P.W.	
11/7/13	298827	51162	1155	5.6	↓	↓	↓	P.W.	
11/8/13	297143	4689	1155	5.9	↓	↓	↓	P.W.	
11/11/13	296117	5247	1150	5.8	↓	↓	↓	P.W.	
11/12/13	298601	4693	1150	5.8	↓	↓	↓	P.W.	
11/13/13	294749	4651	1150	5.8	↓	↓	↓	P.W.	
11/14/13	299356	4808	1149	5.8	↓	↓	↓	P.W.	
11/15/13	282782	4520	1150	5.8	↓	↓	↓	P.W.	
11/18/13	293017	4543	1151	5.8	↓	↓	↓	P.W.	
11/19/13	288055	4227	1152	5.7	↓	↓	↓	P.W.	
11/20/13	299972	4828	1152	5.6	↓	↓	↓	P.W.	
11/21/13	294855	4315	1152	5.6	↓	↓	↓	P.W.	
11/22/13	283318	4837	1151	5.6	↓	↓	↓	P.W.	N/A
11/23/13	296756	4693	1151	5.6	↓	↓	↓	P.W.	
11/25/13	291714	4802	1150	5.7	↓	↓	↓	P.W.	
11/26/13	295768	4926	1150	5.7	↓	↓	↓	P.W.	
			N	A					

Completed By: Pam Wells Date: 11/26/13
Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147512	Setup Date:	28-Aug-13
Cal. Date:	August 21, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19768	Source SN:	808131

Ranges Background: 3,625 cpm to 5,438 cpm using ± 20%
Source: 238,914 cpm to 358,371 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	298598	4840	1152	5.6	Sat	Sat	N/A	P.W.	
12/3/13	292743	4822	1151	5.6	✓	✓	✓	P.W.	
12/4/13	297357	4521	1151	5.6	✓	✓	✓	P.W.	
12/5/13	299649	5043	1155	5.6	✓	✓	✓	P.W.	
12/9/13	303650	4633	1155	5.6	✓	✓	✓	P.W.	
12/10/13	294821	4820	1153	5.6	✓	✓	✓	P.W.	
12/11/13	293444	4881	1155	5.6	✓	✓	✓	P.W.	
12/12/13	292694	5265	1152	5.6	✓	✓	✓	P.W.	
12/13/13	294884	5007	1151	5.6	✓	✓	✓	P.W.	
12/16/13	293737	4918	1151	5.9	✓	✓	✓	P.W.	
12/17/13	296584	5074	1157	5.8	✓	✓	✓	P.W.	
12/18/13	292263	5253	1152	5.4	✓	✓	✓	P.W.	
12/19/13	298107	4834	1153	5.5	✓	✓	✓	PW	
12/20/13	294611	4787	1153	6.0	✓	✓	✓	PW	
				N/A					N/A

Completed By: Ryan Wells Date: 12/24/14
Reviewed By: Date: 1/19/14

Gilbane

Instrument Daily Source Check **Type:** Gamma (20' Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147512	Setup Date:	28-Aug-13
Cal. Date:	August 21, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19768	Source SN:	808131

Ranges Background: 3,952 cpm to 5,928 cpm using ± 20%
Source: 240,454 cpm to 360,680 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/2/2014	5,487	294,499	1156	6	Sat	Sat/	N / A	P.W.	
				N/A					N/A

Completed By: Pam Wells
Reviewed By: Jay Cosgrove

Date: 3/24/14
Date: 24 Mar 2014

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147512	Setup Date:	28-Aug-13
Cal. Date:	August 21, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19768	Source SN:	808131

Ranges Background: 3,625 cpm to 5,438 cpm using ± 20%
Source: 238,914 cpm to 358,371 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	292,865	4,575	Sat	Sat	Sat	Sat	N / A	JEW	
2/19/2014	297,179	4,212	✓	✓	✓	Sat	✓	P.W.	
2/20/2014	292348	4736	✓	✓	✓	✓	✓	P.W.	
2/21/2014	292261	4763	✓	✓	✓	✓	✓	P.W.	
				N/A					N/A

Completed By: Pam Wells Date: 3/24/14
Reviewed By: Jim Compton Date: 24 Mar 2014

Gilbane

Instrument Daily Source Check **Type:** Gamma (Coiled Cord) **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #:	2221 / 147512	Setup Date:	28-Aug-13
Cal. Date:	August 21, 2014	Source Type:	Cs-137
Probe #:	44-10 / RN19768	Source SN:	808131

Ranges Background: 3,625 cpm to 5,438 cpm using ± 20%
Source: 238,914 cpm to 358,371 cpm using ± 20% High Voltage (if applicable): 1150

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	291,154	4,668	1153	5.8	Sat	Sat	N / A	P.W.	
3/25/2014	290348	4869	1155	5.7	√	√	√	P.W.	
3/26/2014	280,000	4620	1155	5.7	√	√	√	P.W.	
3/27/2014	290111	4569	1155	5.7	√	√	√	P.W.	
3/31/2014	289693	4895	1154	5.7	√	√	√	P.W.	
					N	A			N A

Completed By: [signature] Date: 4/1/2014
Reviewed By: [signature] Date: 4/2/14

Gilbane

SCALER INITIAL SETUP SHEET | **Gamma** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	21-Apr-14
Instrument / SN:	2350 / 228708	**Cal. Due:**	15-Apr-15	**Source Cert. Date:**	08-Aug-13
Probe Type / SN:	44-2 / PR273814	**Cal. Due:**	15-Apr-15	**Source SN:**	808131
Technician:	P. Wells			**Surface Emission Rate:**	2,100,120 particles/min
Location:	Trailer			**Source Type:**	Cs-137
				HV Check/Setting:	700

1. Total Background Counts observed:

Chi-squared Calculations

1	949
2	891
3	964
4	1,041
5	1,021
6	852
7	898
8	889
9	912
10	908
11	879
12	938
13	962
14	938
15	852
16	938
17	948
18	907
19	867
20	907

Background Count Time: 1 minutes

Source/Sample Count Time: 1 minutes

Average Counts = 923.1 counts

Average Count Rate = 923.1 cpm

2. Total Source Counts observed:

Chi-squared Calculations

1	108,000
2	108,587
3	108,987
4	109,316
5	108,904
6	108,819
7	108,874
8	109,178
9	109,314
10	108,681
11	109,054
12	108,808
13	109,234
14	109,095
15	108,792
16	108,643
17	108,446
18	109,085
19	109,155
20	109,205

Average Counts = 108,909 counts

Average Count Rate = 108,909 cpm

Bkg count range	738	to	1,108	(± 20%)
Source count range	87,127	to	130,691	(± 20%)

Jim Coopens

Technical Reviewer

22 Apr 2014

Date

Safety and Ecology Corporation
2800 Solway Road, Knoxville, TN 37931

SEC PROCEDURE # SEC-IS-424 Rev 2

4/15/2014

Calibration Certificate

Calibration Certificate for 2350-1,Serial # 228708, Bar Code # ,Property # SEC-6145

Date: 04/15/14 **Date Last Cal. Expires:** 07/29/14 **Technician:** Thomas Thompson

Location: 9999, **Reason For Calibration:** Due for Calibration

EQUIPMENT USED DURING CALIBRATION

MODEL: 500-2	**SERIAL #:** 190580	**CAL. DUE:** 07/23/14
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:	1497	AF

AS FOUND HV Setting: 1000 V **AS LEFT HV Setting:** 700 V

AS FOUND THRESHOLD: 14 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:	25.00 K	**% ERR:** 0.00%	**AL 25K:**	AF K	**% ERR:** 0.00%
AF 250K:	250.0 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:** 44-2 **Serial #:** PR273814 **Bar Code #:**

☑ Does Instrument Meet Final Acceptance Criteria?

☑ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 04/15/15

Performed by: _____ **Reviewed by** _____ **Date:** 4-15-14

Printed Name: Thomas Thompson

Calibration Certificate for 44-2,Serial # PR273814, Bar Code # ,Property # SEC-6739

Date: 04/15/14 **Date Last Cal. Expires:** **Technician:** Thomas Thompson
Location: 9999, **Reason For Calibration:** Due for Calibration

EQUIPMENT USED DURING CALIBRATION

MODEL: 2350-1 **SERIAL #:** 228708 **CAL DUE:** 04/15/15
MODEL: **SERIAL #:** **CAL DUE:**

NIST TRACEABLE SOURCES USED

SOURCE	ISOTOPE	ACTIVITY	2π	ASSAY DATE
99CS250-0288	Cs-137	6.655 uCi		12/26/2012

Efficiency from Last Calibration: 0.14 % **HV From Last Calibration:** 650 V **Calibration Threshold:** 10 mV

AS FOUND DATA

AS FOUND Instrument Condition: SAT
HV: V
Center: 0
Background: 0
4 π Probe Efficiency: Cs-137 0.00%

1 MINUTE COUNTS (CPM)

AS LEFT DATA after repair of HV adjust

AS LEFT Instrument Condition: SAT
HV: 700 V
Center: 23199
Background: 962
4 π Probe Efficiency: Cs-137 0.15%

"AF" in the AL Efficiency fields means to refer to the AF Efficiencies in the AS FOUND DATA Section

☐ Is the As Found Efficiency Within 20% of the efficiency from the last cal.?

Reproducibility: Isotope: Cs-137 23257 23279 22927 **Average:** 23154 ☑ 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.

PLATEAU AND SET POINT DATA (CPM)

High Voltage	Source Response	Background
500	6058	191
550	17192	506
600	19861	828
650	21900	837
700	22773	914
750	23052	842
800	23232	846
850	23415	877
900	25440	950

HV	CENTER	Background	4 π Efficiency
700 V	23199	962	Cs-137 0.15%

Comments: Married as a set with: **Model:** 2350-1 **Serial #:** 228708 **Bar Code #:**
Calibrated for use with 50 foot cable.

☑ Does Instrument Meet Final Acceptance Criteria? ☑ Calibration Sticker Attached?

Date Instrument is Due For Next Calibration: 04/15/15

Performed by: _____ **Reviewed by:** _____ **Date:** 4-15-14
Printed Name: Thomas Thompson

SPECTECH

SPECTRUM TECHNIQUES, L.L.C.
106 Union Valley Road
Oak Ridge, TN 37830
Tel: (865) 482-9937 Fax: (865) 483-0473
Email: sales@spectrumtechniques.com
Web: www.spectrumtechniques.com

Certificate of Calibration

Radioactive material, Limited Quantity NOS UN2910,
Exempt Quantity 10CFR30.18, BS 5288/C11111

This source has been calibrated using a HPGe detector whose efficiency was established with the NIST traceable mixed nuclide standard SRS: 80899-854. The stated activity is the weighted average of the measured gamma lines with an estimated uncertainty of 5%. The source is of sealed construction and wipe tested.

Radionuclide: Cs-137

Half-Life: 30.07 years

Decay Constant: 0.02305

Serial Number: 808131

Calibration Date: August 8, 2013 **Activity:** 0.946 **uCi.** 35,002 **Bq.**

Photon Energy (keV)	Intensity (%)	Emission Rate (sec-1)
661.66	**85.1**	29,787

Certified by: *Roger K. Stevens* **Date:** August 8, 2013

Gilbane

Instrument Daily Source Check **Type:** Gamma **Project/#:** Rad Scoping Surveys, Treasure Island / 07204.0006

Instrument #: 2350 / 228708 Setup Date: 21-Apr-14
Cal. Date: April 15, 2015 Source Type: Cs-137
Probe #: 44-2 / PR273814 Source SN: 808131

Ranges Background: 738 cpm to 1,108 cpm using ± 20%
Source: 87,127 cpm to 130,691 cpm using ± 20%
High Voltage (if applicable): 700

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
4/22/2014	109060	997	700	5.3	SAT	SAT	N/A	DW	
4/23/2014	109874	981	700	5.2	↓	↓	↓	DW	
4/24/2014	125099	975	700	5.2	↓	↓	↓	JEW	
4/28/2014	110,794	953	700	5.2	↓	↓	↓	JEW	

Completed By: _____ Date: _____
Reviewed By: _____ Date: _____

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Response: **Alpha**

{Blue cells for input}

Instrument / SN: 2360/178154 — **Cal. Due:** 24-Jul-15
Probe Type / SN: 43-93/PR311168 — **Cal. Due:** 24-Jul-15
Technician: K. Gordon
Location: Treasure Island

Setup Date: 08-Oct-14
Source Cert. Date: 15-Sep-13
Source SN: K7-323
Surface Emission Rate: 23,650 particles/min
Source Type: Th-230
HV Check/Setting: 650

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

1. Total Background Counts observed:
Chi-squared Calculations

1	0	-0.1	0.0
2	0	-0.1	0.0
3	0	-0.1	0.0
4	0	-0.1	0.0
5	0	-0.1	0.0
6	0	-0.1	0.0
7	0	-0.1	0.0
8	0	-0.1	0.0
9	0	-0.1	0.0
10	0	-0.1	0.0
11	2	1.9	3.6
12	0	-0.1	0.0
13	0	-0.1	0.0
14	0	-0.1	0.0
15	0	-0.1	0.0
16	0	-0.1	0.0
17	0	-0.1	0.0
18	0	-0.1	0.0
19	0	-0.1	0.0
20	0	-0.1	0.0
		0	

Average Counts = 0.1 counts
Average Count Rate = 0.1 cpm
Standard Deviation = 0.4 counts
Sum of Squares = 4
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval = 1.00 sec

2. Total Source Counts observed:
Chi-squared Calculations

1	7,872	-104	10,795
2	7,868	-108	11,642
3	7,996	20	404
4	8,140	164	26,929
5	8,016	40	1,608
6	7,997	21	445
7	7,993	17	292
8	7,865	-111	12,299
9	7,967	-9	79
10	7,956	-20	396
11	7,985	9	83
12	8,089	113	12,792
13	8,125	149	22,231
14	7,894	-82	6,708
15	8,038	62	3,856
16	8,089	113	12,792
17	7,899	-77	5,914
18	7,792	-184	33,819
19	7,975	-1	1
20	7,962	-14	193
		0	

Average Counts = 7,976 counts
Average Count Rate = 7,976 cpm
Standard Deviation = 93 counts
Sum of the Squares = 163,278
Chi-Squared Statistic = 20.47

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Net source cts = 7,976 counts
Std. Dev. Net = 93 counts
Net Ct. Rate = 7,976 cpm

Instrument Efficiency (E_I) = 0.3372 cpm/dpm
Surface Efficiency (E_s) = 0.2500 cpm/dpm
Total Efficiency (E_T) = 0.0843 cpm/dpm

MDCR = N/A cpm (@ 95% confidence level)

MDA Scan= N/A dpm/100 cm^2
MDA Static= 53.03 dpm/100 cm^2

Bkg count range 0 to 1 (2 sigma)
Source count range 7,790 to 8,161 (2 sigma)

Jan Cooper — 8 Oct 2014

Technical Reviewer — Date

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Activity Correction Worksheet

Isotope	Th-230
ID #	K7-323
Initial Activity (dpm)	23,650
Ref. Date	15-Sep-13
Half-life (years)	7.54E+04
Current Date	8-Oct-14

2.75E+07 days (Half-life)
388.00 days (t)

Equation: $Act_f = Act_o \times e^{-((.693/t)T)}$

Corrected Surface Emission Rate =

23,650 ***particles/min***

Equations

Chi-squared Calculations $\chi 2=\Sigma(n-n)^2$

s_i = 0.06 counts

s_i = minimum detectable number of net source counts in scan observation interval *i*
i = scan observation interval (sec)

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
b_i = number of background counts in scan observation interval *i*

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

R_b = number of background counts over background count time interval t_b
t_s = sample count time interval (min)
t_b = background count time interval (min)
E = total (instrument + surface) efficiency (cpm/dpm)
A = area correction factor (i.e., detector active area divided by 100) (cm^2)

Review:

Technical Reviewer — Date: 8 Oct 2014

Gilbane

DAILY RESPONSE CHECK SHEET

Contract Number/Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Instrument #: 2360/178154
Cal. Due: July 24, 2015
Probe #: 43-93/PR311168

Setup Date: 8-Oct-14
Source ID: K7-323
Source Type: Th-230

High Voltage: 650
Total Efficiency: 8.43%
MDA (in dpm): 53.03

Ranges
Background: 0 counts to 1 counts using ± 2 Sigma
Source: 7,790 counts to 8,161 counts using ± 2 Sigma

Bkgd Cnt Time (min): 1
Source Cnt Time (min): 1

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Technician Initials	Additional Comments
10/8/2014	7,974	0	650	ok	ok	Sat	JP	Pre-check
10/8/2014	7,954	1	650	ok	ok	Unsat	JP	Post-check

Completed By: Jair Rosa Date 8-OCT-2014
Reviewed By: Doug Carpenter Date 8 Oct 2014

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Response: **Beta**

{Blue cells for input}

Instrument / SN: 2360/178154
Probe Type / SN: 43-93/PR311168
Technician: K. Gordon
Location: Treasure Island

Cal. Due: 24-Jul-15
Cal. Due: 24-Jul-15

Setup Date: 08-Oct-14
Source Cert. Date: 15-Sep-13
Source SN: K7-321
Surface Emission Rate: 27,870 particles/min
Source Type: Tc-99
HV Check/Setting: 650

1. Total Background Counts observed:

Chi-squared Calculations

1	103	9.2	84.6
2	94	0.2	0.0
3	110	16.2	262.4
4	91	-2.8	7.8
5	88	-5.8	33.6
6	112	18.2	331.2
7	92	-1.8	3.2
8	72	-21.8	475.2
9	105	11.2	125.4
10	91	-2.8	7.8
11	91	-2.8	7.8
12	99	5.2	27.0
13	88	-5.8	33.6
14	87	-6.8	46.2
15	97	3.2	10.2
16	94	0.2	0.0
17	93	-0.8	0.6
18	83	-10.8	116.6
19	102	8.2	67.2
20	84	-9.8	96.0
		0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 93.8 counts
Average Count Rate = 93.8 cpm
Standard Deviation = 9.6 counts
Sum of Squares = 1,737
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval = 1.00 sec

2. Total Source Counts observed:

Chi-squared Calculations

1	5,751	43	1,884
2	5,698	-10	92
3	5,750	42	1,798
4	5,694	-14	185
5	5,685	-23	511
6	5,815	107	11,535
7	5,778	70	4,956
8	5,675	-33	1,063
9	5,656	-52	2,663
10	5,678	-30	876
11	5,652	-56	3,091
12	5,704	-4	13
13	5,788	80	6,464
14	5,751	43	1,884
15	5,618	-90	8,028
16	5,664	-44	1,901
17	5,661	-47	2,172
18	5,757	49	2,440
19	5,661	-47	2,172
20	5,716	8	71
		0	

Average Counts = 5,708 counts
Average Count Rate = 5,708 cpm
Standard Deviation = 53 counts
Sum of the Squares = 53,797
Chi-Squared Statistic = 9.43

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) = 0.2014 cpm/dpm
Surface Efficiency (E_s) = 0.5000 cpm/dpm
Total Efficiency (E_T) = 0.1007 cpm/dpm

Net source cts = 5,614 counts
Std. Dev. Net = 54 counts
Net Ct. Rate = 5,614 cpm

MDCR = 104 cpm (@ 95% confidence level)

MDA Scan= 1,453.72 **dpm/100 cm^2**
MDA Static= 477.21 **dpm/100 cm^2**

Bkg count range	75	to	113	(2 sigma)
Source count range	5,601	to	5,814	(2 sigma)

Technical Reviewer

8 Oct 2014
Date

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Activity Correction Worksheet

Isotope	Tc-99	
ID #	K7-321	
Initial Activity (dpm)	27,870	Equation: $Act_t = Act_o \times e^{-((.693/t)T)}$
Ref. Date	15-Sep-13	
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)
Current Date	8-Oct-14	388.00 days (t)

Corrected Surface Emission Rate =

27,870 ***particles/min***

Equations

Chi-squared Calculations $\chi 2=\Sigma(n-n)^2$

s_i = 1.73 counts

s_i = minimum detectable number of net source counts in scan observation interval *i*
i = scan observation interval (sec)

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
b_i = number of background counts in scan observation interval *i*

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

R_b = number of background counts over background count time interval t_b
t_s = sample count time interval (min)
t_b = background count time interval (min)
E = total (instrument + surface) efficiency (cpm/dpm)
A = area correction factor (i.e., detector active area divided by 100) (cm^2)

Review:

Jay Cooper 8 Oct 2014

Technical Reviewer Date

Gilbane

DAILY RESPONSE CHECK SHEET

Contract Number/Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Instrument #: 2360/178154
Cal. Due: July 24, 2015
Probe #: 43-93/PR311168

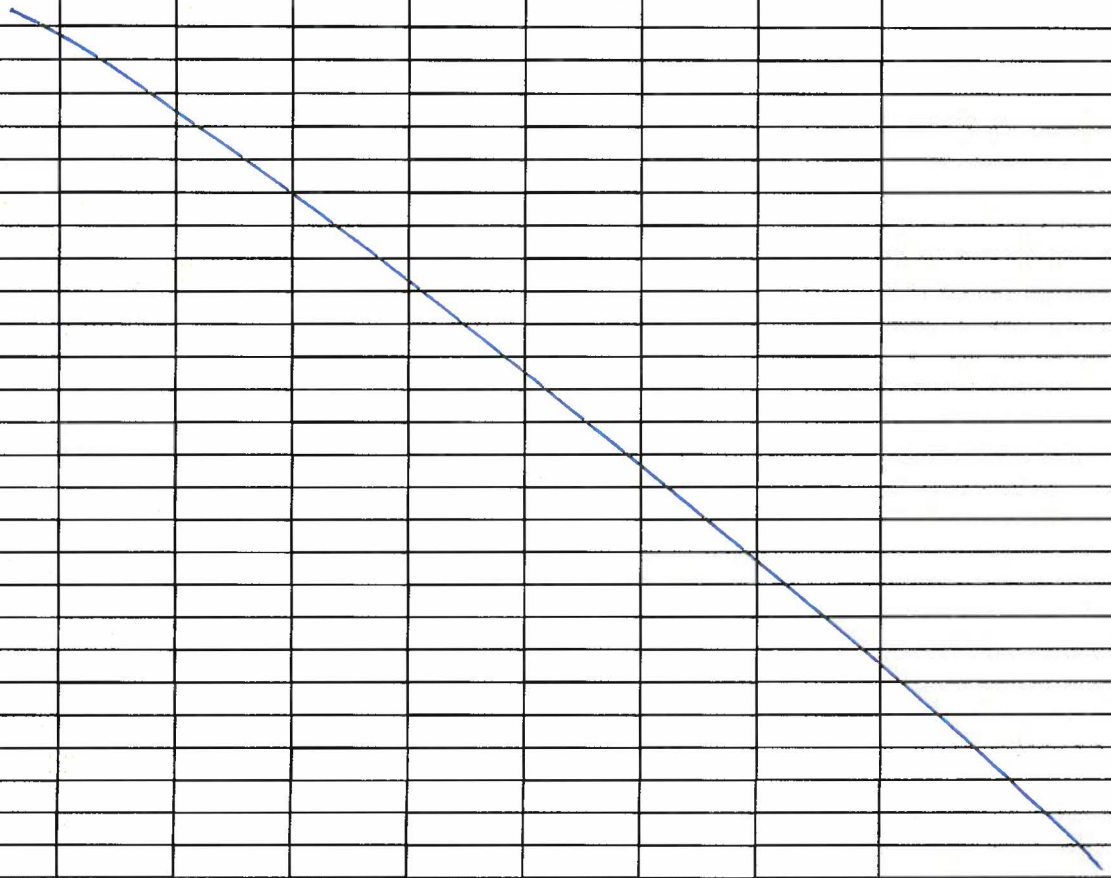
Setup Date: 8-Oct-14
Source ID: K7-321
Source Type: Tc-99

High Voltage: 650
Total Efficiency: 10.07%
MDA (in dpm): 477.21

Ranges
Background: 75 counts to 113 counts using ± 2 Sigma
Source: 5,601 counts to 5,814 counts using ± 2 Sigma

Bkgd Cnt Time (min): 1
Source Cnt Time (min): 1

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Technician Initials	Additional Comments
10/8/2014	5,701	98	650	ok	ok	Sat	JP	Pre-check
10/8/2014	5,754	92	650	ok	ok	Sat	JP	Post-check



Completed By: Jairo Pena
Date: 8-OCT-2014

Reviewed By: Jay Coopman
Date: 8 Oct 2014

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER RES, LLC ORDER NO. 20249409/409089

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 178154

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR311168

Cal. Date 24-Jul-14 Cal Due Date 24-Jul-15 Cal. Interval 1 Year Meterface 202-855

Check mark ✓ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 32 % Alt 694.8 mm Hg

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

✓ Mechanical ck. ✓ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ✓ Reset ck. ✓ Window Operation ✓ Geotropism
✓ Audio ck. ✓ Alarm Setting ck. ✓ Batt. ck. (Min. Volt) 2.2 VDC ☐ RS-232 Port OK
☐ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 650 V

✓ HV Readout (2 points) Ref./Inst. 500 / 502 V Ref./Inst. 2000 / 2002 V

Firmware Version: 39010x24
Alpha Threshold: 120 mV
Beta Threshold: 3.5 mV
Beta Window: 30 mV
Overload SET TO SIMULATE LIGHT LEAK.
Instrument calibrated with a 39" cable.
High voltage set with detector NOT CONNECTED.

(EEPROM Settings)
User Time: 0.1
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date: 7/24/2014
Calibration Date Due: 7/24/2015

COMMENTS:

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400k cpm	400	400
x1000	100k cpm	100	100
x100	40k cpm	400	400
x100	10k cpm	100	100
x10	4k cpm	400	400
x10	1k cpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

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

ALL Range(s) Calibrated Electronically

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	40032 (0)	40032 (0)
	40kcpm	4003	4003
	4kcpm	400	400
	400cpm	40	40
	40cpm	4	4

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

Ludlum Measurements, Inc. certifies that the above instrument has been calibrated by standards traceable to the National Institute of Standards and Technology, or to the calibration facilities of other International Standards Organization members, or have been derived from accepted values of natural physical constants or have been derived by the ratio type of calibration techniques. The calibration system conforms to the requirements of ANSI/NCSL Z540-1-1994 and ANSI N323-1978

State of Texas Calibration License No. LO-1963

Reference Instruments and/or Sources: Cs-137 S/N ☐ 059 ☐ 2171CP ☐ 2261CP ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 5105 ☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T10081 ☐ T10082 Neutron Am-241 Be S/N ☐ T-304 Ra-226 S/N ☐ Y982

✓ Alpha S/N Pu239 SN:7053 ✓ Beta S/N Tc99SN:5280,SrY90SN:5281 ☐ Other

✓ m 500 S/N 190566 ☐ Oscilloscope S/N ✓ Multimeter S/N 86250390

Calibrated By: [signature] Date 24-Jul-14

Reviewed By: [signature] Date 24 JUL 14

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

AC Inst Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A

10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A

Bench Test Data For Detector

Detector 43-93 Serial No. PR311168

Customer RES, LLC

Counter 2360 Serial No. 178154

Count Time 1Minute

Other

Order #. 20249409/409089

Alpha Input Sensitivity 120 mV

Beta Input Sensitivity 3.5 mV

Beta Window 30 mV

Distance Source to Detector Surface

High Voltage	Background		Isotope Pu239 Size 24900dpm		Isotope Tc99 Size 93200dpm		Isotope Sr/90 Size 94422dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
625	0	113	4737	395	22	10784	0	20254
650	0	186	5531	386	18	16000	0	27314
675	1	246	5723	470	22	19993	0	33097
700	1	316	6112	651	19	23737	3	36362

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature [signature] Date 24-July-14

• *Serving The Nuclear Industry Since 1962* •

Model 2360 Log Data **Date: 07/24/2014** **Time: 02:02:48 PM** **Page: 1**

Header 1: John Q. Public
Header 2: SN: 178154
Header 3: SN: PR311168
Header 4: Site: Bldg 1
Header 5: RM 008, S. Wall
Header 6: Comment
Location: Table 007

Calibration Due Date: 07/24/2015
Model 2360 Date: 07/24/2014
Model 2360 Time: 11:40:55 AM

Logged Samples: 0

User PC Scaler Count Time: 0.1 minutes

Alpha Ratemeter Alarm Setpoint:	999999
Beta Ratemeter Alarm Setpoint:	999999
Alpha + Beta Ratemeter Alarm Setpoint:	999999

Alpha Scaler Alarm Setpoint:	999999
Beta Scaler Alarm Setpoint:	999999
Alpha + Beta Scaler Alarm Setpoint:	999999

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	RES, LLC
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	10557 EZIP
Catalog No.:	EAB-230-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-323	**Contained Radioactivity:**	21.09 **nCi** 780.3 **Bq**

Physical Description:

A. Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active diameter/volume:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 23650 α/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Tc-99	**Customer:**	RES, LLC
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	10557 EZIP
Catalog No.:	EAB-099-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-321	**Contained Radioactivity:**	22.83 **nCi** 844.7 **Bq**

Physical Description:

A.	Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B.	Nature of active deposit:	Electrodeposited and diffusion bonded Technetium metal
C.	Active diameter/volume:	41 mm
D.	Backing:	Stainless steel
E.	Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A.	Type A (random) uncertainty:	± 0.4	%
B.	Type B (systematic) uncertainty:	± 3.0	%
C.	Uncertainty in aliquot weighing:	± 0.0	%
D.	Total uncertainty at the 99% confidence level:	± 3.0	%

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 27870 β/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Alpha** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	06-Sep-13
Instrument / SN:	2360 / 278600	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR311198	**Cal. Due:**	29-Aug-14	**Source SN:**	A7-270
Technician:	P. Wells			**Surface Emission Rate:**	54,750 particles/min
Location:	Trailer			**Source Type:**	Th-230
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	1	0.4	0.2
2	1	0.4	0.2
3	0	-0.6	0.4
4	0	-0.6	0.4
5	0	-0.6	0.4
6	1	0.4	0.2
7	1	0.4	0.2
8	1	0.4	0.2
9	1	0.4	0.2
10	0	-0.6	0.4
11	0	-0.6	0.4
12	1	0.4	0.2
13	0	-0.6	0.4
14	1	0.4	0.2
15	0	-0.6	0.4
16	0	-0.6	0.4
17	3	2.4	5.8
18	0	-0.6	0.4
19	1	0.4	0.2
20	0	-0.6	0.4
		0.0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 0.6 counts
Average Count Rate = 0.6 cpm
Standard Deviation = 0.8 counts
Sum of Squares = 11
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval (i) = 1.80 seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	18,977	80	6,472
2	18,985	88	7,823
3	18,989	92	8,547
4	19,005	108	11,761
5	18,803	-94	8,752
6	19,159	262	68,880
7	18,958	61	3,776
8	18,840	-57	3,198
9	18,823	-74	5,410
10	18,674	-223	49,529
11	19,006	109	11,979
12	18,926	29	867
13	18,978	81	6,634
14	18,918	21	460
15	18,836	-61	3,666
16	18,693	-204	41,433
17	18,673	-224	49,975
18	18,855	-42	1,726
19	18,861	-36	1,264
20	18,972	75	5,693
		0.0	

Average Counts = 18,897 counts
Average Count Rate = 18,897 cpm
Standard Deviation = 125 counts
Sum of the Squares = 297,845
Chi-Squared Statistic = 15.76

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) = 0.345 cpm/dpm
Surface Efficiency (E_s) = 0.250 cpm/dpm
Total Efficiency (E_T) = 0.086 cpm/dpm

Net source cts = 18,896 counts
Std. Dev. Net = 125 counts
Net Ct. Rate = 18,896 cpm

MDCR = 6 cpm (@ 95% confidence level)

MDA Scan= 101 dpm/100 cm^2
MDA Static= 77 dpm/100 cm^2

Bkg count range 0 to 2 (2 sigma)
Source count range 18,646 to 19,147 (2 sigma)

Jay C Cooper — Technical Reviewer

6 Sep 2013 — Date

Source Activity Correction Worksheet

Equation: $Activity(Act)_f = Act_o \times e^{-((.693/t)T)}$

Isotope	Th-230	
ID #	A7-270	
Initial Activity (Act_0) (dpm)	54,750	
Ref. Date	1-Sep-02	
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)
Current Date	6-Sep-13	4023.00 days (t)

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 0.19 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer Date 6 Sep 2013

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 278600	**Cal. Due:**	29-Aug-14
Probe Type / SN:	43-93 / PR311198	**Cal. Due:**	29-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	06-Sep-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-273	
Surface Emission Rate:	56,390	particles/min
Source Type:	Tc-99	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	142	14.2	201.6
2	141	13.2	174.2
3	140	12.2	148.8
4	110	-17.8	316.8
5	121	-6.8	46.2
6	119	-8.8	77.4
7	117	-10.8	116.6
8	144	16.2	262.4
9	127	-0.8	0.6
10	127	-0.8	0.6
11	128	0.2	0.0
12	130	2.2	4.8
13	130	2.2	4.8
14	123	-4.8	23.0
15	146	18.2	331.2
16	122	-5.8	33.6
17	135	7.2	51.8
18	127	-0.8	0.6
19	109	-18.8	353.4
20	118	-9.8	96.0
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	127.8	counts
Average Count Rate =	127.8	cpm
Standard Deviation =	10.9	counts
Sum of Squares =	2,245	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	12,006	23	534
2	12,182	199	39,641
3	11,995	12	146
4	11,968	-15	222
5	12,103	120	14,424
6	11,883	-100	9,980
7	11,913	-70	4,886
8	12,018	35	1,232
9	11,820	-163	26,536
10	12,020	37	1,376
11	11,963	-20	396
12	12,022	39	1,529
13	11,977	-6	35
14	11,898	-85	7,208
15	11,940	-43	1,840
16	12,057	74	5,491
17	12,156	173	29,964
18	11,979	-4	15
19	11,947	-36	1,289
20	11,811	-172	29,550
		0.0	

Average Counts =	11,983	counts
Average Count Rate =	11,983	cpm
Standard Deviation =	96	counts
Sum of the Squares =	176,294	
Chi-Squared Statistic =	14.71	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.210	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.105	cpm/dpm

Net source cts =	11,855	counts
Std. Dev. Net =	97	counts
Net Ct. Rate =	11,855	cpm

MDCR = 90 cpm (@ 95% confidence level)

MDA Scan=	1,212	dpm/100 cm^2
MDA Static=	529	dpm/100 cm^2

Bkg count range	106	to	150	(2 sigma)
Source count range	11,790	to	12,176	(2 sigma)

Technical Reviewer — Date: 6 Sep 2013

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	6-Sep-13	4023.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/mln

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 2.70 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer Date 6 Sep 2013

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER **ENVIRACHEM, INC.** ORDER NO. 20229136/396037

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 278600

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR 311198

Cal. Date 29-Aug-13 Cal Due Date 29-Aug-14 Cal. Interval 1 Year Meterface 202-855

Check mark ✓applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 701.8 mm Hg

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

✓ Mechanical ck. ✓ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ✓ Reset ck. ✓ Window Operation ✓ Geotropism
✓ Audio ck. ✓ Alarm Setting ck. ✓ Batt. ck. (Min. Volt) 2.2 VDC ✓ RS-232 Port OK

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

Instrument Volt Set 725 V

✓ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 2000 / 1503 V

Firmware Version: 3901.N24
Alpha Threshold: 120 mv
Beta Threshold: 3.5 mv
Beta Window: 30 mv
Overload Set to Simulate light leak
Instrument calibrated with a 39" cable.
High voltage set with detector not connected.

(EEPROM Settings)
User Time: 0.1
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date: 8/29/2013
Calibration Date Due: 8/29/2014

COMMENTS:

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400k cpm	400	400
x1000	100k cpm	100	100
x100	40k cpm	400	400
x100	10k cpm	100	100
x10	4k cpm	400	400
x10	1k cpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

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

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	40032 (0)	40032 (0)	Log Scale			
	40kcpm	4003	4003				
	4kcpm	400	400				
	400cpm	40	40				
	40cpm	4	4				

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

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1698 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60648 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

✓ Alpha S/N Pu239 SN:7053 ✓ Beta S/N Tc99SN:5280,SrY90SN:5281 ☐ Other

✓ m 500 S/N 190566 ☐ Oscilloscope S/N ✓ Multimeter S/N 86250390

Calibrated By: Dana Fuller Date 29-Aug-13

Reviewed By: Mark H Date 29 Aug 13

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

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed

Model 2360 Log Data **Date: 08/29/2013** **Time: 11:36:42 AM** **Page: 1**

Header 1: John Q. Public
Header 2: SN: 278600
Header 3: SN: PR311198
Header 4: Site: Bldg 1
Header 5: RM 008, S. Wall
Header 6: Comment
Location:

Calibration Due Date: 08/29/2014
Model 2360 Date: 08/29/2013
Model 2360 Time: 11:21:26 AM

Logged Samples: 0

User PC Scaler Count Time: 0.1 minutes

Alpha Ratemeter Alarm Setpoint:	999999
Beta Ratemeter Alarm Setpoint:	999999
Alpha + Beta Ratemeter Alarm Setpoint:	999999
Alpha Scaler Alarm Setpoint:	999999
Beta Scaler Alarm Setpoint:	999999
Alpha + Beta Scaler Alarm Setpoint:	999999

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	NEW WORLD TECHNOLOGY		
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	20400		
Catalog No.:	EAB-230-47LB	**Reference Date:**	1-Sep-02	12:00 PST	
Source No.:	A7-270	**Contained Radioactivity:**	49.32	**nCi**	1825 **Bq**
		Contained Radioactivity: (Total Alpha)	109500	**dpm**	

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ra-226 = 0.400% and Am-241 = 0.110% on 1 Sep 02.

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 54750 α/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

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:	Tc-99	**Customer:**	NEW WORLD TECHNOLOGY			
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	20400			
Catalog No.:	EAB-099-47LB	**Reference Date:**	1-Sep-02	12:00	PST	
Source No.:	A7-273	**Contained Radioactivity:**	47.93	**nCi**	1773	**Bq**
		Contained Radioactivity:	106400	**dpm**		

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electroplated and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

None detected

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had surface emission rate of 56390 β/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

ITSI Gamma

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 6-Sep-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-273 Total Efficiency: 10.51%
Probe #: 43-93 / PR311198 Project/#: :oping Surveys, Treasure Island / 0720 MDA (in dpm): 528.90

Ranges Background: 106 counts to 150 counts using ± 2 Sigma Count Time (min): 1
Source: 11,790 counts to 12,176 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	12,012	114	725	Sat	Sat	Sat	N/A	P.W.	
9/10/2013	11,974	134	↓	↓	↓	Sat		P.W.	
9/11/2013	11,793	133	↓	↓	↓	Sat		P.W.	
9/12/2013	11,835	128	↓	↓	↓	Sat		P.W.	
9/16/13	11816	107	↓	↓	↓	Sat		P.W.	
9/17/13	11801	125	↓	↓	↓	Sat		P.W.	
9/18/13	11808	132	↓	↓	↓	Sat		P.W.	
9/19/13	11799	127	↓	↓	↓	Sat		P.W.	
9/23/13	11803	113	↓	↓	↓	Sat		P.W.	
9/24/13	11844	124	↓	↓	↓	Sat		P.W.	
9/25/13	11873	134	↓	↓	↓	Sat		P.W.	
9/26/13	11911	120	↓	↓	↓	Sat		P.W.	
9/27/13	11793	130	↓	↓	↓	Sat		P.W.	
9/30/13	11865	133	↓	↓	↓	Sat		P.W.	
				N/A			↓		N/A

Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: [signature] Date: 1 Oct 2013

ITSI Canberra

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 6-Sep-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 8.63%
Probe #: 43-93 / PR311198 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 76.53

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 18,646 counts to 19,147 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	19,050	0	725	Sat	Sat	Sat	N/A	P.W.	
9/10/2013	19,077	0	↓	↓	↓	Sat		P.W.	
9/11/2013	18,952	1	↓	↓	↓	Sat		P.W.	
9/12/2013	18,684	0	↓	↓	↓	Sat		P.W.	
9/16/13	19060	1	↓	↓	↓	Sat		P.W.	
9/17/13	19024	0	↓	↓	↓	Sat		P.W.	
9/18/13	19101	1	↓	↓	↓	Sat		P.W.	
9/19/13	19097	0	↓	↓	↓	Sat		P.W.	
9/23/13	18891	0	↓	↓	↓	Sat		P.W.	
9/24/13	18846	0	↓	↓	↓	Sat		P.W.	
9/25/13	18940	0	↓	↓	↓	Sat		P.W.	
9/26/13	19078	0	↓	↓	↓	Sat		P.W.	
9/27/13	18970	0	↓	↓	↓	Sat		P.W.	
9/30/13	19088	0	↓	↓	↓	Sat		P.W.	
				U	A				U A

Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: [signature] Date: 1 Oct 2013

ITSI Cabane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 6-Sep-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 8.63%
Probe #: 43-93 / PR311198 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 76.53

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 18,646 counts to 19,147 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/13	18975	0	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	19122	0	↓	↓	↓	↓		P.W.	
10/3/13	18922	0	↓	↓	↓	↓		P.W.	
10/7/13	19022	0	↓	↓	↓	↓		P.W.	
10/8/13	18672	0	↓	↓	↓	↓		P.W.	
10/9/13	19057	0	↓	↓	↓	↓		P.W.	
10/10/13	19130	0	↓	↓	↓	↓		P.W.	
10/15/13	19061	0	↓	↓	↓	↓		P.W.	
10/16/13	18688	0	↓	↓	↓	↓		P.W.	
10/17/13	18970	0	↓	↓	↓	↓		P.W.	
10/18/13	18734	0	↓	↓	↓	↓		P.W.	
10/21/13	18822	0	↓	↓	↓	↓		P.W.	
10/22/13	18772	1	↓	↓	↓	↓		P.W.	
10/23/13	18899	0	↓	↓	↓	↓		P.W.	
10/24/13	18872	0	↓	↓	↓	↓		P.W.	
10/28/13	19131	0	↓	↓	↓	↓		P.W.	
10/29/13	19055	0	↓	↓	↓	↓		P.W.	
10/30/13	18868	0	↓	↓	↓	↓		P.W.	
10/31/13	18711	0	↓	↓	↓	↓		P.W.	

N/A

N/A

Completed By: [signature] Date: ~~10/13/13~~ AW 10/31/13 10/31/13
Reviewed By: [signature] Date: 11/5/13

ITSI Crane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 6-Sep-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-273 Total Efficiency: 10.51%
Probe #: 43-93 / PR311198 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 528.90

Ranges Background: 106 counts to 150 counts using ± 2 Sigma Count Time (min): 1
Source: 11,790 counts to 12,176 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/13	11796	125	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	11799	124	↓	↓	↓	↓		P.W.	
10/3/13	11815	123	↓	↓	↓	↓		P.W.	
10/7/13	11995	141	↓	↓	↓	↓		P.W.	
10/8/13	11822	147	↓	↓	↓	↓		P.W.	
10/9/13	11913	134	↓	↓	↓	↓		P.W.	
10/10/13	11858	130	↓	↓	↓	↓		P.W.	
10/15/13	11913	128	↓	↓	↓	↓		P.W.	
10/16/13	11921	131	↓	↓	↓	↓		P.W.	
10/17/13	11792	130	↓	↓	↓	↓		P.W.	
10/18/13	11891	130	↓	↓	↓	↓		P.W.	
10/21/13	11877	126	↓	↓	↓	↓		P.W.	
10/22/13	11852	121	↓	↓	↓	↓		P.W.	
10/23/13	11913	123	↓	↓	↓	↓		P.W.	
10/24/13	11819	144	↓	↓	↓	↓		P.W.	
10/28/13	11818	140	↓	↓	↓	↓		P.W.	
10/29/13	11811	141	↓	↓	↓	↓		P.W.	
10/30/13	11996	137	↓	↓	↓	↓		P.W.	
10/31/13	11811	120	↓	↓	↓	↓		P.W.	
				N	A				N A

Completed By: [signature] Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

Gilbane

SCALER INITIAL SETUP SHEET — **Alpha** — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 278600	**Cal. Due:**	29-Aug-14
Probe Type / SN:	43-93 / PR311198	**Cal. Due:**	29-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	30-Oct-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-270	
Surface Emission Rate:	54,750	particles/min
Source Type:	Th-230	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.9	0.7
2	2	1.2	1.3
3	1	0.2	0.0
4	1	0.2	0.0
5	1	0.2	0.0
6	3	2.2	4.6
7	1	0.2	0.0
8	2	1.2	1.3
9	0	-0.9	0.7
10	1	0.2	0.0
11	1	0.2	0.0
12	1	0.2	0.0
13	0	-0.9	0.7
14	0	-0.9	0.7
15	2	1.2	1.3
16	0	-0.9	0.7
17	0	-0.9	0.7
18	0	-0.9	0.7
19	0	-0.9	0.7
20	1	0.2	0.0
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	0.9	counts
Average Count Rate =	0.9	cpm
Standard Deviation =	0.9	counts
Sum of Squares =	15	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	18,937	-123	15,006
2	18,775	-285	80,940
3	19,100	41	1,640
4	19,048	-12	132
5	19,027	-33	1,056
6	19,238	179	31,862
7	18,917	-143	20,306
8	19,221	162	26,082
9	19,207	148	21,756
10	19,048	-12	132
11	19,172	113	12,656
12	19,293	234	54,522
13	18,738	-322	103,362
14	18,999	-61	3,660
15	18,948	-112	12,432
16	19,132	73	5,256
17	19,088	29	812
18	19,405	346	119,370
19	18,909	-151	22,650
20	18,988	-72	5,112
		0.0	

Average Counts =	19,060	counts
Average Count Rate =	19,060	cpm
Standard Deviation =	168	counts
Sum of the Squares =	538,749	
Chi-Squared Statistic =	28.27	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.348	cpm/dpm
Surface Efficiency (E_s) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.087	cpm/dpm

Net source cts =	19,059	counts
Std. Dev. Net =	168	counts
Net Ct. Rate =	19,059	cpm

MDCR = 7 cpm (@ 95% confidence level)

MDA Scan=	119	dpm/100 cm^2
MDA Static=	84	dpm/100 cm^2

Bkg count range	0	to	3	(2 sigma)
Source count range	18,723	to	19,396	(2 sigma)

Technical Reviewer — Date: 10/31/13

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	30-Oct-13	4077.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2=\frac{\Sigma(X_i-\mu)^2}{\sigma}$

s_i = 0.22 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 10/31/13 Date

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	30-Oct-13
Instrument / SN:	2360 / 278600	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR311198	**Cal. Due:**	29-Aug-14	**Source SN:**	A7-273
Technician:	P. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	156	17.8	316.8
2	169	30.8	948.6
3	155	16.8	282.2
4	143	4.8	23.0
5	139	0.8	0.6
6	135	-3.2	10.2
7	166	27.8	772.8
8	138	-0.2	0.0
9	158	19.8	392.0
10	143	4.8	23.0
11	140	1.8	3.2
12	91	-47.2	2227.8
13	133	-5.2	27.0
14	121	-17.2	295.8
15	120	-18.2	331.2
16	125	-13.2	174.2
17	137	-1.2	1.4
18	131	-7.2	51.8
19	127	-11.2	125.4
20	137	-1.2	1.4
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	138.2	counts
Average Count Rate =	138.2	cpm
Standard Deviation =	17.8	counts
Sum of Squares =	6,009	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	10,971	-152	23,013
2	11,023	-100	9,940
3	11,217	94	8,892
4	11,024	-99	9,742
5	11,172	49	2,430
6	11,210	87	7,621
7	11,113	-10	94
8	11,078	-45	1,998
9	11,314	191	36,596
10	11,212	89	7,974
11	11,005	-118	13,853
12	11,086	-37	1,347
13	11,252	129	16,718
14	11,094	-29	824
15	11,179	56	3,170
16	11,177	54	2,948
17	10,880	-243	58,903
18	11,153	30	918
19	11,343	220	48,532
20	10,951	-172	29,481
		0.0	

Average Counts =	11,123 counts
Average Count Rate =	11,123 cpm
Standard Deviation =	122 counts
Sum of the Squares =	284,996
Chi-Squared Statistic =	25.62

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.195	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.097	cpm/dpm

Net source cts =	10,985	counts
Std. Dev. Net =	124	counts
Net Ct. Rate =	10,985	cpm

MDCR = 94 cpm (@ 95% confidence level)

MDA Scan=	1,360	dpm/100 cm^2
MDA Static=	592	dpm/100 cm^2

Bkg count range	103	to	174	(2 sigma)
Source count range	10,878	to	11,368	(2 sigma)

Technical Reviewer — Date: 10/31/13

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	30-Oct-13	4077.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = 2.81 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 10/31/13 Date

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 30-Oct-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-273 Total Efficiency: 9.74%
Probe #: 43-93 / PR311198 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 592.37

Ranges Background: 103 counts to 174 counts using ± 2 Sigma Count Time (min): 1
Source: 10,878 counts to 11,368 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	11,204	122	SAT	SAT	SAT	Sat	N / A	PW	
11/5/13	10997	131	✓	✓	✓	✓	✓	P.W.	
11/6/13	11026	137	✓	✓	✓	✓	✓	P.W.	
11/7/13	10992	122	✓	✓	✓	✓	✓	P.W.	
11/8/13	11005	114	✓	✓	✓	✓	✓	P.W.	
11/11/13	11015	136	✓	✓	✓	✓	✓	PW	
11/12/13	10887	130	✓	✓	✓	✓	✓	P.W.	
11/13/13	10894	154	✓	✓	✓	✓	✓	P.W.	
11/14/13	10921	148	✓	✓	✓	✓	✓	P.W.	
11/15/13	11061	120	✓	✓	✓	✓	✓	P.W.	
11/18/13	10912	126	✓	✓	✓	✓	✓	P.W.	
11/19/13	11024	143	✓	✓	✓	✓	✓	PW	
11/20/13	10960	125	✓	✓	✓	✓	✓	P.W.	
11/21/13	10882	141	✓	✓	✓	✓	✓	PW	
11/22/13	11077	135	✓	✓	✓	✓	✓	PW	
11/23/13	10896	123	✓	✓	✓	✓	✓	PW	
11/25/13	10886	124	✓	✓	✓	✓	✓	P.W.	
11/26/13	11198	145	✓	✓	✓	✓	✓	P.W.	
				N	A				N / A

Completed By: [signature] Date: 11/26/13
Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 30-Oct-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 8.70%
Probe #: 43-93 / PR311198 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 83.76

Ranges Background: 0 counts to 3 counts using ± 2 Sigma Count Time (min): 1
Source: 18,723 counts to 19,396 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	19,393	0	SAT	SAT	SAT	Sat	N / A	PW	
11/5/13	19172	0	↓	↓	↓	↓	↓	P.W.	
11/6/13	18792	0	↓	↓	↓	↓	↓	P.W.	
11/7/13	18995	0	↓	↓	↓	↓	↓	P.W.	
11/8/13	19236	0	↓	↓	↓	↓	↓	P.W.	
11/11/13	18952	0	↓	↓	↓	↓	↓	PW	
11/12/13	18856	0	↓	↓	↓	↓	↓	P.W.	
11/13/13	18807	0	↓	↓	↓	↓	↓	P.W.	
11/14/13	18869	0	↓	↓	↓	↓	↓	P.W.	
11/15/13	18823	0	↓	↓	↓	↓	↓	P.W.	
11/18/13	18838	0	↓	↓	↓	↓	↓	P.W.	
11/19/13	18896	0	↓	↓	↓	↓	↓	PW	
11/20/13	18874	0	↓	↓	↓	↓	↓	P.W.	
11/21/13	18901	0	↓	↓	↓	↓	↓	PW	
11/22/13	18770	0	↓	↓	↓	↓	↓	PW	
11/23/13	18863	0	↓	↓	↓	↓	↓	PW	
11/25/13	19118	0	↓	↓	↓	↓	↓	P.W	
11/26/13	19390	0	↓	↓	↓	↓	↓	PW	
					N	A			N / A

Completed By: R. Wells Date: 11/26/13
Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily Th-230 Source Check 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 30-Oct-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 8.70%
Probe #: 43-93 / PR311198 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 83.76

Ranges Background: 0 counts to 3 counts using ± 2 Sigma Count Time (min): 1
Source: 18,723 counts to 19,396 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	19261	0	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	19337	0	"	"	"	"	"	P.W.	
12/4/13	19329	0	"	"	"	"	"	P.W.	
12/5/13	19392	0	"	"	"	"	"	P.W.	
12/9/13	19310	0	"	"	"	"	"	P.W.	
12/10/13	19322	0	"	"	"	"	"	P.W.	
					N/A				N/A

Completed By: Tamara Wells Date: 12/10/13
Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 30-Oct-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-273 Total Efficiency: 9.74%
Probe #: 43-93 / PR311198 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 592.37

Ranges Background: 103 counts to 174 counts using ± 2 Sigma Count Time (min): 1
Source: 10,878 counts to 11,368 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	11219	122	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	10895	121	↓	↓	↓	↓	↓	P.W.	
12/4/13	10899	127	↓	↓	↓	↓	↓	P.W.	
12/5/13	11120	141	↓	↓	↓	↓	↓	P.W.	
12/9/13	11071	131	↓	↓	↓	↓	↓	P.W.	
12/10/13	10934	133	↓	↓	↓	↓	↓	P.W.	
					N/A				N/A

Completed By: Dana Wells Date: 12/10/13
Reviewed By: Date: 12/11/13

Gilbane

SCALER INITIAL SETUP SHEET | **Alpha** | ***(Blue cells for input)***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 278600	**Cal. Due:**	29-Aug-14
Probe Type / SN:	43-93 / PR311198	**Cal. Due:**	29-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	10-Dec-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-270	
Surface Emission Rate:	54,750	particles/min
Source Type:	Th-230	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	1	0.3	0.1
2	0	-0.8	0.6
3	0	-0.8	0.6
4	1	0.3	0.1
5	1	0.3	0.1
6	0	-0.8	0.6
7	0	-0.8	0.6
8	0	-0.8	0.6
9	3	2.3	5.1
10	0	-0.8	0.6
11	0	-0.8	0.6
12	3	2.3	5.1
13	0	-0.8	0.6
14	0	-0.8	0.6
15	1	0.3	0.1
16	0	-0.8	0.6
17	2	1.3	1.6
18	0	-0.8	0.6
19	3	2.3	5.1
20	0	-0.8	0.6
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	0.8	counts
Average Count Rate =	0.8	cpm
Standard Deviation =	1.1	counts
Sum of Squares =	24	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	19,143	22	469
2	18,988	-133	17,782
3	19,248	127	16,040
4	19,097	-24	593
5	19,453	332	109,992
6	18,971	-150	22,605
7	19,053	-68	4,672
8	19,249	128	16,295
9	18,735	-386	149,266
10	19,144	23	513
11	18,935	-186	34,726
12	19,242	121	14,556
13	19,437	316	99,635
14	18,959	-162	26,358
15	19,026	-95	9,092
16	19,208	87	7,508
17	19,329	208	43,119
18	18,991	-130	16,991
19	19,047	-74	5,528
20	19,172	51	2,565
		0.0	

Average Counts =	19,121	counts
Average Count Rate =	19,121	cpm
Standard Deviation =	177	counts
Sum of the Squares =	598,305	
Chi-Squared Statistic =	31.29	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.349	cpm/dpm
Surface Efficiency (E_s) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.087	cpm/dpm

Net source cts =	19,121	counts
Std. Dev. Net =	177	counts
Net Ct. Rate =	19,121	cpm

MDCR = 7 cpm (@ 95% confidence level)

MDA Scan=	112	dpm/100 cm^2
MDA Static=	81	dpm/100 cm^2

Bkg count range	0	to	3	(2 sigma)
Source count range	18,766	to	19,476	(2 sigma)

Technical Reviewer — Date: 12/10/13

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	10-Dec-13	4118.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 0.21 counts

x = count
μ = mean
σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s [1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
i = scan observation interval (sec)
b_i = number of background counts in scan observation interval i
s_i = minimum detectable number of net source counts in scan observation interval i
p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

12/19/13

Technical Reviewer Date

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	10-Dec-13
Instrument / SN:	2360 / 278600	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR311198	**Cal. Due:**	29-Aug-14	**Source SN:**	A7-273
Technician:	P. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	122	-2.3	5.5
2	139	14.7	214.6
3	111	-13.4	178.2
4	131	6.7	44.2
5	117	-7.3	54.0
6	118	-6.3	40.3
7	113	-11.4	128.8
8	123	-1.3	1.8
9	132	7.7	58.5
10	144	19.7	386.1
11	119	-5.3	28.6
12	118	-6.3	40.3
13	119	-5.3	28.6
14	118	-6.3	40.3
15	146	21.7	468.7
16	114	-10.4	107.1
17	111	-13.4	178.2
18	99	-25.4	642.6
19	140	15.7	244.9
20	153	28.7	820.8
		0.0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 124.4 counts

Average Count Rate = 124.4 cpm

Standard Deviation = 14.0 counts

Sum of Squares = 3,713

Area Correction Factor (ACF) = 1.00 $100cm^2$

Scan Observation Interval (i) = 1.80 seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	10,641	49	2,372
2	10,752	160	25,504
3	10,382	-210	44,226
4	10,693	101	10,140
5	10,665	73	5,285
6	10,496	-96	9,274
7	10,569	-23	543
8	10,676	84	7,006
9	10,619	27	713
10	10,401	-191	36,596
11	10,388	-204	41,738
12	10,617	25	610
13	10,571	-21	454
14	10,725	133	17,609
15	10,899	307	94,065
16	10,557	-35	1,246
17	10,627	35	1,204
18	10,506	-86	7,448
19	10,453	-139	19,404
20	10,609	17	279
		0.0	

Average Counts = 10,592 counts

Average Count Rate = 10,592 cpm

Standard Deviation = 131 counts

Sum of the Squares = 325,716

Chi-Squared Statistic = 30.75

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) = 0.186 cpm/dpm
Surface Efficiency (E_s) = 0.500 cpm/dpm
Total Efficiency (E_T) = 0.093 cpm/dpm

Net source cts = 10,468 counts
Std. Dev. Net = 132 counts
Net Ct. Rate = 10,468 cpm

MDCR = 89 cpm (@ 95% confidence level)

MDA Scan= 1,354 dpm/100 cm^2
MDA Static= 591 dpm/100 cm^2

Bkg count range 96 to 152 (2 sigma)
Source count range 10,330 to 10,854 (2 sigma)

Technical Reviewer — Date 12/10/13

RSOP-03.01 Rev 19Aug2013

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	10-Dec-13	4118.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 2.67 counts

x = count

μ = mean

σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s [1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval i

s_i = minimum detectable number of net source counts in scan observation interval i

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

12/10/13

Technical Reviewer Date

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 278600 Setup Date: 10-Dec-13 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: A7-273 Total Efficiency: 9.28%
Probe #: 43-93 / PR311198 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 591.29

Ranges Background: 96 counts to 152 counts using ± 2 Sigma Count Time (min): 1
Source: 10,330 counts to 10,854 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/11/13	10433	141	Sat	Sat	Sat	Sat	N/A	P.W.	
12/12/13	10427	144	↓	↓	↓	↓	↓	P.W.	
12/13/13	10570	123	↓	↓	↓	↓	↓	P.W.	
12/16/13	10551	146	↓	↓	↓	↓	↓	P.W.	
12/17/13	10810	141	↓	↓	↓	↓	↓	P.W.	
12/18/13	10556	148	↓	↓	↓	↓	↓	P.W.	
12/19/13	10817	122	↓	↓	↓	↓	↓	PW	
12/20/13	10606	138	↓	↓	↓	↓	↓	PW	
12/23/13	10759	150	↓	↓	↓	↓	↓	PW	
					N/A	N/A			N/A

Completed By: Ryan Wells Date: 1/2/14
Reviewed By: [signature] Date: 1/19/14

Gilbane

Instrument Daily Th-230 Source Check 54,744 Corrected Activity (in dpm)

Instrument #:	2360 / 278600	Setup Date:	10-Dec-13	High Voltage:	725 v
Cal. Date:	August 29, 2014	Source ID:	A7-270	Total Efficiency:	8.73%
Probe #:	43-93 / PR311198	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	80.50

Ranges Background: 0 counts to 3 counts using ± 2 Sigma Count Time (min): 1

Source: 18,766 counts to 19,476 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/11/13	19323	0	Sat	Sat	Sat	Sat	N/A	P.W.	
12/12/13	19212	0	↓	↓	↓	↓	↓	P.W.	
12/13/13	19435	0	↓	↓	↓	↓	↓	P.W.	
12/16/13	19392	0	↓	↓	↓	↓	↓	P.W.	
12/17/13	19338	0	↓	↓	↓	↓	↓	P.W.	
12/18/13	19143	0	↓	↓	↓	↓	↓	P.W.	
12/19/13	19354	0	↓	↓	↓	↓	↓	P.W.	
12/20/13	19369	0	↓	↓	↓	↓	↓	P.W.	
12/23/13	19098	0	↓	↓	↓	↓	↓	P.W.	
					N/A				N/A

Completed By: Penny Wells Date: 1/2/14

Reviewed By: [signature] Date: 12/19/14
1/7/14

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Alpha** | ***{Blue cells for Input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14
Probe Type / SN:	43-93 / PR311163	**Cal. Due:**	29-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	06-Sep-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-270	
Surface Emission Rate:	54,750	particles/min
Source Type:	Th-230	
HV Check/Setting:	800 v	

1. Total Background Counts observed:

		Chi-squared Calculations	
1	0	-0.1	0.0
2	0	-0.1	0.0
3	0	-0.1	0.0
4	1	0.9	0.8
5	0	-0.1	0.0
6	0	-0.1	0.0
7	0	-0.1	0.0
8	0	-0.1	0.0
9	0	-0.1	0.0
10	0	-0.1	0.0
11	0	-0.1	0.0
12	0	-0.1	0.0
13	0	-0.1	0.0
14	0	-0.1	0.0
15	0	-0.1	0.0
16	1	0.9	0.8
17	0	-0.1	0.0
18	0	-0.1	0.0
19	0	-0.1	0.0
20	0	-0.1	0.0
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	0.1	counts
Average Count Rate =	0.1	cpm
Standard Deviation =	0.3	counts
Sum of Squares =	2	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

		Chi-squared Calculations	
1	20,297	12	155
2	20,143	-142	20,036
3	20,485	200	40,180
4	20,556	271	73,685
5	19,998	-287	82,111
6	20,366	81	6,634
7	20,470	185	34,392
8	20,264	-21	422
9	20,400	115	13,329
10	20,047	-238	56,430
11	20,089	-196	38,240
12	20,353	68	4,685
13	20,420	135	18,347
14	20,302	17	305
15	20,413	128	16,499
16	20,383	98	9,692
17	20,047	-238	56,430
18	20,504	219	48,158
19	20,151	-134	17,836
20	20,003	-282	79,270
		0.0	

Average Counts =	20,285	counts
Average Count Rate =	20,285	cpm
Standard Deviation =	180	counts
Sum of the Squares =	616,837	
Chi-Squared Statistic =	30.41	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.371	cpm/dpm
Surface Efficiency (E_s) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.093	cpm/dpm

Net source cts =	20,284	counts
Std. Dev. Net =	180	counts
Net Ct. Rate =	20,284	cpm

MDCR = 3 cpm (@ 95% confidence level)

MDA Scan=	38	dpm/100 cm^2
MDA Static=	48	dpm/100 cm^2

Bkg count range	0	to	1	(2 sigma)
Source count range	19,924	to	20,645	(2 sigma)

Technical Reviewer — Date: 9 Sep 2013

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	6-Sep-13	4023.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 0.08 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer Date 9 Sep 2013

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	06-Sep-13
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR311163	**Cal. Due:**	29-Aug-14	**Source SN:**	A7-273
Technician:	P. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	800 v

1. Total Background Counts observed:

Chi-squared Calculations

1	125	-37.3	1387.6
2	137	-25.3	637.6
3	138	-24.3	588.1
4	159	-3.3	10.6
5	141	-21.3	451.6
6	162	-0.3	0.1
7	155	-7.3	52.6
8	162	-0.3	0.1
9	180	17.8	315.1
10	174	11.8	138.1
11	170	7.8	60.1
12	176	13.8	189.1
13	165	2.8	7.6
14	160	-2.3	5.1
15	165	2.8	7.6
16	179	16.8	280.6
17	176	13.8	189.1
18	178	15.8	248.1
19	152	-10.3	105.1
20	191	28.8	826.6
		0.0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 162.3 counts
Average Count Rate = 162.3 cpm
Standard Deviation = 17.0 counts
Sum of Squares = 5,500
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval (i) = 1.80 seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	13,073	1	0
2	12,953	-119	14,244
3	13,089	17	277
4	12,963	-109	11,957
5	13,092	20	386
6	13,005	-67	4,536
7	12,919	-153	23,516
8	13,059	-13	178
9	12,893	-179	32,166
10	13,291	219	47,808
11	13,080	8	59
12	13,335	263	68,985
13	13,232	160	25,488
14	13,125	53	2,772
15	13,021	-51	2,637
16	13,309	237	56,003
17	13,110	38	1,418
18	12,952	-120	14,484
19	13,115	43	1,819
20	12,831	-241	58,250
		0.0	

Average Counts = 13,072 counts
Average Count Rate = 13,072 cpm
Standard Deviation = 139 counts
Sum of the Squares = 366,985
Chi-Squared Statistic = 28.07

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) = 0.229 cpm/dpm
Surface Efficiency (E_s) = 0.500 cpm/dpm
Total Efficiency (E_T) = 0.114 cpm/dpm

Net source cts = 12,910 counts
Std. Dev. Net = 140 counts
Net Ct. Rate = 12,910 cpm

MDCR = 101 cpm (@ 95% confidence level)

MDA Scan= 1,254 dpm/100 cm^2
MDA Static= 544 dpm/100 cm^2

Bkg count range 128 to 196 (2 sigma)
Source count range 12,794 to 13,350 (2 sigma)

Jim C Cooper. 9 Sep 2013

Technical Reviewer — Date

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	6-Sep-13	4023.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 3.04 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer Date

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER **ENVIRACHEM, INC.** ORDER NO. 20229136/396037

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 278618

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR311163

Cal. Date 29-Aug-13 Cal Due Date 29-Aug-14 Cal. Interval 1 Year Meterface 202-855

Check mark ✓ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 36 % Alt 701.8 mm Hg

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

✓ Mechanical ck. ✓ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ✓ Reset ck. ✓ Window Operation ✓ Geotropism
✓ Audio ck. ✓ Alarm Setting ck. ✓ Batt. ck. (Min. Volt) 2.2 VDC — RS-232 Port OK

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

Instrument Volt Set 800 V

✓ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 2000 / 2001 V

Firmware Version: 39010v24
Alpha Threshold: 120 mv
Beta Threshold: 3.5 mv
Beta Window: 30 mv
Overload Set to Simulate light leak.
Instrument calibrated with a 39" cable.
High voltage set with detector NOT connected.

(EEPROM Settings)
User Time 0.1
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date 8/29/2013
Calibration Date Due: 8/29/2014

COMMENTS:

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400k cpm	405	400
x1000	100k cpm	101	100
x100	40k cpm	405	400
x100	10k cpm	101	100
x10	4k cpm	405	400
x10	1k cpm	101	100
x1	400 cpm	405	400
x1	100 cpm	101	100

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

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	40034 (0)	40034 (0)
	40kcpm	4003	4003
	4kcpm	400	400
	400cpm	40	40
	40cpm	4	4

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

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

Reference Instruments and/or Sources: ☐ 059 ☐ 260 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

✓ Alpha S/N Pu239 SN:7053 ✓ Beta S/N Tc99SN:5280,SrY90SN:5281 ☐ Other

✓ m 500 S/N 190566 ☐ Oscilloscope S/N ✓ Multimeter S/N 86250390

Calibrated By: [signature] Date 29-Aug-13

Reviewed By: [signature] Date 29Aug13

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

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed

Model 2360 Log Data **Date: 08/29/2013** **Time: 11:17:31 AM** **Page: 1**

Header 1: John Q. Public
Header 2: SN: 278618
Header 3: SN: PR311163
Header 4: Site: Bldg 1
Header 5: RM 008, S. Wall
Header 6: Comment
Location:

Calibration Due Date: 08/29/2014
Model 2360 Date: 08/29/2013
Model 2360 Time: 10:40:33 AM

Logged Samples: 0

User PC Scaler Count Time: 0.1 minutes

Alpha Ratemeter Alarm Setpoint:	999999
Beta Ratemeter Alarm Setpoint:	999999
Alpha + Beta Ratemeter Alarm Setpoint:	999999
Alpha Scaler Alarm Setpoint:	999999
Beta Scaler Alarm Setpoint:	999999
Alpha + Beta Scaler Alarm Setpoint:	999999

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide: Th-230
Half-life: (7.54 ± 0.03)E+04 years
Catalog No.: EAB-230-47LB
Source No.: A7-270

Customer: NEW WORLD TECHNOLOGY
P.O. No.: 20400
Reference Date: 1-Sep-02 12:00 PST
Contained Radioactivity: 49.32 nCi 1825 Bq
Contained Radioactivity (Total Alpha): 109500 dpm

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ra-226 = 0.400% and Am-241 = 0.110% on 1 Sep 02.

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 54750 α/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

Isotope Products Laboratories
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CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Tc-99	**Customer:**	NEW WORLD TECHNOLOGY			
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	20400			
Catalog No.:	EAB-099-47LB	**Reference Date:**	1-Sep-02	12:00	PST	
Source No.:	A7-273	**Contained Radioactivity:**	47.93	**nCi**	1773	**Bq**
		Contained Radioactivity:	106400	**dpm**		

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electroplated and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

None detected

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had surface emission rate of 56390 β/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

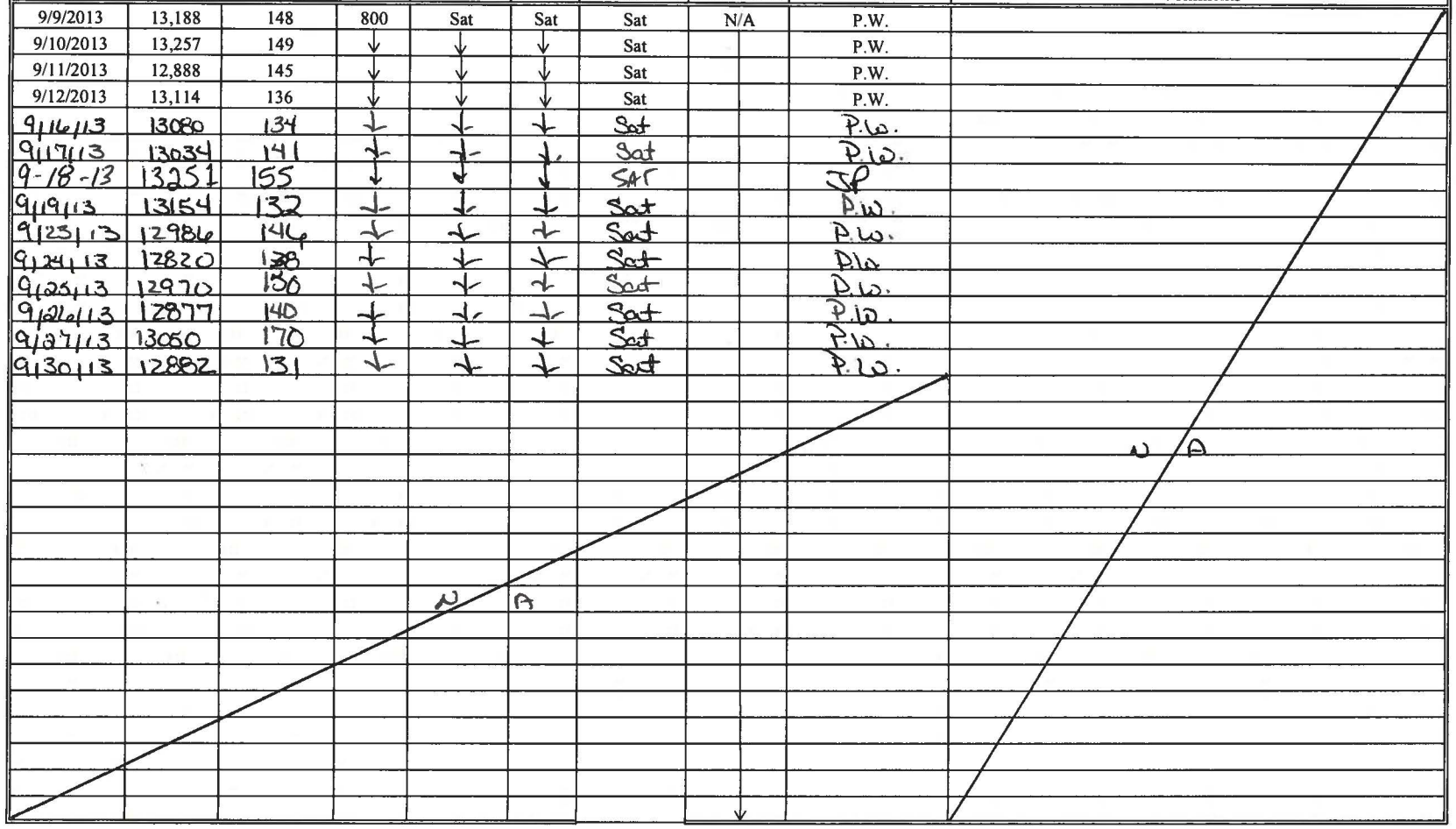
ITSI Crane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #:	2360 / 278618	Setup Date:	6-Sep-13	High Voltage:	800 v
Cal. Date:	August 29, 2014	Source ID:	A7-273	Total Efficiency:	11.45%
Probe #:	43-93 / PR311163	Project/#:	oping Surveys, Treasure Island / 0720	MDA (in dpm):	543.92

Ranges Background: 128 counts to 196 counts using ± 2 Sigma Count Time (min): 1
Source: 12,794 counts to 13,350 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	13,188	148	800	Sat	Sat	Sat	N/A	P.W.	
9/10/2013	13,257	149	↓	↓	↓	Sat		P.W.	
9/11/2013	12,888	145	↓	↓	↓	Sat		P.W.	
9/12/2013	13,114	136	↓	↓	↓	Sat		P.W.	
9/16/13	13080	134	↓	↓	↓	Sat		P.W.	
9/17/13	13034	141	↓	↓	↓	Sat		P.W.	
9-18-13	13251	155	↓	↓	↓	Sat		JP	
9/19/13	13154	132	↓	↓	↓	Sat		P.W.	
9/23/13	12986	146	↓	↓	↓	Sat		P.W.	
9/24/13	12820	138	↓	↓	↓	Sat		P.W.	
9/25/13	12970	130	↓	↓	↓	Sat		P.W.	
9/26/13	12877	140	↓	↓	↓	Sat		P.W.	
9/27/13	13050	170	↓	↓	↓	Sat		P.W.	
9/30/13	12882	131	↓	↓	↓	Sat		P.W.	



Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: Jay C. Cooper Date: 1 Oct 2013

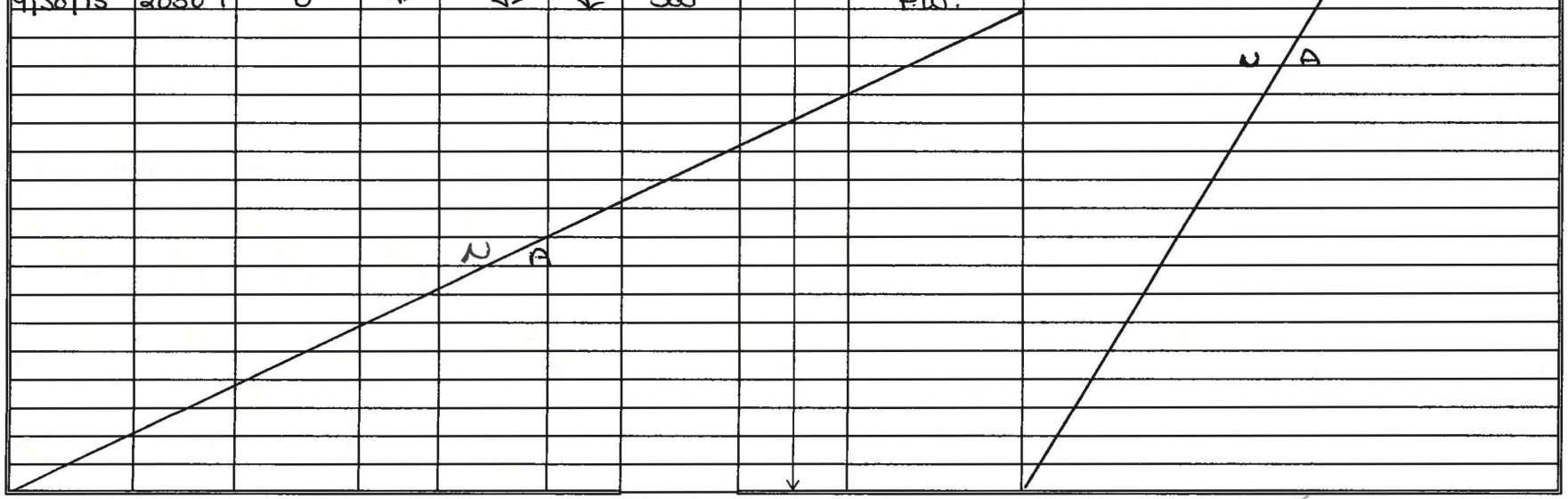
ITSI Crane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 6-Sep-13 High Voltage: 800 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 9.26%
Probe #: 43-93 / PR311163 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 48.27

Ranges Background: 0 counts to 1 counts using ± 2 Sigma Count Time (min): 1
Source: 19,924 counts to 20,645 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	20,552	0	800	Sat	Sat	Sat	N/A	P.W.	
9/10/2013	20,445	0	↓	↓	↓	Sat		P.W.	
9/11/2013	20,315	0	↓	↓	↓	Sat		P.W.	
9/12/2013	19,997	0	↓	↓	↓	Sat		P.W.	
9/16/13	20191	0	↓	↓	↓	Sat		P.W.	
9/17/13	20528	0	↓	↓	↓	Sat		P.W.	
9-18-13	20624	1	↓	↓	↓	SAT		J.P	
9/19/13	20608	0	↓	↓	↓	Sat		P.W.	
9/23/13	20502	0	↓	↓	↓	Sat		P.W.	
9/24/13	20024	0	↓	↓	↓	Sat		P.W.	
9/25/13	20262	1	↓	↓	↓	Sat		P.W.	
9/26/13	20276	0	↓	↓	↓	Sat		P.W.	
9/27/13	20541	0	↓	↓	↓	Sat		P.W.	
9/30/13	20509	0	↓	↓	↓	Sat		P.W.	



Completed By: Paul Wells Date: Oct. 1, 2013
Reviewed By: Jay C Cooper Date: 1 Oct 2013

ITSI Cabane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #:	2360 / 278618	Setup Date:	6-Sep-13	High Voltage:	800 v
Cal. Date:	August 29, 2014	Source ID:	A7-270	Total Efficiency:	9.26%
Probe #:	43-93 / PR311163	Project/#:	oping Surveys, Treasure Island / 0720	MDA (in dpm):	48.27

Ranges Background: 0 counts to 1 counts using ± 2 Sigma Count Time (min): 1

Source: 19,924 counts to 20,645 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/13	20352	0	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	20537	0	"	"	"	"		P.W.	
10/3/13	20463	0	"	"	"	"		P.W.	
10/7/13	20079	1	"	"	"	"		P.W.	
10/8/13	20102	1	"	"	"	"		P.W.	
10/9/13	20497	0	"	"	"	"		P.W.	
10/10/13	20201	0	"	"	"	"		P.W.	
10/15/13	20412	0	"	"	"	"		P.W.	
10/16/13	20174	0	"	"	"	"		P.W.	
10/17/13	20314	0	"	"	"	"		P.W.	
10/18/13	19967	0	"	"	"	"		P.W.	
10/21/13	20254	0	"	"	"	"		P.W.	
10/22/13	20502	0	"	"	"	"		P.W.	
10/23/13	20096	0	"	"	"	"		P.W.	
10/24/13	19970	0	"	"	"	"		P.W.	
10/28/13	19983	0	"	"	"	"		P.W.	
10/29/13	20538	0	"	"	"	"		P.W.	
10/30/13	19971	0	"	"	"	"		P.W.	
10/31/13	19960	0	"	"	"	"		P.W.	
				N/A					N/A

Completed By: Ron Wells Date: 10/31/13

Reviewed By: Date: 11/5/13

ITSI Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #:	2360 / 278618	Setup Date:	6-Sep-13	High Voltage:	800 v
Cal. Date:	August 29, 2014	Source ID:	A7-273	Total Efficiency:	11.45%
Probe #:	43-93 / PR311163	Project/#:	oping Surveys, Treasure Island / 0720	MDA (in dpm):	543.92

Ranges Background: 128 counts to 196 counts using ± 2 Sigma Count Time (min): 1
Source: 12,794 counts to 13,350 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/13	12815	153	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	12782	157	Sat	Sat	Sat	Sat		P.W	
10/3/13	12917	154	↓	↓	↓	↓		P.W.	
10/7/13	12972	149	↓	↓	↓	↓		P.W.	
10/8/13	12934	151	↓	↓	↓	↓		P.W.	
10/9/13	12799	161	↓	↓	↓	↓		P.W	
10/10/13	12802	169	↓	↓	↓	↓		P.W	
10/15/13	12870	160	↓	↓	↓	↓		P.W	
10/16/13	12829	134	↓	↓	↓	↓		P.W	
10/17/13	12802	154	↓	↓	↓	↓		P.W.	
10/18/13	12798	151	↓	↓	↓	↓		P.W.	
10/21/13	12819	164	↓	↓	↓	↓		P.W.	
10/22/13	12858	151	↓	↓	↓	↓		P.W.	
10/23/13	12801	153	↓	↓	↓	↓		P.W.	
10/24/13	12839	167	↓	↓	↓	↓		P.W.	
10/28/13	12853	146	↓	↓	↓	↓		P.W.	
10/29/13	12798	158	↓	↓	↓	↓		P.W.	N A
10/30/13	12895	139	↓	↓	↓	↓		P.W.	
10/31/13	12802	138	↓	↓	↓	↓		P.W.	
				N					
				A					

Completed By: Pam Wells Date: 10/31/13
Reviewed By: Date: 11/5/13

NOTE THAT THE 10/2/13 COUNT IS 12 CPM LOW, BUT WITHIN 2σL 3σ. ACCEPTABLE BASED ON FURTHER PERFORMANCE MC 11/5/13

Gilbane

SCALER INITIAL SETUP SHEET — Alpha — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14
Probe Type / SN:	43-93 / PR311163	**Cal. Due:**	29-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	31-Oct-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-270	
Surface Emission Rate:	54,750	particles/min
Source Type:	Th-230	
HV Check/Setting:	800 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.6	0.4
2	0	-0.6	0.4
3	0	-0.6	0.4
4	0	-0.6	0.4
5	0	-0.6	0.4
6	0	-0.6	0.4
7	0	-0.6	0.4
8	1	0.4	0.2
9	1	0.4	0.2
10	0	-0.6	0.4
11	1	0.4	0.2
12	1	0.4	0.2
13	1	0.4	0.2
14	0	-0.6	0.4
15	0	-0.6	0.4
16	1	0.4	0.2
17	1	0.4	0.2
18	4	3.4	11.6
19	0	-0.6	0.4
20	1	0.4	0.2
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	0.6	counts
Average Count Rate =	0.6	cpm
Standard Deviation =	0.9	counts
Sum of Squares =	17	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	20,152	-132	17,332
2	20,284	0	0
3	20,134	-150	22,395
4	20,185	-99	9,732
5	20,355	71	5,091
6	20,019	-265	70,040
7	20,299	15	236
8	20,217	-67	4,442
9	20,222	-62	3,801
10	20,660	376	141,639
11	20,040	-244	59,365
12	20,637	353	124,856
13	20,114	-170	28,781
14	20,194	-90	8,037
15	20,257	-27	710
16	20,439	155	24,134
17	20,502	218	47,677
18	20,521	237	56,335
19	20,150	-134	17,862
20	20,292	8	70
		0.0	

Average Counts =	20,284	counts
Average Count Rate =	20,284	cpm
Standard Deviation =	184	counts
Sum of the Squares =	642,535	
Chi-Squared Statistic =	31.68	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.371	cpm/dpm
Surface Efficiency (E_s) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.093	cpm/dpm

Net source cts =	20,283	counts
Std. Dev. Net =	184	counts
Net Ct. Rate =	20,283	cpm

MDCR = 6 cpm (@ 95% confidence level)

MDA Scan=	94	dpm/100 cm^2
MDA Static=	71	dpm/100 cm^2

Bkg count range	0	to	2	(2 sigma)
Source count range	19,916	to	20,651	(2 sigma)

Technical Reviewer — Date: 10/31/13

Source Activity Correction Worksheet

Equation: Activity$(Act)_f = Act_o \times e^{-((.693/t)T)}$

Isotope	Th-230	
ID #	A7-270	
Initial Activity (Act_0) (dpm)	54,750	
Ref. Date	1-Sep-02	
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)
Current Date	31-Oct-13	4078.00 days (t)

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 0.19 counts

x = count
μ = mean
σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
i = scan observation interval (sec)
b_i = number of background counts in scan observation interval *i*
s_i = minimum detectable number of net source counts in scan observation interval *i*
p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 10/31/13 Date

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	31-Oct-13
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR311163	**Cal. Due:**	29-Aug-14	**Source SN:**	A7-273
Technician:	P. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	800 v

1. Total Background Counts observed:

Chi-squared Calculations

1	105	-29.8	888.0
2	117	-17.8	316.8
3	105	-29.8	888.0
4	119	-15.8	249.6
5	139	4.2	17.6
6	115	-19.8	392.0
7	115	-19.8	392.0
8	145	10.2	104.0
9	145	10.2	104.0
10	133	-1.8	3.2
11	134	-0.8	0.6
12	143	8.2	67.2
13	136	1.2	1.4
14	131	-3.8	14.4
15	150	15.2	231.0
16	128	-6.8	46.2
17	163	28.2	795.2
18	158	23.2	538.2
19	170	35.2	1239.0
20	145	10.2	104.0
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	134.8	counts
Average Count Rate =	134.8	cpm
Standard Deviation =	18.3	counts
Sum of Squares =	6,393	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	12,078	-29	864
2	11,984	-123	15,228
3	12,237	130	16,796
4	12,164	57	3,204
5	12,027	-80	6,464
6	12,259	152	22,983
7	12,190	83	6,823
8	11,941	-166	27,689
9	12,035	-72	5,242
10	12,109	2	3
11	12,212	105	10,941
12	12,316	209	43,514
13	12,299	192	36,711
14	12,030	-77	5,991
15	11,738	-369	136,456
16	12,042	-65	4,277
17	12,210	103	10,527
18	11,965	-142	20,278
19	12,173	66	4,303
20	12,139	32	999
		0.0	

Average Counts =	12,107	counts
Average Count Rate =	12,107	cpm
Standard Deviation =	141	counts
Sum of the Squares =	379,291	
Chi-Squared Statistic =	31.33	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.212	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.106	cpm/dpm

Net source cts =	11,973	counts
Std. Dev. Net =	142	counts
Net Ct. Rate =	11,973	cpm

MDCR = 93 cpm (@ 95% confidence level)

MDA Scan= 1,232 dpm/100 cm^2
MDA Static= 537 dpm/100 cm^2

Bkg count range	98	to	171	(2 sigma)
Source count range	11,825	to	12,390	(2 sigma)

Technical Reviewer — Date: 10/31/13

Source Activity Correction Worksheet

Equation: $Activity(Act)_f = Act_o \times e^{-((.693/t)T)}$

Isotope	Tc-99	
ID #	A7-273	
Initial Activity (Act_0) (dpm)	56,390	
Ref. Date	1-Sep-02	
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)
Current Date	31-Oct-13	4078.00 days (t)

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 2.78 counts

x = count

μ = mean

σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 10/31/13 Date

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 31-Oct-13 High Voltage: 800 v
Cal. Date: August 29, 2014 Source ID: A7-273 Total Efficiency: 10.62%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 537.10

Ranges Background: 98 counts to 171 counts using ± 2 Sigma Count Time (min): 1
Source: 11,825 counts to 12,390 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/1/2013	12,171	130	SAT	SAT	SAT	Sat	N / A	TC	
11/4/2013	12,212	149	↓	↓	↓	Sat	↓	PW	
11/5/13	12040	150	↓	↓	↓	↓	↓	P.W.	
11/6/13	11954	159	↓	↓	↓	↓	↓	P.W.	
11/7/13	12110	162	↓	↓	↓	↓	↓	PW	
11/8/13	11971	148	↓	↓	↓	↓	↓	P.W.	
11/11/13	11975	165	↓	↓	↓	↓	↓	P.W.	
11/12/13	12093	164	↓	↓	↓	↓	↓	P.W.	
11/13/13	11903	159	↓	↓	↓	↓	↓	P.W.	
11/14/13	11956	148	↓	↓	↓	↓	↓	P.W.	
11/18/13	12005	150	↓	↓	↓	↓	↓	P.W.	
11/18/13	12121	140	↓	↓	↓	↓	↓	P.W.	
11/19/13	11850	164	↓	↓	↓	↓	↓	PW	
11/20/13	11856	165	↓	↓	↓	↓	↓	P.W.	
11/21/13	11882	155	↓	↓	↓	↓	↓	PW	
11/22/13	11844	147	↓	↓	↓	↓	↓	PW	
11/26/13	12326	155	↓	↓	↓	↓	↓	P.W.	
				N		A			N A

Completed By: Pam Wells Date: 11/26/13
Reviewed By: [signature] Date: 12/19/13

Gilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 31-Oct-13 High Voltage: 800 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 9.26%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 71.30

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 19,916 counts to 20,651 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/1/2013	19,925	0	SAT	SAT	SAT	Sat	N / A	TC	
11/4/2013	20,155	0	↓	↓	↓	Sat	↓	PW	
11/5/13	20268	0	↓	↓	↓	↓	↓	P.W.	
11/6/13	19950	0	↓	↓	↓	↓	↓	P.W.	
11/7/13	20055	0	↓	↓	↓	↓	↓	P.W.	
11/8/13	20174	0	↓	↓	↓	↓	↓	P.W.	
11/11/13	20409	0	↓	↓	↓	↓	↓	P.W.	
11/12/13	19972	0	↓	↓	↓	↓	↓	P.W.	
11/13/13	20465	0	↓	↓	↓	↓	↓	P.W.	
11/14/13	20300	0	↓	↓	↓	↓	↓	P.W.	
11/15/13	20148	0	↓	↓	↓	↓	↓	P.W.	
11/18/13	20111	0	↓	↓	↓	↓	↓	P.W.	
11/19/13	20028	0	↓	↓	↓	↓	↓	P.W.	
11/20/13	19994	0	↓	↓	↓	↓	↓	P.W.	
11/21/13	20350	0	↓	↓	↓	↓	↓	P.W.	
11/22/13	19983	0	↓	↓	↓	↓	↓	P.W.	
11/26/13	20291	0	↓	↓	↓	↓	↓	P.W.	
									N/A
			N/A						

Completed By: Pam Wells Date: 11/26/13
Reviewed By: Date: 12/10/13

Gilbane

Instrument Daily Th-230 Source Check 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 31-Oct-13 High Voltage: 800 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 9.26%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 71.30

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 19,916 counts to 20,651 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	20573	0	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	20145	0	"	"	"	"	"	P.W.	
12/4/13	20407	0	"	"	"	"	"	P.W.	
12/5/13	19977	0	"	"	"	"	"	P.W.	
12/9/13	20150	0	"	"	"	"	"	P.W.	
12/10/13	20804	0	"	"	"	"	"	P.W.	
						N/A			N/A

Completed By: Pamela Wells Date: 12/10/13
Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #:	2360 / 278618	Setup Date:	31-Oct-13	High Voltage:	800 v
Cal. Date:	August 29, 2014	Source ID:	A7-273	Total Efficiency:	10.62%
Probe #:	43-93 / PR311163	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	537.10

Ranges Background: 98 counts to 171 counts using ± 2 Sigma Count Time (min): 1
Source: 11,825 counts to 12,390 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	12102	132	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	12374	141	↓	↓	↓	↓	↓	P.W.	
12/4/13	12198	140	↓	↓	↓	↓	↓	P.W.	
12/5/13	12290	123	↓	↓	↓	↓	↓	P.W.	
12/9/13	12012	145	↓	↓	↓	↓	↓	P.W.	
12/10/13	12032	162	↓	↓	↓	↓	↓	P.W.	
					N/A				N/A

Completed By: Pam Wells Date: 12/10/13
Reviewed By: Date: 12/16/13

Gilbane

SCALER INITIAL SETUP SHEET | **Alpha** | *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	10-Dec-13
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR311163	**Cal. Due:**	29-Aug-14	**Source SN:**	A7-270
Technician:	P. Wells			**Surface Emission Rate:**	54,750 particles/min
Location:	Trailer			**Source Type:**	Th-230
				HV Check/Setting:	800 v

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.8	0.6
2	0	-0.8	0.6
3	0	-0.8	0.6
4	0	-0.8	0.6
5	1	0.3	0.1
6	2	1.3	1.6
7	0	-0.8	0.6
8	0	-0.8	0.6
9	2	1.3	1.6
10	0	-0.8	0.6
11	0	-0.8	0.6
12	3	2.3	5.1
13	0	-0.8	0.6
14	0	-0.8	0.6
15	1	0.3	0.1
16	0	-0.8	0.6
17	1	0.3	0.1
18	1	0.3	0.1
19	3	2.3	5.1
20	1	0.3	0.1
		0.0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 0.8 counts

Average Count Rate = 0.8 cpm

Standard Deviation = 1.0 counts

Sum of Squares = 20

Area Correction Factor (ACF) = 1.00 $100cm^2$

Scan Observation Interval (i) = 1.80 seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	21,025	-132	17,411
2	20,956	-201	40,381
3	21,076	-81	6,553
4	20,858	-299	89,371
5	21,154	-3	9
6	21,103	-54	2,911
7	21,104	-53	2,804
8	20,925	-232	53,801
9	21,241	84	7,064
10	21,277	120	14,412
11	20,860	-297	88,179
12	21,219	62	3,850
13	21,189	32	1,027
14	21,226	69	4,768
15	21,300	143	20,463
16	21,522	365	133,262
17	21,387	230	52,923
18	21,316	159	25,297
19	20,978	-179	32,023
20	21,423	266	70,783
		0.0	

Average Counts = 21,157 counts

Average Count Rate = 21,157 cpm

Standard Deviation = 187 counts

Sum of the Squares = 667,291

Chi-Squared Statistic = 31.54

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) = 0.386 cpm/dpm
Surface Efficiency (E_s) = 0.250 cpm/dpm
Total Efficiency (E_T) = 0.097 cpm/dpm

Net source cts = 21,156 counts
Std. Dev. Net = 187 counts
Net Ct. Rate = 21,156 cpm

MDCR = 7 cpm (@ 95% confidence level)

MDA Scan= 101 dpm/100 cm^2
MDA Static= 73 dpm/100 cm^2

Bkg count range 0 to 3 (2 sigma)
Source count range 20,782 to 21,532 (2 sigma)

Technical Reviewer — Date: 12/10/13

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	10-Dec-13	4118.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = 0.21 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 12/10/13 Date

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	10-Dec-13
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR311163	**Cal. Due:**	29-Aug-14	**Source SN:**	A7-273
Technician:	P. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	800 v

1. Total Background Counts observed:

Chi-squared Calculations

1	126	-9.7	94.1
2	136	0.3	0.1
3	132	-3.7	13.7
4	138	2.3	5.3
5	124	-11.7	136.9
6	118	-17.7	313.3
7	144	8.3	68.9
8	128	-7.7	59.3
9	136	0.3	0.1
10	124	-11.7	136.9
11	144	8.3	68.9
12	138	2.3	5.3
13	140	4.3	18.5
14	138	2.3	5.3
15	132	-3.7	13.7
16	141	5.3	28.1
17	105	-30.7	942.5
18	148	12.3	151.3
19	168	32.3	1043.3
20	154	18.3	334.9
		0.0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 135.7 counts
Average Count Rate = 135.7 cpm
Standard Deviation = 13.5 counts
Sum of Squares = 3,440
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval (i) = 1.80 seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	13,059	51	2,586
2	12,911	-97	9,438
3	13,271	263	69,090
4	12,905	-103	10,640
5	13,134	126	15,838
6	12,765	-243	59,122
7	13,104	96	9,187
8	13,067	59	3,463
9	12,899	-109	11,914
10	12,845	-163	26,618
11	12,699	-309	95,574
12	13,133	125	15,588
13	13,111	103	10,578
14	13,097	89	7,894
15	13,110	102	10,373
16	12,937	-71	5,062
17	13,043	35	1,215
18	13,171	163	26,520
19	12,941	-67	4,509
20	12,961	-47	2,223
		0.0	

Average Counts = 13,008 counts
Average Count Rate = 13,008 cpm
Standard Deviation = 145 counts
Sum of the Squares = 397,433
Chi-Squared Statistic = 30.55

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) = 0.228 cpm/dpm
Surface Efficiency (E_S) = 0.500 cpm/dpm
Total Efficiency (E_T) = 0.114 cpm/dpm

Net source cts = 12,872 counts
Std. Dev. Net = 145 counts
Net Ct. Rate = 12,872 cpm

MDCR = 93 cpm (@ 95% confidence level)

MDA Scan= 1,150 dpm/100 cm^2
MDA Static= 501 dpm/100 cm^2

Bkg count range 109 to 163 (2 sigma)
Source count range 12,719 to 13,297 (2 sigma)

Technical Reviewer — Date 12/10/13

Source Activity Correction Worksheet

Equation: $Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$

Isotope	Tc-99	
ID #	A7-273	
Initial Activity (Act_0) (dpm)	56,390	
Ref. Date	1-Sep-02	
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)
Current Date	10-Dec-13	4118.00 days (t)

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 2.78 counts

x = count
μ = mean
σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
i = scan observation interval (sec)
b_i = number of background counts in scan observation interval *i*
s_i = minimum detectable number of net source counts in scan observation interval *i*
p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

12/10/13

Technical Reviewer Date

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 10-Dec-13 High Voltage: 800 v
Cal. Date: August 29, 2014 Source ID: A7-273 Total Efficiency: 11.41%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 501.13

Ranges Background: 109 counts to 163 counts using ± 2 Sigma Count Time (min): 1
Source: 12,719 counts to 13,297 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/11/13	12936	160	Sat	Sat	Sat	Sat	N/A	P.W.	
12/12/13	13048	156	↓	↓	↓	↓	↓	P.W.	
12/13/13	12871	153	↓	↓	↓	↓	↓	PW.	
12/14/13	12958	163	↓	↓	↓	↓	↓	MEC	
12/16/13	12998	140	↓	↓	↓	↓	↓	P.W.	
12/17/13	13034	158	↓	↓	↓	↓	↓	P.W.	
12/18/13	12854	159	↓	↓	↓	↓	↓	PW	
12/19/13	12728	126	↓	↓	↓	↓	↓	PW	
12/20/13	13197	160	↓	↓	↓	↓	↓	PW	
					N/A				N/A

Completed By: Pam Wells Date: 12/19/13
Reviewed By: [signature] Date: 12/19/13

Gilbane

Instrument Daily Th-230 Source Check 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 10-Dec-13 High Voltage: 800 v
Cal. Date: August 29, 2014 Source ID: A7-270 Total Efficiency: 9.66%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 72.76

Ranges Background: 0 counts to 3 counts using ± 2 Sigma Count Time (min): 1
Source: 20,782 counts to 21,532 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/11/13	20805	0	Sat	Sat	Sat	Sat	N/A	P.W.	
12/12/13	20831	0	↓	↓	↓	↓	↓	P.W.	
12/13/13	20839	0	↓	↓	↓	↓	↓	P.W.	
12/14/13	20790	0	↓	↓	↓	↓	↓	MEC	
12/16/13	20794	0	↓	↓	↓	↓	↓	PW	
12/17/13	20878	0	↓	↓	↓	↓	↓	PW	
12/18/13	20831	0	↓	↓	↓	↓	↓	PW	
12/19/13	21053	0	↓	↓	↓	↓	↓	PW	
12/20/13	21229	0	↓	↓	↓	↓	↓	PW	
					N/A	N/A			N/A

Completed By: Penny Wells Date: 1/2/14
Reviewed By: [signature] Date: 1/9/14

Gilbane

SCALER INITIAL SETUP SHEET — **Alpha** — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14
Probe Type / SN:	43-93 / PR311163	**Cal. Due:**	29-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	18-Feb-14	
Source Cert. Date:	15-Sep-13	
Source SN:	K7-324	
Surface Emission Rate:	23,790	particles/min
Source Type:	Th-230	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	1	0.6	0.3
2	0	-0.5	0.2
3	0	-0.5	0.2
4	0	-0.5	0.2
5	0	-0.5	0.2
6	1	0.6	0.3
7	0	-0.5	0.2
8	0	-0.5	0.2
9	0	-0.5	0.2
10	2	1.6	2.4
11	0	-0.5	0.2
12	0	-0.5	0.2
13	0	-0.5	0.2
14	1	0.6	0.3
15	0	-0.5	0.2
16	2	1.6	2.4
17	1	0.6	0.3
18	0	-0.5	0.2
19	0	-0.5	0.2
20	1	0.6	0.3
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	0.5	counts
Average Count Rate =	0.5	cpm
Standard Deviation =	0.7	counts
Sum of Squares =	9	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	9,319	49	2,381
2	9,134	-136	18,550
3	9,133	-137	18,824
4	9,372	102	10,363
5	9,365	95	8,987
6	9,079	-191	36,557
7	9,365	95	8,987
8	9,211	-59	3,505
9	9,520	250	62,400
10	9,396	126	15,826
11	9,417	147	21,550
12	9,247	-23	538
13	9,195	-75	5,655
14	9,086	-184	33,930
15	9,212	-58	3,387
16	9,299	29	829
17	9,202	-68	4,651
18	9,401	131	17,109
19	9,204	-66	4,382
20	9,247	-23	538
		0.0	

Average Counts =	9,270	counts
Average Count Rate =	9,270	cpm
Standard Deviation =	121	counts
Sum of the Squares =	278,951	
Chi-Squared Statistic =	30.09	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.390	cpm/dpm
Surface Efficiency (E_S) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.097	cpm/dpm

Net source cts =	9,270	counts
Std. Dev. Net =	121	counts
Net Ct. Rate =	9,270	cpm

MDCR = 5 cpm (@ 95% confidence level)

MDA Scan=	78	dpm/100 cm^2
MDA Static=	63	dpm/100 cm^2

Bkg count range	0	to	2	(2 sigma)
Source count range	9,028	to	9,513	(2 sigma)

Technical Reviewer — Date: 18 Feb 2014

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_r = Act_o \times e^{-((.693/t)T)}$
ID #	K7-324		
Initial Activity (Act_0) (dpm)	23,790		
Ref. Date	15-Sep-13		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	18-Feb-14	156.00 days (t)	

Corrected Surface Emission Rate = 23,790 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2=\Sigma(X_i-\mu)^2/\sigma$

x = count

μ = mean

σ =standard deviation

s_i = 0.16 counts

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 18 Feb 2014 Date

Eckert & Ziegler
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Valencia, California 91355

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Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	RES, LLC
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	10557
Catalog No.:	EAB-230-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-324	**Contained Radioactivity:**	21.22 **nCi** 785.1 **Bq**

Physical Description:

A. Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active diameter/volume:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

**CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA**

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 23790 α/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	18-Feb-14
Instrument / SN:	2360 / 278618	**Cal. Due:**	29-Aug-14	**Source Cert. Date:**	15-Sep-13
Probe Type / SN:	43-93 / PR~~320625~~ 311163	**Cal. Due:**	29-Aug-14	**Source SN:**	K7-322
Technician:	P. Wells			**Surface Emission Rate:**	28,170 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	141	-2.3	5.3
2	146	2.7	7.3
3	131	-12.3	151.3
4	160	16.7	278.9
5	151	7.7	59.3
6	124	-19.3	372.5
7	152	8.7	75.7
8	153	9.7	94.1
9	122	-21.3	453.7
10	134	-9.3	86.5
11	132	-11.3	127.7
12	138	-5.3	28.1
13	164	20.7	428.5
14	144	0.7	0.5
15	139	-4.3	18.5
16	139	-4.3	18.5
17	162	18.7	349.7
18	124	-19.3	372.5
19	163	19.7	388.1
20	147	3.7	13.7
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	143.3	counts
Average Count Rate =	143.3	cpm
Standard Deviation =	13.2	counts
Sum of Squares =	3,330	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	8,812	50	2,455
2	8,611	-151	22,937
3	8,634	-128	16,499
4	8,762	0	0
5	8,762	0	0
6	8,627	-135	18,347
7	8,877	115	13,122
8	8,930	168	28,073
9	8,916	154	23,578
10	8,602	-160	25,744
11	8,737	-25	648
12	8,852	90	8,019
13	8,620	-142	20,292
14	8,712	-50	2,545
15	8,604	-158	25,106
16	8,793	31	933
17	8,863	101	10,110
18	8,922	160	25,456
19	8,907	145	20,895
20	8,706	-56	3,187
		0.0	

Average Counts =	8,762	counts
Average Count Rate =	8,762	cpm
Standard Deviation =	119	counts
Sum of the Squares =	267,947	
Chi-Squared Statistic =	30.58	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.306	cpm/dpm
Surface Efficiency (E_S) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.153	cpm/dpm

Net source cts =	8,619	counts
Std. Dev. Net =	119	counts
Net Ct. Rate =	8,619	cpm

MDCR = 95 cpm (@ 95% confidence level)

MDA Scan=	882	dpm/100 cm^2
MDA Static=	384	dpm/100 cm^2

Bkg count range	117	to	170	(2 sigma)
Source count range	8,525	to	9,000	(2 sigma)

Jim Cooper — 18 Feb 2014

Technical Reviewer — Date

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	K7-322		
Initial Activity (Act_0) (dpm)	28,170		
Ref. Date	15-Sep-13		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	18-Feb-14	156.00 days (t)	

Corrected Surface Emission Rate = 28,170 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = 2.86 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 18 Feb 2014 Date

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Tc-99	**Customer:**	RES, LLC
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	10557
Catalog No.:	EAB-099-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-322	**Contained Radioactivity:**	23.07 nCi 853.6 Bq

Physical Description:

A.	Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B.	Nature of active deposit:	Electrodeposited and diffusion bonded Technetium metal
C.	Active diameter/volume:	41 mm
D.	Backing:	Stainless steel
E.	Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A.	Type A (random) uncertainty:	± 0.5 %
B.	Type B (systematic) uncertainty:	± 3.0 %
C.	Uncertainty in aliquot weighing:	± 0.0 %
D.	Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 28170 β/min in 2π on 28-Aug-13.

Daniel James Van Dalsen
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Gilbane

Instrument Daily Th-230 Source Check 23,790 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 18-Feb-14 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: K7-324 Total Efficiency: 9.74%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 62.84

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 9,028 counts to 9,513 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	9,383	0	Sat	Sat	Sat	Sat	N / A	P.W.	
2/19/2014	9,138	0	√	√	√	Sat	√	P.W.	
2/20/2014	9229	0	√	√	√	√	√	PW	
2/21/2014	9065	1	√	√	√	√	√	PW	
						N / A			N / A

Completed By: Pam Wells Date: 3/24/14
Reviewed By: Jim Cooperman Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 18-Feb-14 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: K7-322 Total Efficiency: 15.30%
Probe #: 43-93 / PR~~326625~~ 311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 383.68

Ranges Background: 117 counts to 170 counts using ± 2 Sigma Count Time (min): 1
Source: 8,525 counts to 9,000 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	8,809	136	Sat	Sat	Sat	Sat/	N / A	P.W.	
2/19/2014	8,992	123	√	√	√	√	√	P.W.	
2/20/2014	8994	1165	√	√	√	√	√	P.W.	
2/21/2014	8904	135	√	√	√	√	√	P.W.	
						N/A			N/A

Completed By: Pam Wells Date: 3/24/14
Reviewed By: Jim Compere Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #:	2360 / 278618	Setup Date:	18-Feb-14	High Voltage:	725 v
Cal. Date:	August 29, 2014	Source ID:	K7-322	Total Efficiency:	15.30%
Probe #:	43-93 / PR311163	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	383.68

Ranges Background: 117 counts to 170 counts using ± 2 Sigma Count Time (min): 1

Source: 8,525 counts to 9,000 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	8,690	128	Sat	Sat	Sat	Sat/	N / A	P.W.	
3/25/2014	8799	140	√	√	√	√	√	P.W.	
3/26/2014	8769	144	√	√	√	√	√	P.W.	
3/27/2014	8709	152	√	√	√	√	√	P.W.	
3/31/2014	8749	149	√	√	√	√	√	P.W.	
						N	A		N A

Completed By: Pam Wells Date: 4/1/2014

Reviewed By: Date: 4/2/14

Gilbane

Instrument Daily **Th-230** **Source Check** 23,790 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 18-Feb-14 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: K7-324 Total Efficiency: 9.74%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 62.84

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 9,028 counts to 9,513 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	9,221	0	Sat	Sat	Sat	Sat	N / A	P.W.	
3/25/2014	9242	0	↓	↓	↓	↓	↓	P.W.	
3/26/2014	9297	0	↓	↓	↓	↓	↓	P.W.	
3/27/2014	9388	0	↓	↓	↓	↓	↓	P.W.	
3/31/2014	9097	0	↓	↓	↓	↓	↓	P.W.	
						N	N/A		N/A

Completed By: Pam Wells Date: 4/11/2014
Reviewed By: [signature] Date: 4/21/14

Gilbane

Instrument Daily Th-230 Source Check 23,790 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 Setup Date: 18-Feb-14 High Voltage: 725 v
Cal. Date: August 29, 2014 Source ID: K7-324 Total Efficiency: 9.74%
Probe #: 43-93 / PR311163 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 62.84

Ranges Background: 0 counts tc 2 counts using ± 2 Sigma Count Time (min): 1
Source: 9,028 counts tc 9,513 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
4/1/2014	9203	0	Sat	Sat	Sat	Sat	N/A	P.W.	
4/2/2014	9169	0	↓	↓	↓	↓	↓	P.W.	
4/3/2014	9099	0	↓	↓	↓	↓	↓	P.W.	
4/7/2014	9119	0	↓	↓	↓	↓	↓	P.W.	
4/8/2014	9210	0	↓	↓	↓	↓	↓	P.W.	
4/9/2014	9104	0	↓	↓	↓	↓	↓	P.W.	
4/10/2014	9123	0	↓	↓	↓	↓	↓	P.W.	
4/14/2014	9248	0	↓	↓	↓	↓	↓	P.W.	
4/15/2014	9181e	0	↓	↓	↓	↓	↓	P.W.	
4/16/2014	9181	0	↓	↓	↓	↓	↓	P.W.	
4/17/2014	9041	1	↓	↓	↓	↓	↓	P.W.	
4/21/2014	9100	0	↓	↓	↓	↓	↓	P.W.	
4/22/2014	9140	0	↓	↓	↓	↓	↓	P.W.	
4/23/2014	9094	0	↓	↓	↓	↓	↓	P.W.	

Completed By: _____ Date: _____
Reviewed By: _____ Date: _____

Gilbane

Instrument Daily Tc-99 Source Check 28,170 Corrected Activity (in dpm)

Instrument #: 2360 / 278618 | Setup Date: 18-Feb-14 | High Voltage: 725 v
Cal. Date: August 29, 2014 | Source ID: K7-322 | Total Efficiency: 15.30%
Probe #: 43-93 / PR311163 | Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 | MDA (in dpm): 383.68

Ranges Background: 117 counts to 170 counts using ± 2 Sigma Count Time (min): 1
Source: 8,525 counts to 9,000 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
4/1/2014	8859	119	Sat	Sat	Sat	Sat	N/A	P.W.	
4/2/2014	8963	147	↓	↓	↓	↓	↓	P.W.	
4/3/2014	8722	134	↓	↓	↓	↓	↓	P.W.	
4/7/2014	8744	136	↓	↓	↓	↓	↓	P.W.	
4/8/2014	8655	138	↓	↓	↓	↓	↓	P.W.	
4/9/2014	8710	131	↓	↓	↓	↓	↓	P.W.	
4/10/2014	8754	128	↓	↓	↓	↓	↓	P.W.	
4/14/2014	8737	124	↓	↓	↓	↓	↓	P.W.	
4/15/2014	8836	119	↓	↓	↓	↓	↓	P.W.	
4/16/2014	8642	1160	↓	↓	↓	↓	↓	P.W.	
4/17/2014	8704	138	↓	↓	↓	↓	↓	P.W.	
4/21/2014	8776	125	↓	↓	↓	↓	↓	P.W.	
4/22/2014	8636	120	↓	↓	↓	↓	↓	P.W.	
4/23/2014	8679	127	↓	↓	↓	↓	↓	P.W.	

Completed By: _____ Date: _____
Reviewed By: _____ Date: _____

ITSI Gilbane

SCALER INITIAL SETUP SHEET — **Alpha** — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	06-Sep-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-270	
Surface Emission Rate:	54,750	particles/min
Source Type:	Th-230	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.2	0.0
2	0	-0.2	0.0
3	0	-0.2	0.0
4	0	-0.2	0.0
5	1	0.9	0.7
6	0	-0.2	0.0
7	0	-0.2	0.0
8	0	-0.2	0.0
9	0	-0.2	0.0
10	0	-0.2	0.0
11	0	-0.2	0.0
12	0	-0.2	0.0
13	1	0.9	0.7
14	0	-0.2	0.0
15	0	-0.2	0.0
16	0	-0.2	0.0
17	0	-0.2	0.0
18	0	-0.2	0.0
19	1	0.9	0.7
20	0	-0.2	0.0
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	0.2	counts
Average Count Rate =	0.2	cpm
Standard Deviation =	0.4	counts
Sum of Squares =	3	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	20,374	267	71,289
2	20,149	42	1,764
3	19,892	-215	46,225
4	19,839	-268	71,824
5	20,011	-96	9,216
6	20,123	16	256
7	20,184	77	5,929
8	20,275	168	28,224
9	20,186	79	6,241
10	20,213	106	11,236
11	20,240	133	17,689
12	20,340	233	54,289
13	20,048	-59	3,481
14	19,959	-148	21,904
15	20,041	-66	4,356
16	19,974	-133	17,689
17	20,197	90	8,100
18	19,933	-174	30,276
19	20,028	-79	6,241
20	20,134	27	729
		0.0	

Average Counts =	20,107	counts
Average Count Rate =	20,107	cpm
Standard Deviation =	148	counts
Sum of the Squares =	416,958	
Chi-Squared Statistic =	20.74	

Acceptable Ranges for Chi-x^2
8.91 to 32.85

(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.367	cpm/dpm
Surface Efficiency (E_S) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.092	cpm/dpm

Net source cts =	20,107	counts
Std. Dev. Net =	148	counts
Net Ct. Rate =	20,107	cpm

MDCR = 3 cpm (@ 95% confidence level)

MDA Scan=	48	dpm/100 cm^2
MDA Static=	52	dpm/100 cm^2

Bkg count range	0	to	1	(2 sigma)
Source count range	19,811	to	20,403	(2 sigma)

Technical Reviewer — 6 Sep 2013 — Date

Source Activity Correction Worksheet

Equation: **Activity$(Act)_t = Act_0 \times e^{-((.693/t)T)}$**

Isotope	Th-230	
ID #	A7-270	
Initial Activity (Act_0) (dpm)	54,750	
Ref. Date	1-Sep-02	
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)
Current Date	6-Sep-13	4023.00 days (t)

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

x = count

μ = mean

σ =standard deviation

s_i = 0.09 counts

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 6 Sep 2013 Date

ITSI Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Beta

{Blue cells for Input}

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14
Probe Type / SN:	43-93 / 326625	**Cal. Due:**	06-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	06-Sep-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-723	
Surface Emission Rate:	56,390	particles/min
Source Type:	Tc-99	
HV Check/Setting:	725	

1. Total Background Counts observed:

Chi-squared Calculations

1	98	-8.0	64.0
2	111	5.0	25.0
3	104	-2.0	4.0
4	96	-10.0	100.0
5	93	-13.0	169.0
6	102	-4.0	16.0
7	97	-9.0	81.0
8	99	-7.0	49.0
9	107	1.0	1.0
10	104	-2.0	4.0
11	95	-11.0	121.0
12	104	-2.0	4.0
13	118	12.0	144.0
14	106	0.0	0.0
15	187	81.0	6561.0
16	93	-13.0	169.0
17	86	-20.0	400.0
18	105	-1.0	1.0
19	110	4.0	16.0
20	105	-1.0	1.0
		0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	106.0	counts
Average Count Rate =	106.0	cpm
Standard Deviation =	20.4	counts
Sum of Squares =	7,930	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval =	1.80	sec

2. Total Source Counts observed:

Chi-squared Calculations

1	11,500	265	70,358
2	11,258	23	541
3	11,398	163	26,651
4	11,406	171	29,327
5	11,257	22	495
6	11,206	-29	827
7	11,060	-175	30,538
8	11,194	-41	1,661
9	11,172	-63	3,938
10	11,123	-112	12,488
11	11,435	200	40,100
12	11,232	-3	8
13	11,143	-92	8,418
14	11,296	61	3,752
15	10,986	-249	61,877
16	11,289	54	2,943
17	11,317	82	6,765
18	11,144	-91	8,236
19	11,105	-130	16,835
20	11,174	-61	3,691
		0	

Average Counts =	11,235	counts
Average Count Rate =	11,235	cpm
Standard Deviation =	132	counts
Sum of the Squares =	329,444	
Chi-Squared Statistic =	29.32	

Acceptable Ranges for Chi-x^2

8.91 to 32.85

(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.197	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.099	cpm/dpm

Net source cts =	11,129	counts
Std. Dev. Net =	133	counts
Net Ct. Rate =	11,129	cpm

MDCR = 82 cpm (@ 95% confidence level)

MDA Scan= 1,176 dpm/100 cm^2

MDA Static= 516 dpm/100 cm^2

Bkg count range	65	to	147 (2 sigma)
Source count range	10,971	to	11,498 (2 sigma)

Technical Reviewer

6 Sep 2013

Date

ITSI Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Source Activity Correction Worksheet

Isotope	Tc-99		
ID #	A7-723	Equation:	$Act_f = Act_o \times e^{-((.693/t)T)}$
Initial Activity (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	6-Sep-13	4023.00 days (t)	

Corrected Surface Emission Rate = **56,388** ***particles/min***

Equations

Chi-squared Calculations $\chi 2 = \frac{\Sigma(n-n)^2}{n}$

s_i = 2.46 counts

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
i = scan observation interval (sec)
b_i = number of background counts in scan observation interval *i*
s_i = minimum detectable number of net source counts in scan observation interval *i*
p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Jim Cooper 6 Sep 2013

Technical Reviewer Date

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER **ENVIRACHEM, INC.** ORDER NO. 20227364

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 297763

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR 326625

Cal. Date 6-Aug-13 Cal Due Date 6-Aug-14 Cal. Interval 1 Year Meterface 202-855

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 74 °F RH 40 % Alt 700.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☑ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC ☑ RS-232 Port OK
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 725 V

☑ HV Readout (2 points) Ref./Inst. 500 / 512 V Ref./Inst. 1500 / 1498 V

Firmware Version: 39D10N24
Alpha Threshold: 120 mv
Beta Threshold: 3.5 mv
Beta Window: 30 mv
Overload Set with Am241, 91mdpm
Instrument calibrated with a 39" cable.
High voltage set with detector connected

(EEPROM Settings)
User Time: 1.0
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date: 08/06/2013
Calibration Date Due: 08/06/2014

COMMENTS:

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400kcpm	NA	400
x1000	100kcpm		100
x100	40kcpm		400
x100	10kcpm		100
x10	4kcpm		400
x10	1kcpm		100
x1	400kcpm		400
x1	100kcpm		100

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

ALL **Range(s) Calibrated Electronically**

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	NA	399630
	40kcpm		3998
	4kcpm		400
	400cpm		40
	40cpm		4

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

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

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO
☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

☑ Alpha S/N P239#4337 ☑ Beta S/N Tc99#635/83,Sr90y90#5030 ☐ Other

☑ m 500 S/N 235943 ☐ Oscilloscope S/N ☑ Multimeter S/N 92780438

Calibrated By: Date 6-Aug-13

Reviewed By: Date 6 Aug 13

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

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 43-93 Serial No. PR3266625 Order #. 20227364

Customer ENVIRACHEM, INC.

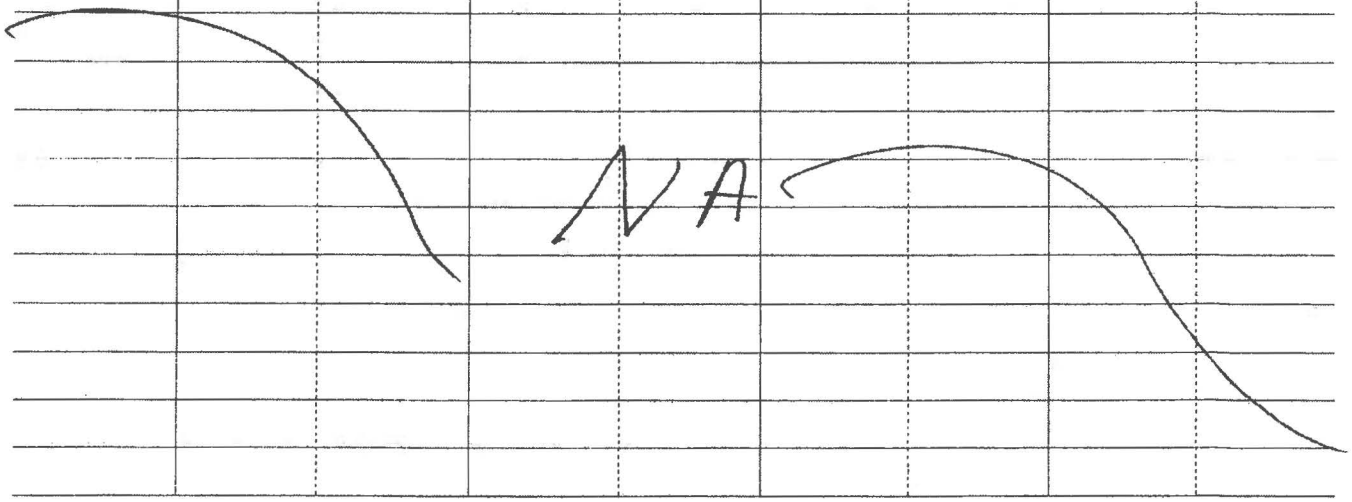
Counter 2360 Serial No. 297763 Alpha Input Sensitivity 120 mV

Count Time 1Minute Beta Input Sensitivity 3.5 mV

Other NA Beta Window 30 mV

Distance Source to Detector Surface

High Voltage	Background		Isotope Pu239 Size 309000dpm		Isotope Tc99 Size 229000dpm		Isotope Sr90y90 Size 8288dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
675	0	48	5279	386	2	2324	0	1602
700	0	57	6022	365	4	3338	0	2255
725	0	97	6510	376	9	4396	1	2586
750	0	132	6779	413	3	5348	0	2998
775	1	164	6898	440	5	6176	0	3268



☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature Dana Ogden Date 6 Aug. 13

• *Serving The Nuclear Industry Since 1962* •

Header 1: John Q. Public
Header 2: SN: 297763
Header 3: SN: PR326625
Header 4: Site: Bldg 1
Header 5: RM 008, S. Wall
Header 6: Comment
Location: Table 007

Calibration Due Date: 08/06/2014
Model 2360 Date: 08/06/2013
Model 2360 Time: 12:45:08 PM

Logged Samples: 0

User PC Scaler Count Time: 0.1 minutes

Alpha Ratemeter Alarm Setpoint:	999999
Beta Ratemeter Alarm Setpoint:	999999
Alpha + Beta Ratemeter Alarm Setpoint:	999999
Alpha Scaler Alarm Setpoint:	999999
Beta Scaler Alarm Setpoint:	999999
Alpha + Beta Scaler Alarm Setpoint:	999999

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	NEW WORLD TECHNOLOGY			
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	20400			
Catalog No.:	EAB-230-47LB	**Reference Date:**	1-Sep-02	12:00	PST	
Source No.:	A7-270	**Contained Radioactivity:**	49.32	**nCi**	1825	**Bq**
		Contained Radioactivity: (Total Alpha)	109500	**dpm**		

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ra-226 = 0.400% and Am-241 = 0.110% on 1 Sep 02.

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 54750 α/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

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:	Tc-99	**Customer:**	NEW WORLD TECHNOLOGY			
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	20400			
Catalog No.:	EAB-099-47LB	**Reference Date:**	1-Sep-02	12:00	PST	
Source No.:	A7-273	**Contained Radioactivity:**	47.93	**nCi**	1773	**Bq**
		Contained Radioactivity:	106400	**dpm**		

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electroplated and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

None detected

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had surface emission rate of 56390 β/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

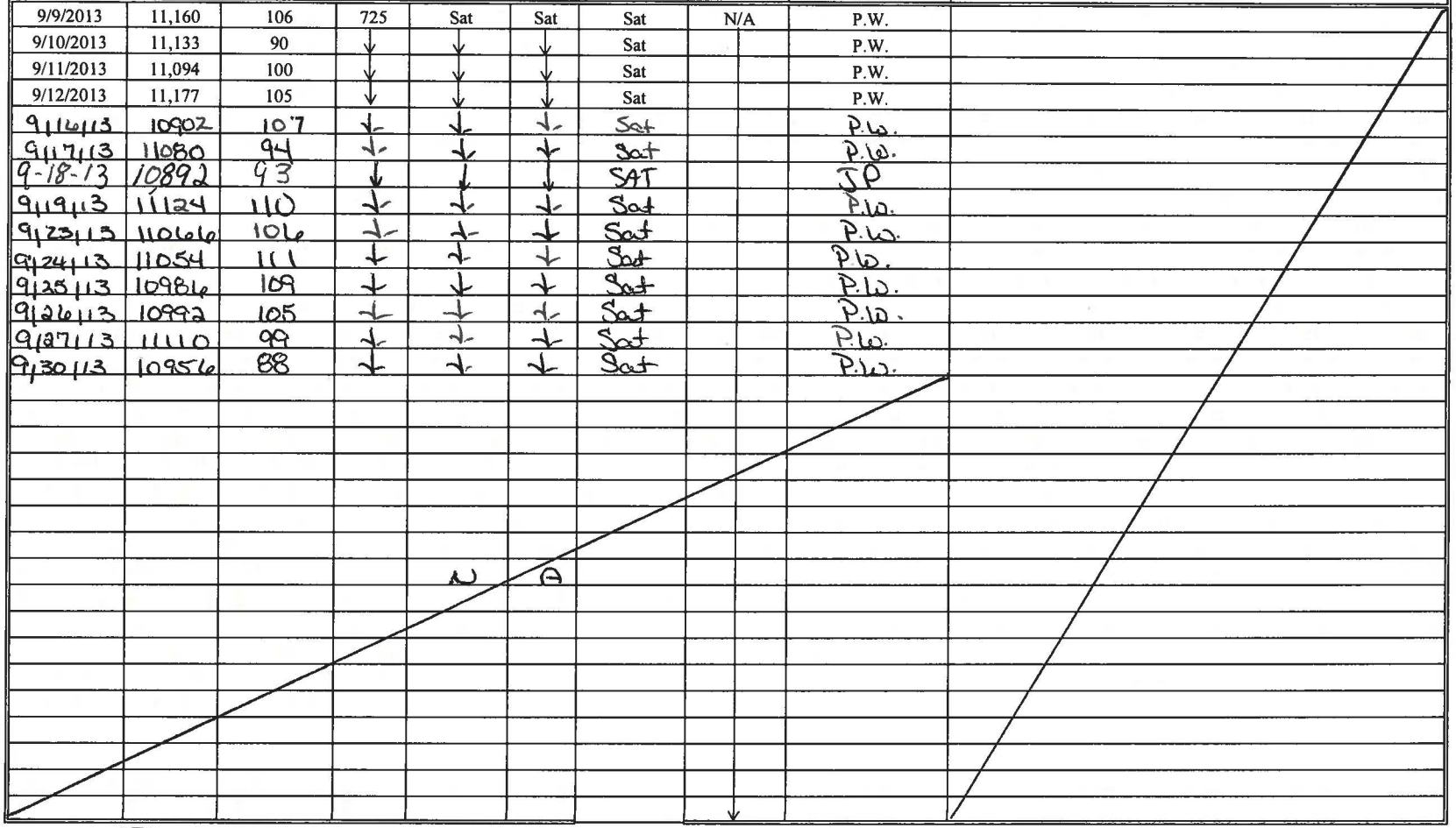
ITSI Gamma

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 28-Aug-13 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: A7-273 Total Efficiency: 9.74%
Probe #: 43-93 / PR326625 Project/#: :oping Surveys, Treasure Island / 0720 MDA (in dpm): 522.48

Ranges Background: 65 counts to 147 counts using ± 2 Sigma Count Time (min): 1
Source: 10,856 counts to 11,331 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	11,160	106	725	Sat	Sat	Sat	N/A	P.W.	
9/10/2013	11,133	90	↓	↓	↓	Sat		P.W.	
9/11/2013	11,094	100	↓	↓	↓	Sat		P.W.	
9/12/2013	11,177	105	↓	↓	↓	Sat		P.W.	
9/16/13	10902	107	↓	↓	↓	Sat		P.W.	
9/17/13	11080	94	↓	↓	↓	Sat		P.W.	
9-18-13	10892	93	↓	↓	↓	SAT		JP	
9/19/13	11124	110	↓	↓	↓	Sat		P.W.	
9/23/13	110616	106	↓	↓	↓	Sat		P.W.	
9/24/13	11054	111	↓	↓	↓	Sat		P.W.	
9/25/13	109816	109	↓	↓	↓	Sat		P.W.	
9/26/13	10992	105	↓	↓	↓	Sat		P.W.	
9/27/13	11110	99	↓	↓	↓	Sat		P.W.	
9/30/13	109956	88	↓	↓	↓	Sat		P.W.	
				N	A				



Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: Pam Wells Date: 1 Oct 2013

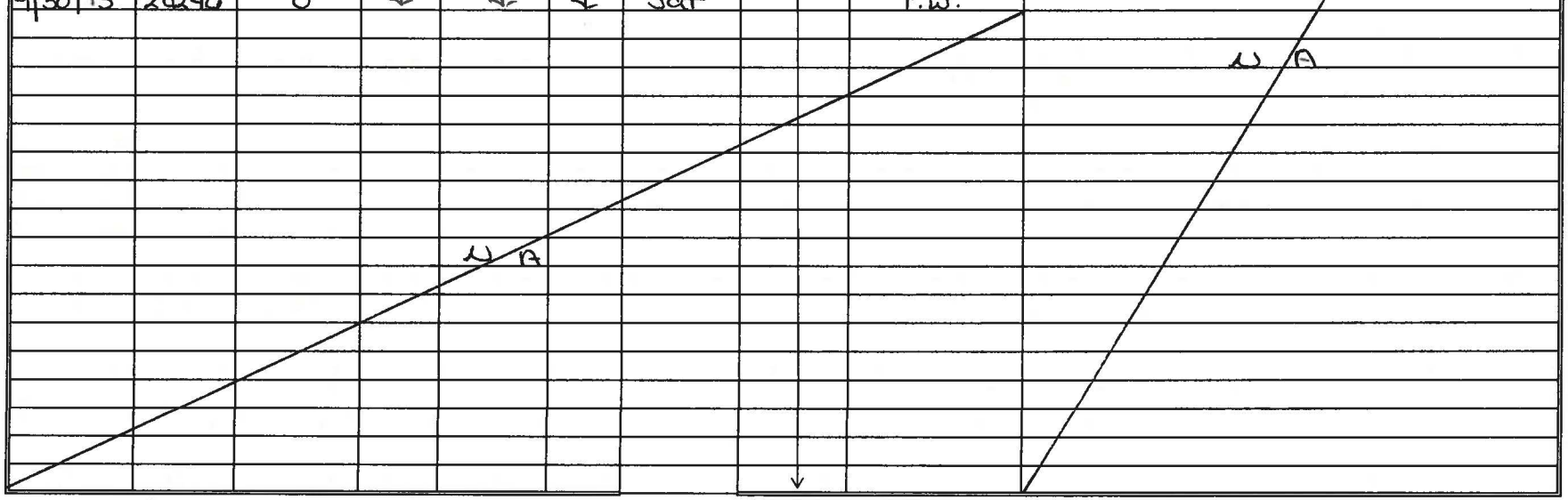
ITSI Canberra

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 6-Sep-13 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: A7-270 Total Efficiency: 9.18%
Probe #: 43-93 / PR326625 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 52.30

Ranges Background: 0 counts to 1 counts using ± 2 Sigma Count Time (min): 1
Source: 19,811 counts to 20,403 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/9/2013	20,125	0	725	Sat	Sat	Sat	N/A	P.W.	
9/10/2013	20,229	0	↓	↓	↓	Sat		P.W.	
9/11/2013	20,111	0	↓	↓	↓	Sat		P.W.	
9/12/2013	19,856	0	↓	↓	↓	Sat		P.W.	
9/16/13	19981	0	↓	↓	↓	Sat		P.W.	
9/17/13	20346	0	↓	↓	↓	Sat		P.W.	
9-18-13	20308	0	↓	↓	↓	SAT		JP	
9/19/13	20321	0	↓	↓	↓	Sat		P.W.	
9/23/13	20123	0	↓	↓	↓	Sat		P.W.	
9/24/13	20256	0	↓	↓	↓	Sat		P.W.	
9/25/13	20232	1	↓	↓	↓	Sat		P.W.	
9/26/13	20278	0	↓	↓	↓	Sat		P.W.	
9/27/13	20361	0	↓	↓	↓	Sat		P.W.	
9/30/13	20246	0	↓	↓	↓	Sat		P.W.	



Completed By: Pam Wells Date: Oct 1, 2013
Reviewed By: [signature] Date: 1 Oct 2013

ITS Tilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 6-Sep-13 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: A7-270 Total Efficiency: 9.18%
Probe #: 43-93 / PR326625 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 52.30

Ranges Background: 0 counts to 1 counts using ± 2 Sigma Count Time (min): 1
Source: 19,811 counts to 20,403 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/13	20035	0	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	20295	0	↓	↓	↓	↓		P.W.	
10/3/13	19981	0	↓	↓	↓	↓		P.W.	
10/7/13	20241	0	↓	↓	↓	↓		P.W.	
10/8/13	20124	0	↓	↓	↓	↓		P.W.	
10/9/13	20296	0	↓	↓	↓	↓		P.W.	
10/10/13	20100	0	↓	↓	↓	↓		P.W.	
10/15/13	20043	0	↓	↓	↓	↓		P.W.	
10/16/13	20285	0	↓	↓	↓	↓		P.W.	
10/17/13	20401	0	↓	↓	↓	↓		P.W.	
10/18/13	19870	0	↓	↓	↓	↓		P.W.	
10/21/13	20028	0	↓	↓	↓	↓		P.W.	
10/22/13	20269	0	↓	↓	↓	↓		P.W.	
10/23/13	20058	0	↓	↓	↓	↓		P.W.	
10/24/13	19822	0	↓	↓	↓	↓		P.W.	
10/28/13	20127	0	↓	↓	↓	↓		P.W.	N/A
10/29/13	19910	0	↓	↓	↓	↓		P.W.	
10/30/13	19835	0	↓	↓	↓	↓		P.W.	
10/31/13	19993	0	↓	↓	↓	↓		P.W.	
				N/A					

Completed By: [signature] Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

ITS Albane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 28-Aug-13 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: A7-273 Total Efficiency: 9.74%
Probe #: 43-93 / PR326625 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 522.48

Ranges Background: 65 counts to 147 counts using ± 2 Sigma Count Time (min): 1
Source: 10,856 counts to 11,331 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/13	10961	91	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	10985	104	"	"	"	"		P.W.	
10/3/13	10949	116	"	"	"	"		P.W.	
10/7/13	10992	94	"	"	"	"		P.W.	
10/8/13	10905	107	"	"	"	"		P.W.	
10/9/13	10978	111	"	"	"	"		P.W.	
10/10/13	10962	116	"	"	"	"		P.W.	
10/15/13	11041	107	"	"	"	"		P.W.	
10/16/13	10992	100	"	"	"	"		P.W.	
10/17/13	10889	102	"	"	"	"		P.W.	
10/18/13	10981	107	"	"	"	"		P.W.	
10/21/13	11067	102	"	"	"	"		P.W.	
10/22/13	10861	102	"	"	"	"		P.W.	
10/23/13	10868	103	"	"	"	"		P.W.	
10/24/13	10883	82	"	"	"	"		P.W.	
10/28/13	10875	103	"	"	"	"		P.W.	
10/29/13	10885	98	"	"	"	"		P.W.	N/A
10/30/13	10860	103	"	"	"	"		P.W.	
10/31/13	10864	117	"	"	"	"		P.W.	
			N/A	N/A					

Completed By: [signature] Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

Gilbane

SCALER INITIAL SETUP SHEET — Alpha — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	30-Oct-13
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14	**Source SN:**	A7-270
Technician:	P. Wells			**Surface Emission Rate:**	54,750 particles/min
Location:	Trailer			**Source Type:**	Th-230
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.3	0.1
2	0	-0.3	0.1
3	0	-0.3	0.1
4	0	-0.3	0.1
5	0	-0.3	0.1
6	0	-0.3	0.1
7	0	-0.3	0.1
8	0	-0.3	0.1
9	0	-0.3	0.1
10	2	1.8	3.1
11	2	1.8	3.1
12	0	-0.3	0.1
13	1	0.8	0.6
14	0	-0.3	0.1
15	0	-0.3	0.1
16	0	-0.3	0.1
17	0	-0.3	0.1
18	0	-0.3	0.1
19	0	-0.3	0.1
20	0	-0.3	0.1
		0.0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 0.3 counts
Average Count Rate = 0.3 cpm
Standard Deviation = 0.6 counts
Sum of Squares = 8
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval (i) = 1.80 seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	20,172	67	4,422
2	20,104	-2	2
3	20,510	405	163,620
4	20,252	147	21,462
5	20,312	207	42,642
6	20,157	52	2,652
7	20,053	-53	2,756
8	20,176	71	4,970
9	19,994	-112	12,432
10	20,064	-42	1,722
11	19,859	-247	60,762
12	20,014	-92	8,372
13	20,089	-17	272
14	20,096	-10	90
15	19,879	-227	51,302
16	19,988	-118	13,806
17	19,996	-110	11,990
18	20,102	-4	12
19	20,183	78	6,006
20	20,110	5	20
		0.0	

Average Counts = 20,106 counts
Average Count Rate = 20,106 cpm
Standard Deviation = 147 counts
Sum of the Squares = 409,317
Chi-Squared Statistic = 20.36

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) = 0.367 cpm/dpm
Surface Efficiency (E_s) = 0.250 cpm/dpm
Total Efficiency (E_T) = 0.092 cpm/dpm

Net source cts = 20,105 counts
Std. Dev. Net = 147 counts
Net Ct. Rate = 20,105 cpm

MDCR = 4 cpm (@ 95% confidence level)

MDA Scan= 61 dpm/100 cm^2
MDA Static= 58 dpm/100 cm^2

Bkg count range 0 to 2 (2 sigma)
Source count range 19,812 to 20,399 (2 sigma)

Technical Reviewer — Date 10/31/13

RSOP-03.01 Rev 19Aug2013

Source Activity Correction Worksheet

Isotope	Th-230	Equation:
ID #	A7-270	
Initial Activity (Act_0) (dpm)	54,750	
Ref. Date	1-Sep-02	
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)
Current Date	30-Oct-13	4077.00 days (t)

$Activity(Act)_f = Act_o \times e^{-((.693/t)T)}$

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

x = count

μ = mean

σ =standard deviation

s_i = 0.12 counts

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer Date 10/31/13

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	30-Oct-13
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14	**Source SN:**	A7-273
Technician:	J. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	83	-9.6	92.2
2	98	5.4	29.2
3	80	-12.6	158.8
4	84	-8.6	74.0
5	100	7.4	54.8
6	72	-20.6	424.4
7	93	0.4	0.2
8	98	5.4	29.2
9	96	3.4	11.6
10	92	-0.6	0.4
11	91	-1.6	2.6
12	104	11.4	130.0
13	139	46.4	2153.0
14	78	-14.6	213.2
15	105	12.4	153.8
16	79	-13.6	185.0
17	83	-9.6	92.2
18	92	-0.6	0.4
19	85	-7.6	57.8
20	100	7.4	54.8
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	92.6	counts
Average Count Rate =	92.6	cpm
Standard Deviation =	14.4	counts
Sum of Squares =	3,917	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	10,906	235	55,108
2	10,700	29	827
3	10,726	55	2,998
4	10,811	140	19,530
5	10,659	-12	150
6	10,611	-60	3,630
7	10,756	85	7,183
8	10,628	-43	1,871
9	10,515	-156	24,414
10	10,676	5	23
11	10,757	86	7,353
12	10,476	-195	38,123
13	10,571	-100	10,050
14	10,842	171	29,156
15	10,624	-47	2,233
16	10,608	-63	4,001
17	10,728	57	3,221
18	10,636	-35	1,243
19	10,488	-183	33,581
20	10,707	36	1,278
		0.0	

Average Counts =	10,671	counts
Average Count Rate =	10,671	cpm
Standard Deviation =	114	counts
Sum of the Squares =	245,968	
Chi-Squared Statistic =	23.05	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.188	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.094	cpm/dpm

Net source cts =	10,579	counts
Std. Dev. Net =	115	counts
Net Ct. Rate =	10,579	cpm

MDCR = 77 cpm (@ 95% confidence level)

MDA Scan=	1,156	dpm/100 cm^2
MDA Static=	509	dpm/100 cm^2

Bkg count range	64	to	121	(2 sigma)
Source count range	10,444	to	10,899	(2 sigma)

Technical Reviewer — Date: 10/31/13

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_f = Act_o \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	30-Oct-13	4077.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 2.30 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s [1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 10/31/13 Date

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 30-Oct-13 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: A7-273 Total Efficiency: 9.38%
Probe #: 43-93 / PR326625 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 509.29

Ranges Background: 64 counts to 121 counts using ± 2 Sigma Count Time (min): 1
Source: 10,444 counts to 10,899 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	10,488	114	SAT	SAT	SAT	Sat	N / A	PW	
11/5/13	10497	103	✓	✓	✓	✓	✓	P.W.	
11/6/13	10744	75	✓	✓	✓	✓	✓	P.W.	
11/7/13	10587	117	✓	✓	✓	✓	✓	P.W.	
11/8/13	10501	99	✓	✓	✓	✓	✓	P.W.	
11/11/13	10547	101	✓	✓	✓	✓	✓	P.W.	
11/12/13	10485	93	✓	✓	✓	✓	✓	P.W.	
11/13/13	10537	98	✓	✓	✓	✓	✓	P.W.	
11/14/13	10536	113	✓	✓	✓	✓	✓	P.W.	
11/15/13	10505	88	✓	✓	✓	✓	✓	P.W.	
11/18/13	10571	84	✓	✓	✓	✓	✓	PW	
11/19/13	10584	72	✓	✓	✓	✓	✓	P.W.	
11/20/13	10598	94	✓	✓	✓	✓	✓	P.W.	
11/21/13	10501	113	✓	✓	✓	✓	✓	PW	
11/22/13	104816	103	✓	✓	✓	✓	✓	P.W.	
11/23/13	10498	90	✓	✓	✓	✓	✓	PW	
11/25/13	10454	109	✓	✓	✓	✓	✓	P.W.	N/A
11/26/13	10478	93	✓	✓	✓	✓	✓	P.W	
				N/A	N/A				

Completed By: [signature] Date: 11/26/13
Reviewed By: [signature] Date: 12/16/13

Gilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 30-Oct-13 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: A7-270 Total Efficiency: 9.18%
Probe #: 43-93 / PR326625 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 58.01

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 19,812 counts to 20,399 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	19,962	0	SAT	SAT	SAT	Sat	N / A	PW	
11/5/13	19878	0	✓	✓	✓	✓	✓	P.W.	
11/6/13	19977	0	✓	✓	✓	✓	✓	P.W.	
11/7/13	19885	0	✓	✓	✓	✓	✓	P.W.	
11/8/13	19850	0	✓	✓	✓	✓	✓	P.W.	
11/11/13	19881	0	✓	✓	✓	✓	✓	P.W.	
11/12/13	19818	0	✓	✓	✓	✓	✓	P.W.	
11/13/13	19855	0	✓	✓	✓	✓	✓	P.W.	
11/14/13	19823	0	✓	✓	✓	✓	✓	P.W.	
11/15/13	19844	0	✓	✓	✓	✓	✓	P.W.	
11/18/13	19820	0	✓	✓	✓	✓	✓	P.W.	
11/19/13	19822	0	✓	✓	✓	✓	✓	P.W.	
11/20/13	19825	0	✓	✓	✓	✓	✓	P.W.	
11/21/13	19918	0	✓	✓	✓	✓	✓	P.W.	
11/22/13	20179	0	✓	✓	✓	✓	✓	P.W.	
11/23/13	20159	0	✓	✓	✓	✓	✓	P.W.	
11/25/13	19847	0	✓	✓	✓	✓	✓	P.W.	N/A
11/26/13	19975	0	✓	✓	✓	✓	✓	P.W.	

N/A

Completed By: [signature] Date: 11/26/13
Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	30-Oct-13	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	A7-270	Total Efficiency:	9.18%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	58.01

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1

Source: 19,812 counts to 20,399 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	20176	0	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	20187	0	↓	↓	↓	↓	↓	P.W.	
12/4/13	19823	0	↓	↓	↓	↓	↓	P.W.	
12/5/13	20158	0	↓	↓	↓	↓	↓	P.W.	
12/6/13	19872	0	↓	↓	↓	↓	↓	P.W.	
12/9/13	19824	0	↓	↓	↓	↓	↓	P.W.	
12/10/13	20125	0	↓	↓	↓	↓	↓	P.W.	
					N	A			N/A

Completed By: Tom Wells Date: 12/10/13

Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2360 / 297763
Cal. Date: August 6, 2014
Probe #: 43-93 / PR326625
Setup Date: 30-Oct-13
Source ID: A7-273
Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006
High Voltage: 725 v
Total Efficiency: 9.38%
MDA (in dpm): 509.29

Ranges Background: 64 counts to 121 counts using ± 2 Sigma
Source: 10,444 counts to 10,899 counts using ± 2 Sigma
Count Time (min): 1

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	10447	101	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	10451	87	↓	↓	↓	↓	↓	P.W.	
12/4/13	10655	88	↓	↓	↓	↓	↓	P.W.	
12/5/13	10491	103	↓	↓	↓	↓	↓	P.W.	
12/6/13	10519	98	↓	↓	↓	↓	↓	P.W.	
12/9/13	10490	816	↓	↓	↓	↓	↓	D.W.	
12/10/13	10909	85	↓	↓	↓	↓	↓	P.W.	
					N/A				N/A

Completed By: Dawn Wells Date: 12/10/13
Reviewed By: Date: 12/16/13

Gilbane

SCALER INITIAL SETUP SHEET — **Alpha** — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	10-Dec-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-270	
Surface Emission Rate:	54,750	particles/min
Source Type:	Th-230	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-1.4	1.8
2	2	0.7	0.4
3	1	-0.4	0.1
4	5	3.7	13.3
5	4	2.7	7.0
6	3	1.7	2.7
7	0	-1.4	1.8
8	1	-0.4	0.1
9	2	0.7	0.4
10	2	0.7	0.4
11	0	-1.4	1.8
12	1	-0.4	0.1
13	2	0.7	0.4
14	1	-0.4	0.1
15	1	-0.4	0.1
16	0	-1.4	1.8
17	2	0.7	0.4
18	0	-1.4	1.8
19	0	-1.4	1.8
20	0	-1.4	1.8
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	1.4	counts
Average Count Rate =	1.4	cpm
Standard Deviation =	1.4	counts
Sum of Squares =	39	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	20,103	163	26,651
2	20,055	115	13,283
3	19,688	-252	63,378
4	20,029	89	7,966
5	20,040	100	10,050
6	20,188	248	61,628
7	20,017	77	5,968
8	20,068	128	16,448
9	20,020	80	6,440
10	19,698	-242	58,443
11	20,080	140	19,670
12	19,689	-251	62,876
13	19,837	-103	10,558
14	19,599	-341	116,111
15	20,085	145	21,098
16	19,820	-120	14,340
17	20,110	170	28,985
18	20,018	78	6,123
19	19,780	-160	25,520
20	19,871	-69	4,727
		0.0	

Average Counts =	19,940	counts
Average Count Rate =	19,940	cpm
Standard Deviation =	175	counts
Sum of the Squares =	580,260	
Chi-Squared Statistic =	29.10	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.364	cpm/dpm
Surface Efficiency (E_S) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.091	cpm/dpm

Net source cts =	19,938	counts
Std. Dev. Net =	175	counts
Net Ct. Rate =	19,938	cpm

MDCR = 9 cpm (@ 95% confidence level)

MDA Scan=	144	$dpm/100\ cm^2$
MDA Static=	92	$dpm/100\ cm^2$

Bkg count range	0	to	4	(2 sigma)
Source count range	19,590	to	20,289	(2 sigma)

Technical Reviewer — 12/10/13 Date

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_f = Act_o \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	10-Dec-13	4118.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 0.28 counts

x = count

μ = mean

σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

12/10/13

Technical Reviewer Date

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	10-Dec-13
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14	**Source SN:**	A7-273
Technician:	J. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	89	-6.4	41.0
2	104	8.6	74.0
3	95	-0.4	0.2
4	96	0.6	0.4
5	84	-11.4	130.0
6	103	7.6	57.8
7	127	31.6	998.6
8	104	8.6	74.0
9	104	8.6	74.0
10	103	7.6	57.8
11	81	-14.4	207.4
12	98	2.6	6.8
13	95	-0.4	0.2
14	89	-6.4	41.0
15	93	-2.4	5.8
16	96	0.6	0.4
17	87	-8.4	70.6
18	82	-13.4	179.6
19	94	-1.4	2.0
20	84	-11.4	130.0
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	95.4	counts
Average Count Rate =	95.4	cpm
Standard Deviation =	10.6	counts
Sum of Squares =	2,151	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	9,939	-50	2,490
2	9,962	-27	724
3	9,836	-153	23,378
4	9,964	-25	620
5	9,932	-57	3,238
6	9,793	-196	38,377
7	9,881	-108	11,642
8	10,011	22	488
9	10,102	113	12,792
10	9,827	-162	26,212
11	10,013	24	581
12	10,164	175	30,660
13	10,111	122	14,908
14	9,962	-27	724
15	9,879	-110	12,078
16	10,023	34	1,163
17	10,031	42	1,772
18	10,247	258	66,616
19	10,047	58	3,376
20	10,054	65	4,238
		0.0	

Average Counts =	9,989	counts
Average Count Rate =	9,989	cpm
Standard Deviation =	116	counts
Sum of the Squares =	256,076	
Chi-Squared Statistic =	25.64	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.175	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.088	cpm/dpm

Net source cts =	9,894	counts
Std. Dev. Net =	117	counts
Net Ct. Rate =	9,894	cpm

MDCR = 78 cpm (@ 95% confidence level)

MDA Scan=	1,255	dpm/100 cm^2
MDA Static=	552	dpm/100 cm^2

Bkg count range	74	to	117	(2 sigma)
Source count range	9,757	to	10,221	(2 sigma)

Technical Reviewer — Date: 12/10/13

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_f = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	10-Dec-13	4118.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = 2.33 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 12/10/13 Date

Gilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	10-Dec-13	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	A7-270	Total Efficiency:	9.11%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	92.32

Ranges Background: 0 counts to 4 counts using ± 2 Sigma Count Time (min): 1

Source: 19,590 counts to 20,289 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/11/13	20154	0	Sat	Sat	Sat	Sat	N/A	P.W.	
12/12/13	20125	0	↓	↓	↓	↓	↓	P.W.	
12/13/13	19785	0	↓	↓	↓	↓	↓	P.W.	
12/16/13	20003	0	↓	↓	↓	↓	↓	P.W.	
12/17/13	19651	0	↓	↓	↓	↓	↓	P.W.	
12/18/13	20201	0	↓	↓	↓	↓	↓	PW	
12/19/13	20223	0	↓	↓	↓	↓	↓	PW	
12/20/13	19628	0	↓	↓	↓	↓	↓	PW	
					N/A				N/A

Completed By: Pam Wells Date: 1/2/14

Reviewed By: [signature] Date: 1/17/14

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	10-Dec-13	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	A7-273	Total Efficiency:	8.77%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	552.22

Ranges Background: 74 counts to 117 counts using ± 2 Sigma Count Time (min): 1

Source: 9,757 counts to 10,221 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/11/13	9953	85	Sat	Sat	Sat	Sat	N/A	P.W.	
12/12/13	9782	84	"	"	"	"	"	P.W.	
12/13/13	10104	113	"	"	"	"	"	P.W.	
12/16/13	10065	94	"	"	"	"	"	P.W.	
12/17/13	10178	112	"	"	"	"	"	P.W.	
12/18/13	10181	100	"	"	"	"	"	PW	
12/19/13	9906	98	"	"	"	"	"	PW	
12/20/13	10083	93	"	"	"	"	"	PW	
					N/A				N/A

Completed By: Pam Wells Date: 12/21/14

Reviewed By: Date: 12/19/14

Gilbane

SCALER INITIAL SETUP SHEET | **Alpha** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	02-Jan-14
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14	**Source SN:**	A7-270
Technician:	P. Wells			**Surface Emission Rate:**	54,750 particles/min
Location:	Trailer			**Source Type:**	Th-230
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.6	0.4
2	1	0.4	0.2
3	0	-0.6	0.4
4	1	0.4	0.2
5	0	-0.6	0.4
6	0	-0.6	0.4
7	0	-0.6	0.4
8	2	1.4	2.0
9	0	-0.6	0.4
10	3	2.4	5.8
11	0	-0.6	0.4
12	1	0.4	0.2
13	0	-0.6	0.4
14	1	0.4	0.2
15	0	-0.6	0.4
16	2	1.4	2.0
17	0	-0.6	0.4
18	1	0.4	0.2
19	0	-0.6	0.4
20	0	-0.6	0.4
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	0.6	counts
Average Count Rate =	0.6	cpm
Standard Deviation =	0.9	counts
Sum of Squares =	15	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	19,034	-188	35,194
2	19,118	-104	10,733
3	19,159	-63	3,919
4	19,213	-9	74
5	19,224	2	6
6	19,341	119	14,256
7	18,995	-227	51,348
8	19,373	151	22,922
9	19,255	33	1,116
10	19,418	196	38,573
11	19,496	274	75,295
12	18,882	-340	115,328
13	19,433	211	44,690
14	19,061	-161	25,792
15	19,190	-32	999
16	19,243	21	458
17	19,030	-192	36,711
18	19,543	321	103,298
19	19,238	16	269
20	19,186	-36	1,267
		0.0	

Average Counts =	19,222	counts
Average Count Rate =	19,222	cpm
Standard Deviation =	175	counts
Sum of the Squares =	582,247	
Chi-Squared Statistic =	30.29	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.351	cpm/dpm
Surface Efficiency (E_s) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.088	cpm/dpm

Net source cts =	19,221	counts
Std. Dev. Net =	175	counts
Net Ct. Rate =	19,221	cpm

MDCR = 6 cpm (@ 95% confidence level)

MDA Scan= 99 dpm/100 cm^2

MDA Static= 75 dpm/100 cm^2

Bkg count range	0	to	2	(2 sigma)
Source count range	18,871	to	19,572	(2 sigma)

Technical Reviewer — Date: 1/19/14

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	2-Jan-14	4141.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = 0.19 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 1/19/14 Date

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	02-Jan-14
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14	**Source SN:**	A7-273
Technician:	P. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	725 v

1. Total Background Counts observed:

Chi-squared Calculations

1	111	11.1	123.2
2	113	13.1	171.6
3	116	16.1	259.2
4	110	10.1	102.0
5	108	8.1	65.6
6	102	2.1	4.4
7	93	-6.9	47.6
8	84	-15.9	252.8
9	89	-10.9	118.8
10	111	11.1	123.2
11	109	9.1	82.8
12	97	-2.9	8.4
13	97	-2.9	8.4
14	96	-3.9	15.2
15	100	0.1	0.0
16	104	4.1	16.8
17	89	-10.9	118.8
18	81	-18.9	357.2
19	104	4.1	16.8
20	84	-15.9	252.8
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes
Average Counts =	99.9	counts
Average Count Rate =	99.9	cpm
Standard Deviation =	10.6	counts
Sum of Squares =	2,146	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	9,266	93	8,668
2	9,261	88	7,762
3	9,362	189	35,759
4	9,010	-163	26,536
5	9,088	-85	7,208
6	9,012	-161	25,889
7	9,257	84	7,073
8	9,206	33	1,096
9	9,194	21	445
10	9,055	-118	13,900
11	9,315	142	20,192
12	9,278	105	11,046
13	9,027	-146	21,287
14	9,185	12	146
15	9,007	-166	27,523
16	9,312	139	19,349
17	9,009	-164	26,863
18	9,278	105	11,046
19	9,250	77	5,944
20	9,086	-87	7,552
		0.0	

Average Counts =	9,173	counts
Average Count Rate =	9,173	cpm
Standard Deviation =	123	counts
Sum of the Squares =	285,284	
Chi-Squared Statistic =	31.10	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.161	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.080	cpm/dpm

Net source cts =	9,073	counts
Std. Dev. Net =	123	counts
Net Ct. Rate =	9,073	cpm

MDCR = 80 cpm (@ 95% confidence level)

MDA Scan=	1,400	dpm/100 cm^2
MDA Static=	615	dpm/100 cm^2

Bkg count range	79	to	121	(2 sigma)
Source count range	8,928	to	9,418	(2 sigma)

Technical Reviewer — Date: 1/9/14

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	2-Jan-14	4141.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = 2.39 counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 1/19/14 Date

Gilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	2-Jan-14	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	A7-270	Total Efficiency:	8.78%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	75.24

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 18,871 counts to 19,572 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/2/2014	18,996	0	Sat	Sat	Sat	Sat/	N/A	P.W.	
1/11/2014	19260	0	↓	↓	↓	↓	↓	P.W.	
1/16/2014	19171	0	↓	↓	↓	↓	↓	PW	
						N/A			N/A

Completed By: Pam Wells Date: 1/21/13
Reviewed By: Date: 7 Feb 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	2-Jan-14	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	A7-273	Total Efficiency:	8.05%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	615.33

Ranges Background: 79 counts to 121 counts using ± 2 Sigma Count Time (min): 1
Source: 8,928 counts to 9,418 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/2/2014	9,390	94	Sat	Sat	Sat	Sat	N / A	P.W.	
1/11/2014	9404	106	↓	↓	↓	↓	↓	PW	
1/16/2014	9148	93	↓	↓	↓	↓	↓	P.W.	
					N	A			N A

Completed By: _____ Date: _____
Reviewed By: _____ Date: 7 Feb 2014

Gilbane

SCALER INITIAL SETUP SHEET

Alpha

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Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	21-Jan-14	
Source Cert. Date:	15-Sep-13	
Source SN:	K7-324	
Surface Emission Rate:	23,790	particles/min
Source Type:	Th-230	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.6	0.3
2	1	0.5	0.2
3	0	-0.6	0.3
4	0	-0.6	0.3
5	0	-0.6	0.3
6	0	-0.6	0.3
7	0	-0.6	0.3
8	0	-0.6	0.3
9	0	-0.6	0.3
10	1	0.5	0.2
11	0	-0.6	0.3
12	0	-0.6	0.3
13	1	0.5	0.2
14	1	0.5	0.2
15	0	-0.6	0.3
16	1	0.5	0.2
17	1	0.5	0.2
18	3	2.5	6.0
19	2	1.5	2.1
20	0	-0.6	0.3
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes

Average Counts =	0.6	counts
Average Count Rate =	0.6	cpm
Standard Deviation =	0.8	counts
Sum of Squares =	13	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	8,755	69	4,692
2	8,530	-157	24,492
3	8,556	-131	17,030
4	8,711	25	600
5	8,851	165	27,060
6	8,632	-55	2,970
7	8,705	19	342
8	8,830	144	20,592
9	8,732	46	2,070
10	8,748	62	3,782
11	8,665	-22	462
12	8,529	-158	24,806
13	8,549	-138	18,906
14	8,604	-83	6,806
15	8,863	177	31,152
16	8,517	-170	28,730
17	8,821	135	18,090
18	8,879	193	37,056
19	8,625	-62	3,782
20	8,628	-59	3,422
		0.0	

Average Counts =	8,687	counts
Average Count Rate =	8,687	cpm
Standard Deviation =	121	counts
Sum of the Squares =	276,847	
Chi-Squared Statistic =	31.87	

Acceptable Ranges for Chi-x^2
8.91 to 32.85

(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Net source cts =	8,686	counts
Std. Dev. Net =	121	counts
Net Ct. Rate =	8,686	cpm

Instrument Efficiency (E_I) =	0.365	cpm/dpm
Surface Efficiency (E_S) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.091	cpm/dpm

MDCR = 6 cpm (@ 95% confidence level)

MDA Scan= 92 dpm/100 cm^2

MDA Static= 71 dpm/100 cm^2

Bkg count range	0	to	2	(2 sigma)
Source count range	8,445	to	8,928	(2 sigma)

Technical Reviewer

Digitally signed by Jerry Cooper, CHP
DN: cn=Jerry Cooper, CHP, o, ou, email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:41:20 -08'00'

Date

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$
ID #	K7-324		
Initial Activity (Act_0) (dpm)	23,790		
Ref. Date	15-Sep-13		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	21-Jan-14	128.00 days (t)	

Corrected Surface Emission Rate = 23,790 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 0.18 counts

x = count
μ = mean
σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
i = scan observation interval (sec)
b_i = number of background counts in scan observation interval *i*
s_i = minimum detectable number of net source counts in scan observation interval *i*
p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review: Digitally signed by Jerry Cooper, CHP
DN: cn=Jerry Cooper, CHP, o, ou, email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:41:50 -08'00'

Technical Reviewer Date

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	RES, LLC
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	10557
Catalog No.:	EAB-230-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-324	**Contained Radioactivity:**	21.22 **nCi** 785.1 **Bq**

Physical Description:

A.	Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B.	Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C.	Active diameter/volume:	41 mm
D.	Backing:	Stainless steel
E.	Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A.	Type A (random) uncertainty:	± 0.4 %
B.	Type B (systematic) uncertainty:	± 3.0 %
C.	Uncertainty in aliquot weighing:	± 0.0 %
D.	Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 23790 α/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Gilbane

SCALER INITIAL SETUP SHEET

Beta

(Blue cells for input)

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2360 / 297763	**Cal. Due:**	06-Aug-14
Probe Type / SN:	43-93 / PR326625	**Cal. Due:**	06-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	21-Jan-14	
Source Cert. Date:	15-Sep-13	
Source SN:	K7-322	
Surface Emission Rate:	28,170	particles/min
Source Type:	Tc-99	
HV Check/Setting:	725 v	

1. Total Background Counts observed:

Chi-squared Calculations

1	94	-1.0	0.9
2	79	-16.0	254.4
3	93	-2.0	3.8
4	81	-14.0	194.6
5	96	1.1	1.1
6	100	5.1	25.5
7	97	2.1	4.2
8	116	21.1	443.1
9	85	-10.0	99.0
10	79	-16.0	254.4
11	103	8.1	64.8
12	95	0.0	0.0
13	94	-1.0	0.9
14	97	2.1	4.2
15	108	13.1	170.3
16	93	-2.0	3.8
17	95	0.0	0.0
18	97	2.1	4.2
19	96	1.1	1.1
20	101	6.1	36.6
		0.0	

Background Count Time:	1	minutes
Source/Sample Count Time:	1	minutes

Average Counts =	95.0	counts
Average Count Rate =	95.0	cpm
Standard Deviation =	9.1	counts
Sum of Squares =	1,567	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	1.80	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	6,428	9	89
2	6,419	0	0
3	6,549	130	17,017
4	6,352	-67	4,429
5	6,411	-8	57
6	6,389	-30	873
7	6,439	20	418
8	6,287	-132	17,305
9	6,438	19	378
10	6,359	-60	3,546
11	6,279	-140	19,474
12	6,496	77	5,999
13	6,299	-120	14,292
14	6,644	225	50,828
15	6,354	-65	4,167
16	6,268	-151	22,665
17	6,592	173	30,085
18	6,508	89	8,001
19	6,385	-34	1,126
20	6,475	56	3,187
		0.0	

Average Counts =	6,419	counts
Average Count Rate =	6,419	cpm
Standard Deviation =	104	counts
Sum of the Squares =	203,937	
Chi-Squared Statistic =	31.77	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.224	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.112	cpm/dpm

Net source cts =	6,324	counts
Std. Dev. Net =	104	counts
Net Ct. Rate =	6,324	cpm

MDCR = 78 cpm (@ 95% confidence level)

MDA Scan= 978 dpm/100 cm^2

MDA Static= 431 dpm/100 cm^2

Bkg count range	77	to	113	(2 sigma)
Source count range	6,211	to	6,626	(2 sigma)

Technical Reviewer

Digitally signed by Jerry Cooper, CHP
~~DN: cn=Jerry Cooper, CHP, o, ou,~~ email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:39:20 -08'00'

7 Feb 2014
Date

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$
ID #	K7-322		
Initial Activity (Act_0) (dpm)	28,170		
Ref. Date	15-Sep-13		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	21-Jan-14	128.00 days (t)	

Corrected Surface Emission Rate = 28,170 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = 2.33 counts

x = count

μ = mean

σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review: Digitally signed by Jerry Cooper, CHP
DN: cn=Jerry Cooper, CHP, o, ou, email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:40:10 -08'00'

Technical Reviewer Date

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Tc-99	**Customer:**	RES, LLC
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	10557
Catalog No.:	EAB-099-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-322	**Contained Radioactivity:**	23.07 **nCi** 853.6 **Bq**

Physical Description:

A.	Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B.	Nature of active deposit:	Electrodeposited and diffusion bonded Technetium metal
C.	Active diameter/volume:	41 mm
D.	Backing:	Stainless steel
E.	Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A.	Type A (random) uncertainty:	± 0.5 %
B.	Type B (systematic) uncertainty:	± 3.0 %
C.	Uncertainty in aliquot weighing:	± 0.0 %
D.	Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 28170 β/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Gilbane

Instrument Daily Th-230 Source Check 23,790 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	21-Jan-14	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	K7-324	Total Efficiency:	9.13%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	70.67

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1

Source: 8,445 counts to 8,928 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/21/2014	8,651	0	Sat	Sat	Sat	Sat	N / A	P.W.	
1/29/2014	8652	0	√	√	√	√	√	P.W.	
						N A			N A

Completed By: Pam WELLS Date: 2/21/14

Reviewed By: Jen Carpenter Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	21-Jan-14	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	K7-322	Total Efficiency:	11.22%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	430.66

Ranges Background: 77 counts to 113 counts using ± 2 Sigma Count Time (min): 1
Source: 6,211 counts to 6,626 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/21/2014	6,405	92	Sat	Sat	Sat	Sat/	N / A	P.W.	
1/29/2014	6423	94	√	√	√	√	√	P.W.	
						N/A			N/A

Completed By: Pam Wells Date: 2/21/14
Reviewed By: Jay Cooper Date: 24 Mar 2014

Gilbane

Instrument Daily **Th-230** **Source Check** 23,790 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 21-Jan-14 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: K7-324 Total Efficiency: 9.13%
Probe #: 43-93 / PR326625 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 70.67

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1
Source: 8,445 counts to 8,928 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	8,499	1	Sat	Sat	Sat	Sat	N / A	JEW	
2/19/2014	8,497	0	√	√	√	Sat	√	P.W.	
						N A			N A

Completed By: Pam Wells Date: 3/24/14
Reviewed By: Jim Cooperrider Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	21-Jan-14	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	K7-322	Total Efficiency:	11.22%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	430.66

Ranges Background: 77 counts to 113 counts using ± 2 Sigma Count Time (min): 1

Source: 6,211 counts to 6,626 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	6,358	87	Sat	Sat	Sat	Sat/	N / A	JEW	
2/19/2014	6,449	87	√	√	√	√	√	P.W.	

N / A

N / A

Completed By: Pam Wells

Reviewed By: Jerry Coppens

Date: 3/24/14

Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #: 2360 / 297763 Setup Date: 21-Jan-14 High Voltage: 725 v
Cal. Date: August 6, 2014 Source ID: K7-322 Total Efficiency: 11.22%
Probe #: 43-93 / PR326625 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 430.66

Ranges Background: 77 counts tc 113 counts using ± 2 Sigma Count Time (min): 1
Source: 6,211 counts tc 6,626 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	6,374	101	Sat	Sat	Sat	Sat/	N / A	P.W.	
3/25/2014	6425	80	√	√	√	√	√	P.W.	
3/26/2014	6470	94	√	√	√	√	√	P.W.	
3/27/2014	6565	90	√	√	√	√	√	P.W.	
3/31/2014	6202	103	√	√	√	√	√	P.W.	
						N	A		N/A

Completed By: Pam Wells Date: 4/1/2014
Reviewed By: Date: 4/2/14

Gilbane

Instrument Daily Th-230 Source Check 23,790 Corrected Activity (in dpm)

Instrument #:	2360 / 297763	Setup Date:	21-Jan-14	High Voltage:	725 v
Cal. Date:	August 6, 2014	Source ID:	K7-324	Total Efficiency:	9.13%
Probe #:	43-93 / PR326625	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	70.67

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 1

Source: 8,445 counts to 8,928 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	8,802	0	Sat	Sat	Sat	Sat	N / A	P.W.	
3/25/2014	8688	0	✓	✓	✓	✓	✓	P.W.	
3/26/2014	8921	0	✓	✓	✓	✓	✓	P.W.	
3/27/2014	8791	0	✓	✓	✓	✓	✓	P.W.	
3/31/2014	8778	0	✓	✓	✓	✓	✓	P.W.	

N/A

N/A

Completed By: Pam Wells Date: 4/1/2014

Reviewed By: [signature] Date: 4/2/14

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Response: **Alpha**

(Blue cells for input)

Instrument / SN: 2360/297800
Probe Type / SN: 43-93/PR326666
Technician: K. Gordon
Location: Treasure Island

Cal. Due: 18-Aug-15
Cal. Due: 18-Aug-15

Setup Date: 08-Oct-14
Source Cert. Date: 15-Sep-13
Source SN: K7-323
Surface Emission Rate: 23,650 particles/min
Source Type: Th-230
HV Check/Setting: 775

1. Total Background Counts observed:

Chi-squared Calculations

1	3	2.0	4.0
2	1	0.0	0.0
3	1	0.0	0.0
4	3	2.0	4.0
5	0	-1.0	1.0
6	0	-1.0	1.0
7	1	0.0	0.0
8	2	1.0	1.0
9	1	0.0	0.0
10	0	-1.0	1.0
11	1	0.0	0.0
12	1	0.0	0.0
13	2	1.0	1.0
14	0	-1.0	1.0
15	2	1.0	1.0
16	1	0.0	0.0
17	0	-1.0	1.0
18	0	-1.0	1.0
19	0	-1.0	1.0
20	1	0.0	0.0
		0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 1.0 counts

Average Count Rate = 1.0 cpm

Standard Deviation = 1.0 counts

Sum of Squares = 18

Area Correction Factor (ACF) = 1.00 $100cm^2$

Scan Observation Interval = 1.00 sec

2. Total Source Counts observed:

Chi-squared Calculations

1	7,914	1	1
2	7,877	-36	1,296
3	8,096	183	33,489
4	8,015	102	10,404
5	7,861	-52	2,704
6	7,990	77	5,929
7	7,968	55	3,025
8	7,939	26	676
9	7,890	-23	529
10	7,706	-207	42,849
11	7,851	-62	3,844
12	7,844	-69	4,761
13	7,946	33	1,089
14	7,768	-145	21,025
15	8,067	154	23,716
16	7,920	7	49
17	7,860	-53	2,809
18	8,032	119	14,161
19	7,937	24	576
20	7,779	-134	17,956
		0	

Average Counts = 7,913 counts

Average Count Rate = 7,913 cpm

Standard Deviation = 100 counts

Sum of the Squares = 190,888

Chi-Squared Statistic = 24.12

Acceptable Ranges for Chi-x^2
8.91 to 32.85

(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Net source cts = 7,912 counts
Std. Dev. Net = 100 counts
Net Ct. Rate = 7,912 cpm

Instrument Efficiency (E_i) = 0.3345 cpm/dpm
Surface Efficiency (E_s) = 0.2500 cpm/dpm
Total Efficiency (E_T) = 0.0836 cpm/dpm

MDCR = N/A cpm (@ 95% confidence level)

MDA Scan= N/A dpm/100 cm^2
MDA Static= 91.50 dpm/100 cm^2

Bkg count range 0 to 3 (2 sigma)
Source count range 7,713 to 8,113 (2 sigma)

Technical Reviewer

8 Oct 2014
Date

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Activity Correction Worksheet

Isotope	Th-230	
ID #	K7-323	
Initial Activity (dpm)	23,650	Equation: $Act_f = Act_o \times e^{-((.693/t)T)}$
Ref. Date	15-Sep-13	
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)
Current Date	8-Oct-14	388.00 days (t)

Corrected Surface Emission Rate =

23,650 ***particles/min***

Equations

Chi-squared Calculations $\chi 2=\Sigma(n-n)^2$

s_i = 0.18 counts

s_i = minimum detectable number of net source counts in scan observation interval *i*
i = scan observation interval (sec)

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
b_i = number of background counts in scan observation interval *i*

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

R_b = number of background counts over background count time interval t_b
t_s = sample count time interval (min)
t_b = background count time interval (min)
E = total (instrument + surface) efficiency (cpm/dpm)
A = area correction factor (i.e., detector active area divided by 100) (cm^2)

Review:

Tony Cooper 8 Oct 2014

Technical Reviewer Date

Gilbane

DAILY RESPONSE CHECK SHEET

Contract Number/Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Instrument #:	2360/297800	Setup Date:	8-Oct-14	High Voltage:	775
Cal. Due:	August 18, 2015	Source ID:	K7-323	Total Efficiency:	8.36%
Probe #:	43-93/PR326666	Source Type:	Th-230	MDA (in dpm):	91.50

Ranges						
	Background:	0	counts to	3	counts using ± 2 Sigma	Bkgd Cnt Time (min): 1
	Source:	7,713	counts to	8,113	counts using ± 2 Sigma	Source Cnt Time (min): 1

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Technician Initials	Additional Comments
10/8/2014	8,108	1	775	ok	ok	Sat	JP	Pre-check
10/8/2014	7,961	0	775	ok	ok	Sat	JP	Post-check

Completed By: Jaime Pena Date 8-OCT-2014

Reviewed By: Jim Cosgrove Date 8 Oct 2014

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Response: **Beta**

{Blue cells for input}

Instrument / SN: 2360/297800
Probe Type / SN: 43-93/PR326666
Technician: K. Gordon
Location: Treasure Island

Cal. Due: 18-Aug-15
Cal. Due: 18-Aug-15

Setup Date: 08-Oct-14
Source Cert. Date: 15-Sep-13
Source SN: K7-321
Surface Emission Rate: 27,870 particles/min
Source Type: Tc-99
HV Check/Setting: 775

1. Total Background Counts observed:
Chi-squared Calculations

1	103	-2.5	6.3
2	116	10.5	110.3
3	97	-8.5	72.3
4	114	8.5	72.3
5	117	11.5	132.3
6	109	3.5	12.3
7	93	-12.5	156.3
8	120	14.5	210.3
9	110	4.5	20.3
10	120	14.5	210.3
11	100	-5.5	30.3
12	85	-20.5	420.3
13	98	-7.5	56.3
14	114	8.5	72.3
15	117	11.5	132.3
16	100	-5.5	30.3
17	106	0.5	0.3
18	108	2.5	6.3
19	89	-16.5	272.3
20	94	-11.5	132.3
		0	

Background Count Time: 1 minutes
Source/Sample Count Time: 1 minutes

Average Counts = 105.5 counts
Average Count Rate = 105.5 cpm
Standard Deviation = 10.6 counts
Sum of Squares = 2,155
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval = 1.00 sec

2. Total Source Counts observed:
Chi-squared Calculations

1	5,901	-84	7,048
2	6,014	29	844
3	6,029	44	1,940
4	5,905	-80	6,392
5	5,927	-58	3,358
6	5,963	-22	482
7	6,000	15	227
8	6,130	145	21,040
9	5,863	-122	14,872
10	6,044	59	3,487
11	6,019	34	1,159
12	5,824	-161	25,905
13	6,046	61	3,727
14	6,012	27	732
15	5,995	10	101
16	5,930	-55	3,020
17	6,044	59	3,487
18	6,076	91	8,290
19	6,046	61	3,727
20	5,931	-54	2,911
		0	

Average Counts = 5,985 counts
Average Count Rate = 5,985 cpm
Standard Deviation = 77 counts
Sum of the Squares = 112,747
Chi-Squared Statistic = 18.84

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Net source cts = 5,879 counts
Std. Dev. Net = 78 counts
Net Ct. Rate = 5,879 cpm

Instrument Efficiency (E_I) = 0.2110 cpm/dpm
Surface Efficiency (E_s) = 0.5000 cpm/dpm
Total Efficiency (E_T) = 0.1055 cpm/dpm

MDCR = 110 cpm (@ 95% confidence level)

MDA Scan= 1,472.06 **dpm/100 cm^2**
MDA Static= 481.51 **dpm/100 cm^2**

Bkg count range 84 to 127 (2 sigma)
Source count range 5,831 to 6,139 (2 sigma)

Jim Cooper 8 Oct 2014

Technical Reviewer — Date

Gilbane

SCALER INSTRUMENT SET-UP WORKSHEET

Contract Number / Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Source Activity Correction Worksheet

Isotope	Tc-99
ID #	K7-321
Initial Activity (dpm)	27,870
Ref. Date	15-Sep-13
Half-life (years)	2.13E+05
Current Date	8-Oct-14

7.77E+07 days (Half-life)
388.00 days (t)

Equation: $Act_f = Act_o \times e^{-((.693/t)T)}$

Corrected Surface Emission Rate =
27,870 ***particles/min***

Equations

Chi-squared Calculations $\chi 2=\Sigma(n-n)^2$

s_i = 1.83 counts

s_i = minimum detectable number of net source counts in scan observation interval *i*
i = scan observation interval (sec)

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)
b_i = number of background counts in scan observation interval *i*

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

R_b = number of background counts over background count time interval t_b
t_s = sample count time interval (min)
t_b = background count time interval (min)
E = total (instrument + surface) efficiency (cpm/dpm)
A = area correction factor (i.e., detector active area divided by 100) (cm^2)

Review:

Tom Cooper 8 Oct 2014

Technical Reviewer Date

Gilbane

DAILY RESPONSE CHECK SHEET

Contract Number/Task Order Number:	Project Title / Location:	ITSI Gilbane Project Number:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, CA	7204.0006

Instrument #:	2360/297800	Setup Date:	8-Oct-14	High Voltage:	775
Cal. Due:	August 18, 2015	Source ID:	K7-321	Total Efficiency:	10.55%
Probe #:	43-93/PR326666	Source Type:	Tc-99	MDA (in dpm):	481.51

Ranges						
	Background:	84	counts to	127	counts using ± 2 Sigma	Bkgd Cnt Time (min): 1
	Source:	5,831	counts to	6,139	counts using ± 2 Sigma	Source Cnt Time (min): 1

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Technician Initials	Additional Comments
10/8/2014	6,013	97	775	ok	ok	Sat	JP	Pre-check
10/8/2014	6,049	106	775	ok	ok	Sat	JP	Post-check

Completed By: Jami Pena Date 8-OCT-2014

Reviewed By: Jay Coppens Date 8 Oct 2014

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.
☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

CUSTOMER RES LLC ORDER NO. 20251030/410117

Mfg. Ludlum Measurements, Inc. Model 2360 Serial No. 297800

Mfg. Ludlum Measurements, Inc. Model 43-93 Serial No. PR326666

Cal. Date 18-Aug-14 Cal Due Date 18-Aug-15 Cal. Interval 1 Year Meterface 202-855

Check mark ☑ applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 32 % Alt 702.8 mm Hg

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

☑ Mechanical ck. ☑ Meter Zeroed ☐ Background Subtract ☐ Input Sens. Linearity
☐ F/S Resp. ck ☑ Reset ck. ☑ Window Operation ☑ Geotropism
☑ Audio ck. ☑ Alarm Setting ck. ☑ Batt. ck. (Min. Volt) 2.2 VDC ☐ RS-232 Port OK
☑ Calibrated in accordance with LMI SOP 14.8 rev 12/05/89. ☐ Calibrated in accordance with LMI SOP 14.9 rev 02/07/97.

Instrument Volt Set 775 V

☑ HV Readout (2 points) Ref./Inst. 500 / 501 V Ref./Inst. 2000 / 2001 V

Firmware Version: 39010x24
Alpha Threshold: 120 mv
Beta Threshold: 3.5 mv
Beta Window: 30 mv
Overload SET TO SIMULATE LIGHT LEAK.
Instrument calibrated with a 39" cable.
High voltage set with detector NOT CONNECTED

(EEPROM Settings)
User Time: 0.1
Alpha Alarm: 999999
Beta Alarm: 999999
A/B Alarm: 999999
Model 2360 Date: 8/18/2014
Calibration Date Due: 8/18/2015

COMMENTS:

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

RANGE/MULTIPLIER	REFERENCE CAL. POINT	INSTRUMENT REC'D "AS FOUND READING"	INSTRUMENT METER READING*
x1000	400k cpm	400	400
x1000	100k cpm	100	100
x100	40k cpm	400	400
x100	10k cpm	100	100
x10	4k cpm	400	400
x10	1k cpm	100	100
x1	400 cpm	400	400
x1	100 cpm	100	100

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

ALL **Range(s) Calibrated Electronically**

	REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*		REFERENCE CAL. POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
Digital Readout	400kcpm	40040(0)	40040(0)	Log Scale			
	40kcpm	4004	4004				
	4kcpm	400	400				
	400cpm	40	40				
	40cpm	4	4				

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

Reference Instruments and/or Sources: Cs-137 S/N ☐ 059 ☐ 2171CP ☐ 2251CP ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 1909 ☐ 1916CP ☐ 5105 ☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T10081 ☐ T10082 Neutron Am-241 Be S/N: ☐ T-304 Ra-226 S/N: ☐ Y982

☑ Alpha S/N Pu239 SN:7053 ☑ Beta S/N Tc99SN:5280,SrY90SN:5281 ☐ Other

☑ m 500 S/N 190566 ☐ Oscilloscope S/N ☑ Multimeter S/N 86250390

Calibrated By: Date 18-Aug-14

Reviewed By: Date 19 Aug 14

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

AC Inst. Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ☐ Failed:

Designer and Manufacturer
of
Scientific and Industrial
Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556, U.S.A.

☐ 10744 Dutchtown Road
865-392-4601
Knoxville, TN 37932, U.S.A.

Bench Test Data For Detector

Detector 43-93 Serial No. PR326666

Customer RES LLC

Counter 2360 Serial No. 297800

Count Time 1Minute

Other

Order #. 20251030/410117

Alpha Input Sensitivity 120 mV

Beta Input Sensitivity 3.5 mV

Beta Window 30 mV

Distance Source to Detector Surface

High Voltage	Background		Isotope Pu239 Size 24900dpm		Isotope Tc99 Size 93200dpm		Isotope 51%U Size 94422dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
725	0	103	4857	326	14	11246	0	22217
750	0	166	5374	321	19	15317	0	25980
775	0	193.	5486	335	25	17462	0	30568
800	0	260	5751	399	32	20523	1	34693
825	0	302	5862	480	31	22688	1	35976

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable.

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter.

Signature

Date 18-Aug-14

• *Serving The Nuclear Industry Since 1962* •

Header 1: John Q. Public
Header 2: SN: 297800
Header 3: SN: PR326666
Header 4: Site: Bldg 1
Header 5: RM 008, S. Wall
Header 6: Comment
Location: Table 007

Calibration Due Date: 08/18/2015
Model 2360 Date: 08/18/2014
Model 2360 Time: 02:38:34 PM

Logged Samples: 0

User PC Scaler Count Time: 0.1 minutes

Alpha Ratemeter Alarm Setpoint:	999999
Beta Ratemeter Alarm Setpoint:	999999
Alpha + Beta Ratemeter Alarm Setpoint:	999999

Alpha Scaler Alarm Setpoint:	999999
Beta Scaler Alarm Setpoint:	999999
Alpha + Beta Scaler Alarm Setpoint:	999999

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661·309·1010
Fax 661·257·8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	RES, LLC
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	10557 EZIP
Catalog No.:	EAB-230-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-323	**Contained Radioactivity:**	21.09 **nCi** 780.3 **Bq**

Physical Description:

A. Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active diameter/volume:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 23650 α/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

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CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Tc-99	**Customer:**	RES, LLC
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	10557 EZIP
Catalog No.:	EAB-099-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-321	**Contained Radioactivity:**	22.83 **nCi** 844.7 **Bq**

Physical Description:

A.	Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B.	Nature of active deposit:	Electrodeposited and diffusion bonded Technetium metal
C.	Active diameter/volume:	41 mm
D.	Backing:	Stainless steel
E.	Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A.	Type A (random) uncertainty:	± 0.4	%
B.	Type B (systematic) uncertainty:	± 3.0	%
C.	Uncertainty in aliquot weighing:	± 0.0	%
D.	Total uncertainty at the 99% confidence level:	± 3.0	%

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 27870 β/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Alpha** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	06-Sep-13	
Instrument / SN:	2929 / 265724	**Cal. Due:**	24-Aug-14	**Source Cert. Date:**	01-Sep-02	
Probe Type / SN:	43-10-1 / PR298585	**Cal. Due:**	24-Aug-14	**Source SN:**	A7-270	
Technician:	P. Wells			**Surface Emission Rate:**	54,750	particles/min
Location:	Trailer			**Source Type:**	Th-230	
				HV Check/Setting:	500	

1. Total Background Counts observed:

Chi-squared Calculations

1	1	0.4	0.2
2	1	0.4	0.2
3	1	0.4	0.2
4	1	0.4	0.2
5	1	0.4	0.2
6	1	0.4	0.2
7	1	0.4	0.2
8	0	-0.6	0.4
9	1	0.4	0.2
10	1	0.4	0.2
11	0	-0.6	0.4
12	0	-0.6	0.4
13	0	-0.6	0.4
14	1	0.4	0.2
15	0	-0.6	0.4
16	0	-0.6	0.4
17	0	-0.6	0.4
18	1	0.4	0.2
19	1	0.4	0.2
20	0	-0.6	0.4
		0.0	

Background Count Time:	2	minutes
Source/Sample Count Time:	2	minutes
Average Counts =	0.6	counts
Average Count Rate =	0.3	cpm
Standard Deviation =	0.5	counts
Sum of Squares =	5	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	N/A	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	84,787	157	24,712
2	84,196	-434	188,182
3	84,116	-514	263,990
4	84,524	-106	11,194
5	85,114	484	234,450
6	84,700	70	4,928
7	84,316	-314	98,470
8	84,779	149	22,261
9	83,949	-681	463,489
10	84,306	-324	104,846
11	84,589	-41	1,665
12	85,011	381	145,313
13	84,734	104	10,858
14	85,238	608	369,907
15	84,461	-169	28,493
16	84,924	294	86,554
17	85,340	710	504,384
18	84,567	-63	3,944
19	84,499	-131	17,109
20	84,446	-184	33,782
		0.0	

Average Counts =	84,630 counts
Average Count Rate =	42,315 cpm
Standard Deviation =	371 counts
Sum of the Squares =	2,618,531
Chi-Squared Statistic =	30.94

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.773	cpm/dpm
Surface Efficiency (E_s) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.193	cpm/dpm

Net source cts =	84,629	counts
Std. Dev. Net =	371	counts
Net Ct. Rate =	42,315	cpm

MDCR = #VALUE! cpm (@ 95% confidence level)

MDA Scan=	#VALUE!	dpm/100 cm^2
MDA Static=	17	dpm/100 cm^2

Bkg count range	0	to	3	(2 sigma)
Source count range	83,145	to	86,115	(2 sigma)

Technical Reviewer — Date: 6 Sep 2013

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_o \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	6-Sep-13	4023.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = #VALUE! counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

James C Cooper 6 Sep 2013

Technical Reviewer Date

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	NEW WORLD TECHNOLOGY		
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	20400		
Catalog No.:	EAB-230-47LB	**Reference Date:**	1-Sep-02	12:00	PST
Source No.:	A7-270	**Contained Radioactivity:**	49.32	**nCi**	1825 **Bq**
		Contained Radioactivity: (Total Alpha)	109500	**dpm**	

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

Ra-226 = 0.400% and Am-241 = 0.110% on 1 Sep 02.

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a total alpha surface emission rate of 54750 α/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

ITSI Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | *(Blue cells for input)*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2929 / 265724	**Cal. Due:**	24-Aug-14
Probe Type / SN:	43-10-1 / PR298585	**Cal. Due:**	24-Aug-14
Technician:	J. Wells		
Location:	Trailer		

Setup Date:	06-Sep-13	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-273	
Surface Emission Rate:	56,390	particles/min
Source Type:	Tc-99	
HV Check/Setting:	500	

1. Total Background Counts observed:

Chi-squared Calculations

1	89	12.0	142.8
2	88	11.0	119.9
3	76	-1.1	1.1
4	72	-5.1	25.5
5	75	-2.1	4.2
6	68	-9.1	81.9
7	65	-12.1	145.2
8	75	-2.1	4.2
9	83	6.0	35.4
10	69	-8.1	64.8
11	64	-13.1	170.3
12	77	0.0	0.0
13	87	10.0	99.0
14	74	-3.1	9.3
15	78	1.0	0.9
16	75	-2.1	4.2
17	82	5.0	24.5
18	79	2.0	3.8
19	83	6.0	35.4
20	82	5.0	24.5
		0.0	

Background Count Time:	2	minutes
Source/Sample Count Time:	2	minutes
Average Counts =	77.1	counts
Average Count Rate =	38.5	cpm
Standard Deviation =	7.2	counts
Sum of Squares =	997	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	N/A	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	41,462	119	14,125
2	41,165	-178	31,737
3	41,395	52	2,688
4	41,483	140	19,558
5	41,432	89	7,894
6	41,092	-251	63,076
7	41,398	55	3,009
8	41,073	-270	72,981
9	41,617	274	74,994
10	41,319	-24	583
11	41,239	-104	10,847
12	41,458	115	13,191
13	41,614	271	73,360
14	41,533	190	36,043
15	41,179	-164	26,945
16	41,427	84	7,031
17	41,179	-164	26,945
18	41,015	-328	107,682
19	41,460	117	13,654
20	41,323	-20	406
		0.0	

Average Counts =	41,343	counts
Average Count Rate =	20,672	cpm
Standard Deviation =	179	counts
Sum of the Squares =	606,751	
Chi-Squared Statistic =	14.68	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.366	cpm/dpm
Surface Efficiency (E_S) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.183	cpm/dpm

Net source cts =	41,266	counts
Std. Dev. Net =	179	counts
Net Ct. Rate =	20,633	cpm

MDCR = N/A cpm (@ 95% confidence level)

MDA Scan=	N / A	dpm/100 cm^2
MDA Static=	120	dpm/100 cm^2

Bkg count range	48	to	106	(2 sigma)
Source count range	40,628	to	42,058	(2 sigma)

Technical Reviewer — Date: 6 Sep 2013

RSOP-03.01 Rev 19Aug2013

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_r = Act_o \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	6-Sep-13	4023.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2=\Sigma(X_i-\mu)^2 / \sigma$

x = count

μ = mean

σ =standard deviation

s_i = #VALUE! counts

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer Date 6 Sep 2013

Designer and Manufacturer of Scientific and Industrial Instruments

CERTIFICATE OF CALIBRATION

LUDLUM MEASUREMENTS, INC.
501 Oak Street, 325-235-5494, Sweetwater, TX 79556, U.S.A.
10744 Dutchtown Road, 865-392-4601, Knoxville, TN 37932, U.S.A.

CUSTOMER **ENVIRACHEM, INC.** ORDER NO. 20228594/395728

Mfg. Ludlum Measurements, Inc. Model 2929 Serial No. 265724

Mfg. Ludlum Measurements, Inc. Model 43-10-1 Serial No. PR298585

Cal. Date 24-Aug-13 Cal Due Date 24-Aug-14 Cal. Interval 1 Year Meterface 202-014

Check mark ✓applies to applicable instr. and/or detector IAW mfg. spec. T. 73 °F RH 34 % Alt 708.8 mm Hg

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

✓ Mechanical ck. ✓ Window Operation

✓ Audio ck.

✓ Meter Zeroed Alpha Sensitivity 175 mV Beta Sensitivity 4 mV Beta Window 50 mV

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

Instrument Volt Set 500 V = 2.08 on High Voltage dial. High Voltage set with detector connected.

✓ HV Readout (2 points) Ref./Inst 500 / 502 V Ref./Inst 2000 / 1994 V

COMMENTS:

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

Alpha Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400K cpm	40022 (c)	40022 (c)
	40K cpm	4002	4002
	4K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

Beta/Gamma Channel Digital Readout	REFERENCE CAL POINT	INSTRUMENT RECEIVED	INSTRUMENT METER READING*
	400K cpm	40020 (c)	40020 (c)
	40K cpm	4002	4002
	4K cpm	400	400
	400 cpm	40	40
	40 cpm	4	4

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

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

Reference Instruments and/or Sources: ☐ 059 ☐ 280 ☐ 720 ☐ 734 ☐ 781 ☐ 1131 ☐ 1616 ☐ 1696 ☐ 5105 ☐ 5717CO ☐ 5719CO ☐ 60646 ☐ 70897 ☐ 73410 ☐ E551 ☐ E552 ☐ G112 ☐ M565 ☐ S-394 ☐ S-1054 ☐ T-304 ☐ T879 ☐ T10081 ☐ T10082 ☐ Y982

✓ Alpha S/N Pu239 SN:7053 ✓ Beta S/N Tc99SN:5280 SrY90SN:5281 ☐ Other

✓ m 500 S/N 190566 ☐ Oscilloscope S/N ✓ Multimeter S/N 86250390

Calibrated By: Dan Tolar Date 24-Aug-13

Reviewed By: Paul H. Date 26 Aug 13

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

AC Inst Only ☐ Passed Dielectric (Hi-Pot) and Continuity Test ✓ Failed: AC adaptor

Designer and Manufacturer of Scientific and Industrial Instruments

LUDLUM MEASUREMENTS, INC.
501 Oak Street
325-235-5494
Sweetwater, TX 79556 U.S.A.

10744 Dutchtown Road
865-392-4801
Knoxville, TN 37932 U.S.A.

Bench Test Data For Detector

Detector 43-10-1 Serial No. PR298585

Customer ENVIRACHEM, INC.

Counter 2929 Serial No. 265724

Count Time 1Minute

Other

Order #: 20228594/395728

Alpha Input Sensitivity 175 mV

Beta Input Sensitivity 4 mV

Beta Window 50 mV

Distance Source to Detector TRAY

High Voltage	Background		Isotope Pu239 Size 24900dpm		Isotope Tc99 Size 93200dpm		Isotope Sr/Y90 Size 97293dpm	
	Alpha	Beta	Alpha	Beta	Alpha	Beta	Alpha	Beta
450	0	45	10092	247	24	23123	0	41442
475	0	59	10157	232	35	27649	1	46693
500	0	64	10446	291	46	31282	6	45663
525	0	76	10643	294	36	33471	27	43477
550	1	134	10509	479	37	32990	296	37299

☐ Gas Proportional detector count rate decreased ≤ 10% after 15 hour static test using 39" cable

☐ Gas proportional detector count rate decreased ≤ 10% after 5 hour static test using 39" cable and alpha/beta counter

Signature

Date 24-Aug-13

• Serving The Nuclear Industry Since 1962 •

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:	Tc-99	**Customer:**	NEW WORLD TECHNOLOGY			
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	20400			
Catalog No.:	EAB-099-47LB	**Reference Date:**	1-Sep-02	12:00	PST	
Source No.:	A7-273	**Contained Radioactivity:**	47.93	**nCi**	1773	**Bq**
		Contained Radioactivity:	106400	**dpm**		

Physical description:

A. Capsule type:	EAB-LB (47 mm OD x 3.18 mm THK)
B. Nature of active deposit:	Electroplated and diffusion bonded oxide
C. Active Diameter:	41 mm
D. Backing:	Stainless steel
E. Cover:	None

Radioimpurities:

None detected

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A. Type A (random) uncertainty:	± 0.4 %
B. Type B (systematic) uncertainty:	± 3.0 %
C. Uncertainty in aliquot weighing:	± 0.0 %
D. Total uncertainty at the 99% confidence level:	± 3.0 %

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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had surface emission rate of 56390 β/min in 2π on 20 Aug 02.

Quality Control

21-Aug-02
Date Signed

IPL Ref. No.: 943-61

ITSI Gamma

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #:	2929 / 265724	Setup Date:	6-Sep-13	High Voltage:	500
Cal. Date:	August 24, 2014	Source ID:	A7-273	Total Efficiency:	18.30%
Probe #:	43-10-1 / PR298585	Project/#:	oping Surveys, Treasure Island / 0720	MDA (in dpm):	119.81

Ranges Background: 48 counts to 106 counts using ± 2 Sigma Count Time (min): 2
Source: 40,628 counts to 42,058 counts using ± 2 Sigma

Date / Time	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/7/2013	41,323	85	500	N/A	N/A	Sat	N/A	J.C.C.	
9/9/2013	41,497	84				Sat		P.W.	
9/10/2013	40,763	72				Sat		P.W	
9/11/2013	40,771	76				Sat		P.W.	
9/12/2013	40,767	69				Sat		P.W	
9/16/13	41148	76				Sat		P.W	
9/17/13	41377	68				Sat		P.W.	
9/18/13	41537	81				Sat		TC	
9/19/13	41253	84				Sat		PW.	
9/23/13	41515	74				Sat		P.W.	
9/24/13	40867	99				Sat		P.W.	
9/25/13	41234	69				Sat		P.W.	
9/26/13	41165	86				Sat		P.W.	
9/27/13	40807	78				Sat		P.W.	
9/30/13	40894	75				Sat		P.W.	
						N/A		N/A	N/A
	N/A	N/A							

Completed By: Pam Wilds Date: Oct 1, 2013
Reviewed By: [signature] Date: 1 Oct 2013

ITSI Gilbane

Instrument Daily Th-230 Source Check 54,744 Corrected Activity (in dpm)

Instrument #: 2929 / 265724
Cal. Date: August 24, 2014
Probe #: 43-10-1 / PR298585

Setup Date: 6-Sep-13
Source ID: A7-270
Project/#: :oping Surveys, Treasure Island / 0720

High Voltage: 500
Total Efficiency: 19.32%
MDA (in dpm): 17.09

Ranges
Background: 0 counts to 3 counts using ± 2 Sigma
Source: 83,145 counts to 86,115 counts using ± 2 Sigma

Count Time (min): 2

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
9/7/2013	84,281	0	500	N/A	N/A	Sat	N/A	J.C.C.	
9/9/2013	85,140	0				Sat		P.W.	
9/10/2013	85,160	0				Sat		P.W.	
9/11/2013	84,791	1				Sat		P.W.	
9/12/2013	85,449	0				Sat		P.W.	
9/16/13	85023	0				Sat		P.W.	
9/17/13	85970	0				Sat		P.W.	
9/18/13	85910	0				SAT		[illegible]	
9/19/13	85915	0				Sat		P.W.	
9/23/13	85857	1				Sat		P.W.	
9/24/13	86104	1				Sat		P.W.	
9/25/13	85264	0				Sat		P.W.	
9/26/13	86030	1				Sat		P.W.	
9/27/13	85336	0				Sat		P.W.	
9/30/13	84981	2				Sat		P.W.	
N/A	N/A	N/A				N/A		N/A	

Completed By: Pam Wells
Reviewed By: [signature]

Date: Oct. 1, 2013
Date: 1 Oct 2013

ITSI Crane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 6-Sep-13 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: A7-273 Total Efficiency: 18.30%
Probe #: 43-10-1 / PR298585 Project/#: :oping Surveys, Treasure Island / 0720 MDA (in dpm): 119.81

Ranges Background: 48 counts to 106 counts using ± 2 Sigma Count Time (min): 2
Source: 40,628 counts to 42,058 counts using ± 2 Sigma

Date / Time	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/2013	40860	81	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	40018	89	↓	↓	↓	↓		P.W.	
10/3/13	40719	77	↓	↓	↓	↓		P.W.	
10/7/13	41065	83	↓	↓	↓	↓		P.W.	
10/8/13	40687	69	↓	↓	↓	↓		P.W.	
10/9/13	41680	64	↓	↓	↓	↓		P.W.	
10/10/13	41546	71	↓	↓	↓	↓		P.W.	
10/15/13	40885	78	↓	↓	↓	↓		P.W	
10/16/13	40803	97	↓	↓	↓	↓		P.W.	
10/17/13	40823	97	↓	↓	↓	↓		P.W.	
10/18/13	40862	69	↓	↓	↓	↓		P.W.	
10/21/13	40805	90	↓	↓	↓	↓		P.W	
10/22/13	40955	82	↓	↓	↓	↓		P.W.	
10/23/13	40876	77	↓	↓	↓	↓		P.W.	
10/24/13	40791	69	↓	↓	↓	↓		P.W.	
10/28/13	40839	74	↓	↓	↓	↓		P.W.	N A
10/29/13	40721	79	↓	↓	↓	↓		P.W.	
10/30/13	40641	74	↓	↓	↓	↓		P.W.	
10/31/13	40637	65	↓	↓	↓	↓		P.W.	
				N	A				

Completed By: Ryan Wells Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

ITSI Cabane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 6-Sep-13 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: A7-270 Total Efficiency: 19.32%
Probe #: 43-10-1 / PR298585 Project/#: oping Surveys, Treasure Island / 0720 MDA (in dpm): 17.09

Ranges Background: 0 counts to 3 counts using ± 2 Sigma Count Time (min): 2
Source: 83,145 counts to 86,115 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
10/1/2013	85239	1	Sat	Sat	Sat	Sat	N/A	P.W.	
10/2/13	84716	0	Sat	Sat	Sat	Sat		P.W.	
10/3/13	84821	1	✓	✓	✓	✓		P.W.	
10/7/13	84907	0	✓	✓	✓	✓		P.W.	
10/8/13	84804	0	✓	✓	✓	✓		P.W.	
10/9/13	85011	0	✓	✓	✓	✓		P.W.	
10/10/13	85135	0	✓	✓	✓	✓		P.W.	
10/15/13	84741	0	✓	✓	✓	✓		P.W.	
10/16/13	84837	1	✓	✓	✓	✓		P.W.	
10/17/13	84918	1	✓	✓	✓	✓		P.W.	
10/18/13	84816	0	✓	✓	✓	✓		P.W.	
10/21/13	85178	0	✓	✓	✓	✓		P.W.	
10/22/13	84683	0	✓	✓	✓	✓		P.W.	
10/23/13	84322	0	✓	✓	✓	✓		P.W.	
10/24/13	84954	0	✓	✓	✓	✓		P.W.	
10/28/13	85288	0	✓	✓	✓	✓		P.W.	N/A
10/29/13	84866	0	✓	✓	✓	✓		P.W.	
10/30/13	85567	0	✓	✓	✓	✓		P.W.	
10/31/13	85896	0	✓	✓	✓	✓		P.W.	
			N/A						

Completed By: [signature] Date: 10/31/13
Reviewed By: [signature] Date: 11/5/13

Gilbane

SCALER INITIAL SETUP SHEET — Alpha — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	31-Oct-13
Instrument / SN:	2929 / 265724	**Cal. Due:**	24-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-10-1 / PR298585	**Cal. Due:**	24-Aug-14	**Source SN:**	A7-270
Technician:	P. Wells			**Surface Emission Rate:**	54,750 particles/min
Location:	Trailer			**Source Type:**	Th-230
				HV Check/Setting:	500

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.6	0.4
2	0	-0.6	0.4
3	0	-0.6	0.4
4	0	-0.6	0.4
5	1	0.4	0.2
6	1	0.4	0.2
7	0	-0.6	0.4
8	0	-0.6	0.4
9	0	-0.6	0.4
10	2	1.4	2.0
11	0	-0.6	0.4
12	0	-0.6	0.4
13	3	2.4	5.8
14	0	-0.6	0.4
15	0	-0.6	0.4
16	1	0.4	0.2
17	2	1.4	2.0
18	1	0.4	0.2
19	0	-0.6	0.4
20	1	0.4	0.2
		0.0	

Background Count Time: 2 minutes
Source/Sample Count Time: 2 minutes

Average Counts = 0.6 counts
Average Count Rate = 0.3 cpm
Standard Deviation = 0.9 counts
Sum of Squares = 15
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval (i) = N/A seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	85,288	-103	10,640
2	85,558	167	27,839
3	85,400	9	78
4	85,365	-26	684
5	84,888	-503	253,160
6	85,299	-92	8,492
7	85,248	-143	20,492
8	85,327	-64	4,115
9	85,335	-56	3,153
10	84,783	-608	369,846
11	85,695	304	92,325
12	85,455	64	4,077
13	85,277	-114	13,030
14	85,543	152	23,058
15	85,186	-205	42,087
16	85,507	116	13,421
17	85,688	297	88,120
18	85,403	12	140
19	85,996	605	365,844
20	85,582	191	36,424
		0.0	

Average Counts = 85,391 counts
Average Count Rate = 42,696 cpm
Standard Deviation = 269 counts
Sum of the Squares = 1,377,025
Chi-Squared Statistic = 16.13

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) = 0.780 cpm/dpm
Surface Efficiency (E_S) = 0.250 cpm/dpm
Total Efficiency (E_T) = 0.195 cpm/dpm

Net source cts = 85,391 counts
Std. Dev. Net = 269 counts
Net Ct. Rate = 42,695 cpm

MDCR = #VALUE! cpm (@ 95% confidence level)

MDA Scan= #VALUE! dpm/100 cm^2
MDA Static= 17 dpm/100 cm^2

Bkg count range 0 to 4 (2 sigma)
Source count range 84,314 to 86,468 (2 sigma)

Technical Reviewer — Date 10/31/13

RSOP-03.01 Rev 19Aug2013

Source Activity Correction Worksheet

Equation: $Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$

Isotope	Th-230	
ID #	A7-270	
Initial Activity (Act_0) (dpm)	54,750	
Ref. Date	1-Sep-02	
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)
Current Date	31-Oct-13	4078.00 days (t)

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2=\Sigma(X_i-\mu)^2/\sigma$

x = count

μ = mean

σ =standard deviation

s_i = #VALUE! counts

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 10/31/13 Date

Gilbane

SCALER INITIAL SETUP SHEET | **Beta** | ***{Blue cells for input}***

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	31-Oct-13
Instrument / SN:	2929 / 265724	**Cal. Due:**	24-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-10-1 / PR298585	**Cal. Due:**	24-Aug-14	**Source SN:**	A7-273
Technician:	P. Wells			**Surface Emission Rate:**	56,390 particles/min
Location:	Trailer			**Source Type:**	Tc-99
				HV Check/Setting:	500

1. Total Background Counts observed:

Chi-squared Calculations

1	75	-3.8	14.1
2	89	10.3	105.1
3	77	-1.8	3.1
4	72	-6.8	45.6
5	82	3.3	10.6
6	72	-6.8	45.6
7	65	-13.8	189.1
8	89	10.3	105.1
9	77	-1.8	3.1
10	71	-7.8	60.1
11	81	2.3	5.1
12	77	-1.8	3.1
13	78	-0.8	0.6
14	89	10.3	105.1
15	83	4.3	18.1
16	73	-5.8	33.1
17	76	-2.8	7.6
18	88	9.3	85.6
19	92	13.3	175.6
20	69	-9.8	95.1
		0.0	

Background Count Time:	2	minutes
Source/Sample Count Time:	2	minutes
Average Counts =	78.8	counts
Average Count Rate =	39.4	cpm
Standard Deviation =	7.6	counts
Sum of Squares =	1,110	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	N/A	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	38,972	267	71,423
2	38,778	73	5,366
3	38,568	-137	18,701
4	38,736	31	977
5	39,121	416	173,264
6	38,578	-127	16,066
7	38,563	-142	20,093
8	38,656	-49	2,377
9	38,916	211	44,627
10	38,675	-30	885
11	38,715	10	105
12	38,564	-141	19,811
13	38,405	-300	89,850
14	38,954	249	62,126
15	38,556	-149	22,127
16	38,421	-284	80,514
17	38,882	177	31,418
18	38,675	-30	885
19	38,662	-43	1,828
20	38,698	-7	46
		0.0	

Average Counts =	38,705	counts
Average Count Rate =	19,352	cpm
Standard Deviation =	187	counts
Sum of the Squares =	662,484	
Chi-Squared Statistic =	17.12	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_i) =	0.343	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.171	cpm/dpm

Net source cts =	38,626	counts
Std. Dev. Net =	187	counts
Net Ct. Rate =	19,313	cpm

MDCR = N/A cpm (@ 95% confidence level)

MDA Scan=	N / A	dpm/100 cm^2
MDA Static=	129	dpm/100 cm^2

Bkg count range	48	to	109	(2 sigma)
Source count range	37,958	to	39,452	(2 sigma)

Technical Reviewer — Date: 10/31/13

RSOP-03.01 Rev 19Aug2013

Source Activity Correction Worksheet

Equation: $Activity(Act)_f = Act_o \times e^{-((.693/t)T)}$

Isotope	Tc-99	
ID #	A7-273	
Initial Activity (Act_0) (dpm)	56,390	
Ref. Date	1-Sep-02	
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)
Current Date	31-Oct-13	4078.00 days (t)

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = #VALUE! counts

x = count

μ = mean

σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 10/31/13 Date

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 31-Oct-13 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: A7-273 Total Efficiency: 17.13%
Probe #: 43-10-1 / PR298585 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 129.31

Ranges Background: 48 counts to 109 counts using ± 2 Sigma Count Time (min): 2
Source: 37,958 counts to 39,452 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	39,269	85	SAT	SAT	SAT	Sat	N / A	PW	
11/5/13	387316	77	✓	✓	✓	✓	✓	P.W.	
11/6/13	38652	85	✓	✓	✓	✓	✓	P.W.	
11/7/13	38559	91	✓	✓	✓	✓	✓	P.W.	
11/8/13	38571	74	✓	✓	✓	✓	✓	P.W.	
11/11/13	38442	83	✓	✓	✓	✓	✓	P.W.	
11/12/13	38478	92	✓	✓	✓	✓	✓	P.W.	
11/13/13	38474	80	✓	✓	✓	✓	✓	P.W.	
11/14/13	38434	80	✓	✓	✓	✓	✓	P.W.	
11/15/13	381682	77	✓	✓	✓	✓	✓	P.W.	
11/18/13	38738	73	✓	✓	✓	✓	✓	P.W.	
11/19/13	381057	109	✓	✓	✓	✓	✓	P.W.	
11/20/13	38576	80	✓	✓	✓	✓	✓	P.W.	
11/21/13	384616	90	✓	✓	✓	✓	✓	P.W.	
11/22/13	38352	87	✓	✓	✓	✓	✓	P.W.	
11/23/13	38213	85	✓	✓	✓	✓	✓	P.W.	
11/25/13	38008	79	✓	✓	✓	✓	✓	P.W.	N A
11/26/13	37905	83	✓	✓	✓	✓	✓	P.W.	
				N	A				

Completed By: Pam Wells Date: 11/26/13
Reviewed By: Date: 12/16/13

11/26/13 SOURCE AT 2.14σ, NEXT CHECKIN AT 1.52σ FROM MEAN. ACCEPTED ML 12/16/13

Gilbane

Instrument Daily Th-230 Source Check 54,744 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 31-Oct-13 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: A7-270 Total Efficiency: 19.50%
Probe #: 43-10-1 / PR298585 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 16.94

Ranges Background: 0 counts to 4 counts using ± 2 Sigma Count Time (min): 2
Source: 84,314 counts to 86,468 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
11/4/2013	85,137	0	SAT	SAT	SAT	Sat	N / A	PW	
11/5/13	85035	0	✓	✓	✓	✓	✓	P.W.	
11/6/13	85331	0	✓	✓	✓	✓	✓	P.W.	
11/7/13	85142	0	✓	✓	✓	✓	✓	P.W.	
11/8/13	85672	0	✓	✓	✓	✓	✓	P.W.	
11/11/13	84707	0	✓	✓	✓	✓	✓	P.W.	
11/12/13	84497	0	✓	✓	✓	✓	✓	P.W.	
11/13/13	84553	0	✓	✓	✓	✓	✓	P.W.	
11/14/13	85541	0	✓	✓	✓	✓	✓	P.W.	
11/15/13	84494	0	✓	✓	✓	✓	✓	P.W.	
11/18/13	85462	0	✓	✓	✓	✓	✓	P.W.	
11/19/13	85073	0	✓	✓	✓	✓	✓	P.W.	
11/20/13	85334	0	✓	✓	✓	✓	✓	P.W.	
11/21/13	84829	0	✓	✓	✓	✓	✓	P.W.	
11/22/13	85385	0	✓	✓	✓	✓	✓	P.W.	
11/23/13	84568	0	✓	✓	✓	✓	✓	P.W.	
11/25/13	84912	0	✓	✓	✓	✓	✓	P.W.	
11/26/13	84474	0	✓	✓	✓	✓	✓	P.W.	N/A
				N/A	N/A				

Completed By: Dana Wells Date: 11/26/13
Reviewed By: [signature] Date: 12/10/13

Gilbane

Instrument Daily **Th-230** **Source Check** 54,744 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 31-Oct-13 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: A7-270 Total Efficiency: 19.50%
Probe #: 43-10-1 / PR298585 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 16.94

Ranges Background: 0 counts to 4 counts using ± 2 Sigma Count Time (min): 2
Source: 84,314 counts to 86,468 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	84335	0	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	83400	0	↓	↓	↓	↓	↓	P.W.	
12/4/13	84487	0	↓	↓	↓	↓	↓	P.W.	
12/5/13	85451	0	↓	↓	↓	↓	↓	P.W.	
12/9/13	85090	0	↓	↓	↓	↓	↓	P.W.	
12/10/13	84940	0	↓	↓	↓	↓	↓	P.W.	
12/11/13	85796	0	↓	↓	↓	↓	↓	P.W.	
12/12/13	84852	0	↓	↓	↓	↓	↓	P.W.	
12/13/13	84871	0	↓	↓	↓	↓	↓	P.W.	
12/16/13	84873	0	↓	↓	↓	↓	↓	P.W.	
12/17/13	84472	0	↓	↓	↓	↓	↓	P.W.	
12/18/13	85151	0	↓	↓	↓	↓	↓	P.W.	
12/19/13	84685	0	↓	↓	↓	↓	↓	P.W.	
12/20/13	84961	0	↓	↓	↓	↓	↓	P.W.	
12/23/13	84828	0	↓	↓	↓	↓	↓	P.W.	N/A
				N	A				

Completed By: Dana Wells Date: 1/2/14
Reviewed By: [signature] Date: 1/9/14

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 31-Oct-13 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: A7-273 Total Efficiency: 17.13%
Probe #: 43-10-1 / PR298585 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 129.31

Ranges Background: 48 counts to 109 counts using ± 2 Sigma Count Time (min): 2
Source: 37,958 counts to 39,452 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
12/2/13	38139	89	Sat	Sat	Sat	Sat	N/A	P.W.	
12/3/13	37971	78	✓	✓	✓	✓	✓	P.W.	
12/4/13	38105	67	✓	✓	✓	✓	✓	P.W.	
12/5/13	37963	88	✓	✓	✓	✓	✓	P.W.	
12/9/13	38104	83	✓	✓	✓	✓	✓	P.W.	
12/10/13	38041	61	✓	✓	✓	✓	✓	P.W.	
12/11/13	37988	94	✓	✓	✓	✓	✓	P.W.	
12/12/13	38130	80	✓	✓	✓	✓	✓	P.W.	
12/13/13	38158	85	✓	✓	✓	✓	✓	P.W.	
12/16/13	37995	82	✓	✓	✓	✓	✓	P.W.	
12/17/13	38020	101	✓	✓	✓	✓	✓	P.W.	
12/18/13	38057	74	✓	✓	✓	✓	✓	P.W.	
12/19/13	38050	606	✓	✓	✓	✓	✓	PW	
12/20/13	37989	76	✓	✓	✓	✓	✓	PW	
12/23/13	38170	80	✓	✓	✓	✓	✓	PW	
				N/A		N/A			N/A

Completed By: [signature] Date: 1/14/14
Reviewed By: [signature] Date: 1/14/14

Gilbane

SCALER INITIAL SETUP SHEET — **Alpha** — *{Blue cells for input}*

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006			**Setup Date:**	02-Jan-14
Instrument / SN:	2929 / 265724	**Cal. Due:**	24-Aug-14	**Source Cert. Date:**	01-Sep-02
Probe Type / SN:	43-10-1 / PR298585	**Cal. Due:**	24-Aug-14	**Source SN:**	A7-270
Technician:	P. Wells			**Surface Emission Rate:**	54,750 particles/min
Location:	Trailer			**Source Type:**	Th-230
				HV Check/Setting:	500

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.4	0.2
2	0	-0.4	0.2
3	0	-0.4	0.2
4	0	-0.4	0.2
5	1	0.6	0.4
6	0	-0.4	0.2
7	0	-0.4	0.2
8	0	-0.4	0.2
9	1	0.6	0.4
10	2	1.6	2.6
11	0	-0.4	0.2
12	0	-0.4	0.2
13	0	-0.4	0.2
14	0	-0.4	0.2
15	1	0.6	0.4
16	1	0.6	0.4
17	1	0.6	0.4
18	0	-0.4	0.2
19	0	-0.4	0.2
20	1	0.6	0.4
		0.0	

Background Count Time: 2 minutes
Source/Sample Count Time: 2 minutes

Average Counts = 0.4 counts
Average Count Rate = 0.2 cpm
Standard Deviation = 0.6 counts
Sum of Squares = 7
Area Correction Factor (ACF) = 1.00 $100cm^2$
Scan Observation Interval (i) = N/A seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	84,743	-48	2,338
2	85,022	231	53,199
3	84,902	111	12,243
4	85,407	616	379,025
5	84,543	-248	61,678
6	84,882	91	8,217
7	84,824	33	1,066
8	85,268	477	227,195
9	84,358	-433	187,792
10	84,271	-520	270,764
11	84,741	-50	2,535
12	85,277	486	235,856
13	84,556	-235	55,390
14	84,197	-594	353,252
15	85,025	234	54,592
16	84,843	52	2,668
17	84,188	-603	364,031
18	85,104	313	97,750
19	84,423	-368	135,682
20	85,253	462	213,121
		0.0	

Average Counts = 84,791 counts
Average Count Rate = 42,396 cpm
Standard Deviation = 378 counts
Sum of the Squares = 2,718,395
Chi-Squared Statistic = 32.06

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) = 0.774 cpm/dpm
Surface Efficiency (E_s) = 0.250 cpm/dpm
Total Efficiency (E_T) = 0.194 cpm/dpm

Net source cts = 84,791 counts
Std. Dev. Net = 378 counts
Net Ct. Rate = 42,395 cpm

MDCR = ~~#VALUE!~~ N/A cpm (@ 95% confidence level)

MDA Scan= ~~#VALUE!~~ ~~dpm/100 cm²~~ N/A
MDA Static= 15 dpm/100 cm^2

Bkg count range 0 to 3 (2 sigma)
Source count range 83,278 to 86,304 (2 sigma)

Technical Reviewer — Date 1/19/14

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	A7-270		
Initial Activity (Act_0) (dpm)	54,750		
Ref. Date	1-Sep-02		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	2-Jan-14	4141.00 days (t)	

Corrected Surface Emission Rate = 54,744 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = #VALUE! counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

Technical Reviewer 1/19/14 Date

Gilbane

SCALER INITIAL SETUP SHEET

Beta

{Blue cells for input}

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2929 / 265724	**Cal. Due:**	24-Aug-14
Probe Type / SN:	43-10-1 / PR298585	**Cal. Due:**	24-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	02-Jan-14	
Source Cert. Date:	01-Sep-02	
Source SN:	A7-273	
Surface Emission Rate:	56,390	particles/min
Source Type:	Tc-99	
HV Check/Setting:	500	

1. Total Background Counts observed:

Chi-squared Calculations

1	89	6.2	37.8
2	67	-15.9	251.2
3	79	-3.8	14.8
4	84	1.2	1.3
5	85	2.2	4.6
6	75	-7.8	61.6
7	78	-4.8	23.5
8	84	1.2	1.3
9	70	-12.9	165.1
10	83	0.2	0.0
11	84	1.2	1.3
12	79	-3.8	14.8
13	94	11.2	124.3
14	78	-4.8	23.5
15	95	12.2	147.6
16	85	2.2	4.6
17	84	1.2	1.3
18	85	2.2	4.6
19	90	7.2	51.1
20	89	6.2	37.8
		0.0	

Background Count Time:	2	minutes
Source/Sample Count Time:	2	minutes
Average Counts =	82.9	counts
Average Count Rate =	41.4	cpm
Standard Deviation =	7.2	counts
Sum of Squares =	973	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	N/A	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	36,595	169	28,595
2	36,119	-307	94,188
3	36,553	127	16,154
4	36,119	-307	94,188
5	36,596	170	28,934
6	36,085	-341	116,213
7	36,585	159	25,313
8	36,257	-169	28,527
9	36,714	288	83,002
10	36,199	-227	51,484
11	36,348	-78	6,068
12	36,355	-71	5,027
13	36,671	245	60,074
14	36,748	322	103,748
15	36,636	210	44,142
16	36,099	-327	106,864
17	36,360	-66	4,343
18	36,820	394	155,315
19	36,530	104	10,837
20	36,129	-297	88,150
		0.0	

Average Counts =	36,426	counts
Average Count Rate =	18,213	cpm
Standard Deviation =	246	counts
Sum of the Squares =	1,151,164	
Chi-Squared Statistic =	31.60	

Acceptable Ranges for Chi-x^2
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Instrument Efficiency (E_I) =	0.322	cpm/dpm
Surface Efficiency (E_s) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.161	cpm/dpm

Net source cts =	36,343	counts
Std. Dev. Net =	246	counts
Net Ct. Rate =	18,172	cpm

MDCR = N/A cpm (@ 95% confidence level)

MDA Scan=	~~N/A~~ N/A M	dpm/100 cm^2
MDA Static=	141	dpm/100 cm^2

Bkg count range	54	to	111	(2 sigma)
Source count range	35,441	to	37,410	(2 sigma)

Technical Reviewer — Date: 1/19/14

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	$Activity(Act)_f = Act_o \times e^{-((.693/t)T)}$
ID #	A7-273		
Initial Activity (Act_0) (dpm)	56,390		
Ref. Date	1-Sep-02		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	2-Jan-14	4141.00 days (t)	

Corrected Surface Emission Rate = 56,388 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2=\Sigma(X_i-\mu)^2/\sigma$

s_i = #VALUE! counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) Scan MDC = MDCR/(SQRT(p) x E_T x ACF)

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review:

1/19/14

Technical Reviewer Date

Gilbane

Instrument Daily Th-230 Source Check 54,744 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 2-Jan-14 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: A7-270 Total Efficiency: 19.36%
Probe #: 43-10-1 / PR298585 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 15.35

Ranges Background: 0 counts to 3 counts using ± 2 Sigma Count Time (min): 2
Source: 83,278 counts to 86,304 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/2/2014	84,953	0	Sat	Sat	Sat	Sat	N / A	P.W.	
1/11/2014	84819	0	↓	↓	↓	↓	↓	PW	
					U	A			U A

Completed By: Pam Wells Date: 1/21/14
Reviewed By: Date: 7 Feb 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 56,388 Corrected Activity (in dpm)

Instrument #:	2929 / 265724	Setup Date:	2-Jan-14	High Voltage:	500
Cal. Date:	August 24, 2014	Source ID:	A7-273	Total Efficiency:	16.11%
Probe #:	43-10-1 / PR298585	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	140.73

Ranges Background: 54 counts to 111 counts using ± 2 Sigma Count Time (min): 2

Source: 35,441 counts to 37,410 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/2/2014	36,429	84	Sat	Sat	Sat	Sat	N / A	P.W.	
1/11/2014	36,583	92	↓	↓	↓	↓	↓	P.W.	
						N/A			N/A

Completed By: Pam Wells Date: 1/21/14

Reviewed By: Date: 7 Feb 2014

Gilbane

SCALER INITIAL SETUP SHEET

Alpha

(Blue cells for input)

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2929 / 265724	Cal. Due:	24-Aug-14
Probe Type / SN:	43-10-1 / PR298585	Cal. Due:	24-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	21-Jan-14	
Source Cert. Date:	15-Sep-13	
Source SN:	K7-324	
Surface Emission Rate:	23,790	particles/min
Source Type:	Th-230	
HV Check/Setting:	500	

1. Total Background Counts observed:

Chi-squared Calculations

1	0	-0.4	0.2
2	0	-0.4	0.2
3	1	0.6	0.4
4	0	-0.4	0.2
5	0	-0.4	0.2
6	0	-0.4	0.2
7	1	0.6	0.4
8	1	0.6	0.4
9	1	0.6	0.4
10	0	-0.4	0.2
11	1	0.6	0.4
12	0	-0.4	0.2
13	1	0.6	0.4
14	1	0.6	0.4
15	0	-0.4	0.2
16	0	-0.4	0.2
17	0	-0.4	0.2
18	0	-0.4	0.2
19	1	0.6	0.4
20	0	-0.4	0.2
		0.0	

Background Count Time:	2	minutes
Source/Sample Count Time:	2	minutes
Average Counts =	0.4	counts
Average Count Rate =	0.2	cpm
Standard Deviation =	0.5	counts
Sum of Squares =	5	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	N/A	seconds

2. Total Source Counts observed:

Chi-squared Calculations

1	37,934	-16	246
2	38,139	189	35,834
3	37,960	10	106
4	38,133	183	33,599
5	37,655	-295	86,848
6	38,232	282	79,693
7	38,168	218	47,655
8	38,135	185	34,336
9	38,134	184	33,966
10	37,816	-134	17,876
11	37,503	-447	199,541
12	38,028	78	6,131
13	38,473	523	273,843
14	37,786	-164	26,798
15	37,834	-116	13,386
16	37,605	-345	118,818
17	38,078	128	16,461
18	37,977	27	745
19	37,492	-458	209,489
20	37,912	-38	1,421
		0.0	

Average Counts =	37,950	counts
Average Count Rate =	18,975	cpm
Standard Deviation =	255	counts
Sum of the Squares =	1,236,794	
Chi-Squared Statistic =	32.59	

Acceptable Ranges for Chi-x²
8.91 to 32.85
(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Net source cts =	37,949	counts
Std. Dev. Net =	255	counts
Net Ct. Rate =	18,975	cpm

Instrument Efficiency (E_I) =	0.798	cpm/dpm
Surface Efficiency (E_S) =	0.250	cpm/dpm
Total Efficiency (E_T) =	0.199	cpm/dpm

MDCR = #VALUE! cpm (@ 95% confidence level)

MDA Scan=	#VALUE!	dpm/100 cm^2
MDA Static=	15	dpm/100 cm^2

Bkg count range	0	to	2	(2 sigma)
Source count range	36,929	to	38,970	(2 sigma)

Technical Reviewer

Digitally signed by Jerry Cooper, CHP
DN: cn=Jerry Cooper, CHP, o, ou, email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:44:30 -08'00'

Date

Source Activity Correction Worksheet

Isotope	Th-230	Equation:	$Activity(Act)_t = Act_0 \times e^{-((.693/t)T)}$
ID #	K7-324		
Initial Activity (Act_0) (dpm)	23,790		
Ref. Date	15-Sep-13		
Half-life (years)	7.54E+04	2.75E+07 days (Half-life)	
Current Date	21-Jan-14	128.00 days (t)	

Corrected Surface Emission Rate = 23,790 particles/min

Equations

Chi (χ)-squared Calculations $\chi^2 = \frac{\Sigma(X_i - \mu)^2}{\sigma}$

s_i = #VALUE! counts

x = count

μ = mean

σ = standard deviation

Minimum Detectable Count Rate (MDCR) $MDCR = s_i \times 60/i$ $s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) $Scan\ MDC = MDCR/(SQRT(p) \times E_T \times ACF)$

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval i

s_i = minimum detectable number of net source counts in scan observation interval i

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review: Digitally signed by Jerry Cooper, CHP
DN: cn=Jerry Cooper, CHP, o, ou, email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:44:54 -08'00'

Technical Reviewer Date

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOURCE

Radionuclide:	Th-230	**Customer:**	RES, LLC
Half-life:	(7.54 ± 0.03)E+04 years	**P.O. No.:**	10557
Catalog No.:	EAB-230-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-324	**Contained Radioactivity:**	21.22 **nCi** 785.1 **Bq**

Physical Description:

A.	Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B.	Nature of active deposit:	Electrodeposited and diffusion bonded oxide
C.	Active diameter/volume:	41 mm
D.	Backing:	Stainless steel
E.	Cover:	None

CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A.	Type A (random) uncertainty:	± 0.4 %
B.	Type B (systematic) uncertainty:	± 3.0 %
C.	Uncertainty in aliquot weighing:	± 0.0 %
D.	Total uncertainty at the 99% confidence level:	± 3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 23790 α/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Gilbane

SCALER INITIAL SETUP SHEET

Beta

{Blue cells for input}

Project Name / No:	Rad Scoping Surveys, Treasure Island / 07204.0006		
Instrument / SN:	2929 / 265724	Cal. Due:	24-Aug-14
Probe Type / SN:	43-10-1 / PR298585	Cal. Due:	24-Aug-14
Technician:	P. Wells		
Location:	Trailer		

Setup Date:	21-Jan-14	
Source Cert. Date:	15-Sep-13	
Source SN:	K7-322	
Surface Emission Rate:	28,170	particles/min
Source Type:	Tc-99	
HV Check/Setting:	500	

1. Total Background Counts observed:

		Chi-squared Calculations	
1	66	-16.6	273.9
2	75	-7.6	57.0
3	74	-8.6	73.1
4	74	-8.6	73.1
5	96	13.5	180.9
6	88	5.5	29.7
7	86	3.5	11.9
8	83	0.5	0.2
9	98	15.5	238.7
10	102	19.5	378.3
11	78	-4.6	20.7
12	83	0.5	0.2
13	74	-8.6	73.1
14	84	1.5	2.1
15	81	-1.6	2.4
16	80	-2.6	6.5
17	79	-3.6	12.6
18	88	5.5	29.7
19	73	-9.6	91.2
20	89	6.5	41.6
		0.0	

Background Count Time:	2	minutes
Source/Sample Count Time:	2	minutes
Average Counts =	82.6	counts
Average Count Rate =	41.3	cpm
Standard Deviation =	9.2	counts
Sum of Squares =	1,597	
Area Correction Factor (ACF) =	1.00	$100cm^2$
Scan Observation Interval (i) =	N/A	seconds

2. Total Source Counts observed:

		Chi-squared Calculations	
1	25,502	147	21,683
2	25,411	56	3,164
3	25,691	336	113,064
4	25,352	-3	8
5	25,447	92	8,510
6	24,998	-357	127,271
7	25,394	39	1,541
8	25,526	171	29,327
9	25,342	-13	163
10	25,201	-154	23,639
11	24,889	-466	216,923
12	25,251	-104	10,764
13	25,269	-86	7,353
14	25,182	-173	29,843
15	25,330	-25	613
16	25,683	328	107,748
17	25,292	-63	3,938
18	25,347	-8	60
19	25,583	228	52,098
20	25,405	50	2,525
		0.0	

Average Counts =	25,355	counts
Average Count Rate =	12,677	cpm
Standard Deviation =	200	counts
Sum of the Squares =	760,232	
Chi-Squared Statistic =	29.98	

Acceptable Ranges for Chi-x^2: 8.91 to 32.85

(assumes n-1 degrees of freedom; two-tailed distribution @ 95% confidence level)

Net source cts =	25,272	counts
Std. Dev. Net =	200	counts
Net Ct. Rate =	12,636	cpm

Instrument Efficiency (E_I) =	0.449	cpm/dpm
Surface Efficiency (E_S) =	0.500	cpm/dpm
Total Efficiency (E_T) =	0.224	cpm/dpm

MDCR = N/A cpm (@ 95% confidence level)

MDA Scan=	N / A	dpm/100 cm^2
MDA Static=	101	dpm/100 cm^2

Bkg count range	46	to	119	(2 sigma)
Source count range	24,555	to	26,155	(2 sigma)

Technical Reviewer

Digitally signed by Jerry Cooper, CHP
DN: cn=Jerry Cooper, CHP, o, ou, email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:42:51 -08'00'

Date

Source Activity Correction Worksheet

Isotope	Tc-99	Equation:	Activity(Act)$_t$ = Act$_0$ x e-((.693/t)T)
ID #	K7-322		
Initial Activity (Act$_0$) (dpm)	28,170		
Ref. Date	15-Sep-13		
Half-life (years)	2.13E+05	7.77E+07 days (Half-life)	
Current Date	21-Jan-14	128.00 days (t)	

Corrected Surface Emission Rate = 28,170 particles/min

Equations

Chi (χ)-squared Calculations $\frac{\chi^2=\Sigma(X_i-\mu)^2}{\sigma}$

s_i = #VALUE! counts

x = count

μ = mean

σ =standard deviation

Minimum Detectable Count Rate (MDCR) MDCR = s_i x 60/*i*

$s_i = d' \times SQRT(b_i)$

Scan Minimum Detectable Concentration (Scan MDC) Scan MDC = MDCR/(SQRT(p) x E_T x ACF)

Static MDC

$$MDC = \frac{3 + 3.29(R_b t_s[1 + t_s/t_b])^{1/2}}{(t_s)(E)(A)}$$

d' = 1.38 (source: MARSSIM Table 6.5, pg. 6-40; assumes correct decision rate of 95%)

i = scan observation interval (sec)

b_i = number of background counts in scan observation interval *i*

s_i = minimum detectable number of net source counts in scan observation interval *i*

p = surveyor efficiency (source: MARSSIM Section 6.7.2.1, pg. 6-42)

Review: Digitally signed by Jerry Cooper, CHP
DN: cn=Jerry Cooper, CHP, o, ou, email=jerryccooper@comcast.net, c=US
Date: 2014.02.07 09:43:15 -08'00'

Technical Reviewer Date

Eckert & Ziegler
Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
BETA STANDARD SOURCE

Radionuclide:	Tc-99	**Customer:**	RES, LLC
Half-life:	(2.13 ± 0.05)E+05 years	**P.O. No.:**	10557
Catalog No.:	EAB-099-47LB	**Reference Date:**	15-Sep-13 12:00 PST
Source No.:	K7-322	**Contained Radioactivity:**	23.07 **nCi** 853.6 **Bq**

Physical Description:

A.	Capsule type:	Disk (47 mm OD x 0.76 mm THK)
B.	Nature of active deposit:	Electrodeposited and diffusion bonded Technetium metal
C.	Active diameter/volume:	41 mm
D.	Backing:	Stainless steel
E.	Cover:	None

**CAUTION!
DELICATE SURFACE
DO NOT WIPE
ACTIVE AREA**

Radioimpurities:

None detected

Method of Calibration:

This source was assayed using a windowless internal gas flow proportional counter.

Uncertainty of Measurement:

A.	Type A (random) uncertainty:	±	0.5 %
B.	Type B (systematic) uncertainty:	±	3.0 %
C.	Uncertainty in aliquot weighing:	±	0.0 %
D.	Total uncertainty at the 99% confidence level:	±	3.0 %

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP 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 "Table of Radioactive Isotopes", edited by Virginia Shirley, 1986.
- This source has a working life of 2 years.
- This source had a surface emission rate of 28170 β/min in 2π on 28-Aug-13.

Daniel James Van Dalsem
Quality Control

29-Aug-13
Date

EZIP Ref. No.: 1684-91

Gilbane

Instrument Daily Th-230 Source Check 23,790 Corrected Activity (in dpm)

Instrument #:	2929 / 265724	Setup Date:	21-Jan-14	High Voltage:	500
Cal. Date:	August 24, 2014	Source ID:	K7-324	Total Efficiency:	19.94%
Probe #:	43-10-1 / PR298585	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	14.90

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 2
Source: 36,929 counts to 38,970 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/21/2014	37,784	0	Sat	Sat	Sat	Sat	N / A	P.W.	
1/29/2014	37582	0	√	√	√	√	√	P.W.	
						N / A			N / A

Completed By: Pam Wells Date: 2/21/14
Reviewed By: Jay Compere Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #:	2929 / 265724	Setup Date:	21-Jan-14	High Voltage:	500
Cal. Date:	August 24, 2014	Source ID:	K7-322	Total Efficiency:	22.43%
Probe #:	43-10-1 / PR298585	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	100.93

Ranges Background: 46 counts to 119 counts using ± 2 Sigma Count Time (min): 2

Source: 24,555 counts to 26,155 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
1/21/2014	25,391	81	Sat	Sat	Sat	Sat/	N / A	P.W.	
1/29/2014	25724	77	√	√	√	√	√	P.W.	
						N/A			N/A

Completed By: Pam Wells Date: 2/21/14

Reviewed By: Jay Cooper Date: 24 Mar 2014

Gilbane

Instrument Daily **Th-230** **Source Check** 23,790 Corrected Activity (in dpm)

Instrument #:	2929 / 265724	Setup Date:	21-Jan-14	High Voltage:	500
Cal. Date:	August 24, 2014	Source ID:	K7-324	Total Efficiency:	19.94%
Probe #:	43-10-1 / PR298585	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	14.90

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 2

Source: 36,929 counts to 38,970 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	37,958	0	Sat	Sat	Sat	Sat	N / A	P.W.	
2/19/2014	38,379	0	√	√	√	Sat	√	P.W.	
2/20/2014	37846	0	√	√	√	√	√	PW	
2/21/2014	38057	0	√	√	√	√	√	P.W.	
						N / A			N / A

Completed By: Pam Wells

Reviewed By: Jim Cooper

Date: 3/24/14

Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #:	2929 / 265724	Setup Date:	21-Jan-14	High Voltage:	500
Cal. Date:	August 24, 2014	Source ID:	K7-322	Total Efficiency:	22.43%
Probe #:	43-10-1 / PR298585	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	100.93

Ranges Background: 46 counts to 119 counts using ± 2 Sigma Count Time (min): 2

Source: 24,555 counts to 26,155 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
2/18/2014	25,710	76	Sat	Sat	Sat	Sat/	N / A	P.W.	
2/19/2014	25,674	76	√	√	√	√	√	P.W.	
2/20/2014	25811	75	√	√	√	√	√	P.W.	
2/21/2014	26063	82	√	√	√	√	√	P.W.	
						N/A			N/A

Completed By: Pam Wells Date: 3/24/14

Reviewed By: Jim Cooper Date: 24 Mar 2014

Gilbane

Instrument Daily **Tc-99** **Source Check** 28,170 Corrected Activity (in dpm)

Instrument #:	2929 / 265724	Setup Date:	21-Jan-14	High Voltage:	500
Cal. Date:	August 24, 2014	Source ID:	K7-322	Total Efficiency:	22.43%
Probe #:	43-10-1 / PR298585	Project/#:	Rad Scoping Surveys, Treasure Island / 07204.0006	MDA (in dpm):	100.93

Ranges Background: 46 counts to 119 counts using ± 2 Sigma Count Time (min): 2

Source: 24,555 counts to 26,155 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	25,516	82	Sat	Sat	Sat	Sat/	N / A	P.W.	
3/25/2014	25569	93	√	√	√	√	√	P.W.	
3/26/2014	25740	96	√	√	√	√	√	P.W.	
3/27/2014	25759	78	√	√	√	√	√	P.W.	
3/31/2014	25443	96	√	√	√	√	√	P.W.	
						N	A		N A

Completed By: Pam Wells Date: 4/1/2014

Reviewed By: Date: 4/2/14

Gilbane

Instrument Daily Th-230 Source Check 23,790 Corrected Activity (in dpm)

Instrument #: 2929 / 265724 Setup Date: 21-Jan-14 High Voltage: 500
Cal. Date: August 24, 2014 Source ID: K7-324 Total Efficiency: 19.94%
Probe #: 43-10-1 / PR298585 Project/#: Rad Scoping Surveys, Treasure Island / 07204.0006 MDA (in dpm): 14.90

Ranges Background: 0 counts to 2 counts using ± 2 Sigma Count Time (min): 2
Source: 36,929 counts to 38,970 counts using ± 2 Sigma

Date	Source Counts	Background Counts	HV	BAT	SPKR	Sat/ Unsat	Pre and Post checks	Technician Initials	Additional Comments
3/24/2014	38,030	0	Sat	Sat	Sat	Sat	N / A	P.W.	
3/25/2014	37875	0	✓	✓	✓	✓	✓	P.W.	
3/26/2014	37918	0	✓	✓	✓	✓	✓	P.W.	
3/27/2014	37815	0	✓	✓	✓	✓	✓	P.W.	
3/31/2014	37905	0	✓	✓	✓	✓	✓	P.W.	

N A

N A

Completed By: Pam Wells Date: 4/1/2014
Reviewed By: [signature] Date: 4/2/14

APPENDIX C

Building 233 Sewer Drain Survey Data

Gilbane

RADIOLOGICAL SURVEY FORM

CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	ITSI GILBANE PROJECT NO:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

Survey No.: 06-03-169	Date: 23 Apr 2014	Location: Transport Routes	Survey Type: Scoping

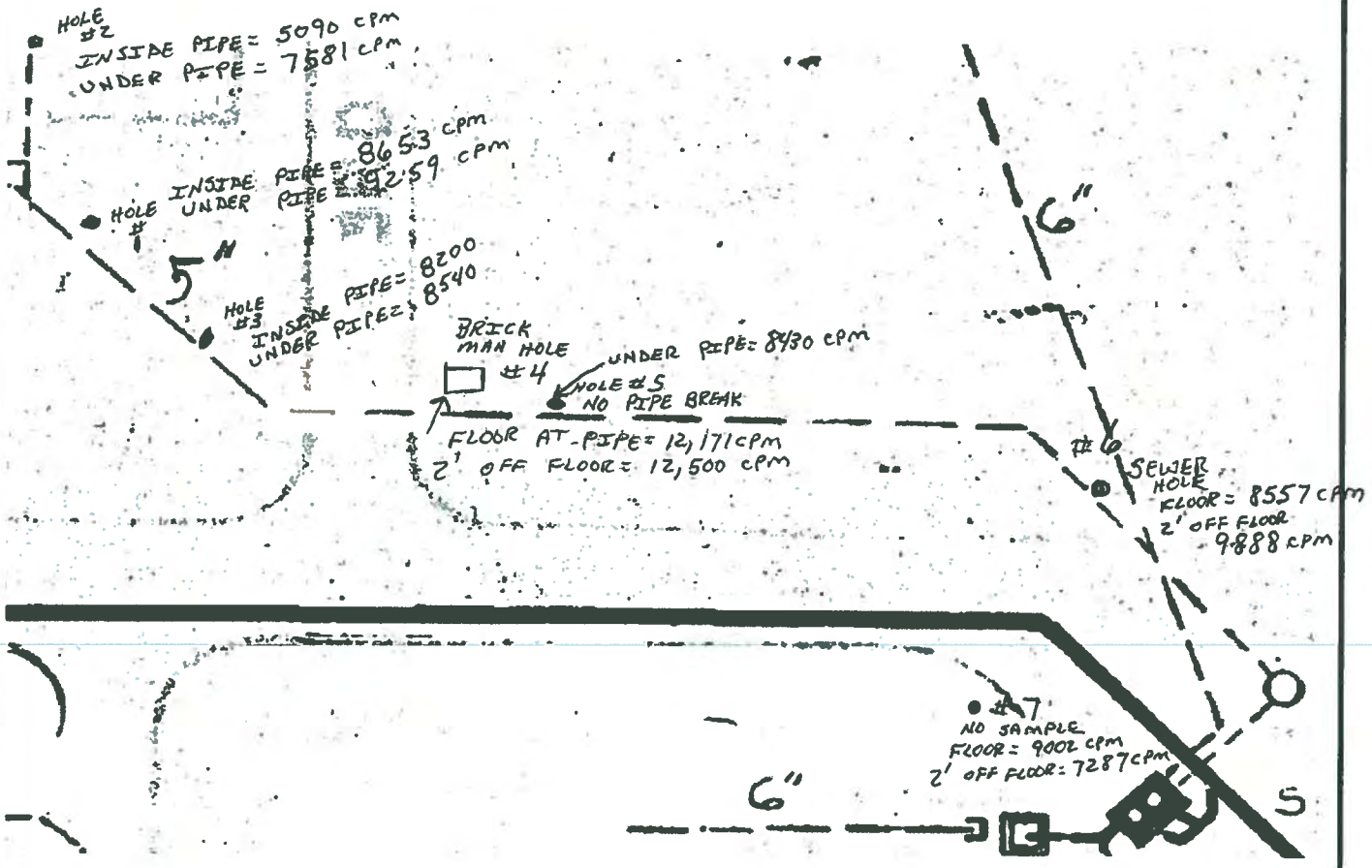
James Wells	James Wells	Jerry Cooper	Digitally signed by Jerry Cooper, CHP DN: cn=Jerry Cooper, CHP, o, ou, email=jerrycooper@comcast.net, c=US Date: 2014.05.01 21:09:29 -07'00'
Tech Printed Name	Signature	RSOR Printed Name	

Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µR/hr	Eff. α	Eff. β
2350-1	228708	4-15-15	44-2	PR273814	4-15-15	N/A	N/A	953	N/A	N/A	N/A
2360	278618	8-29-14	43-93	PR311163	8-29-14	0	127	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A	4-23-14	N/A	N/A	N/A	N/A	N/A	N/A

Survey Description / Map /Photo

Utility Line Downstream of Bldg 233



Survey Coverage:	Survey Measurements:	Scan Coverage	
☒ Floors/Ground	☐ Scans	Biased Static	●
☐ Walls/Overhead	☒ Statics (1 min)	Random Static	☐ (w/# inside)

NORTH

Comments: readings in gross cpm; BKG value is daily instrument check 1-min count

PULLED LAS FROM PIPE AT BREAKS ALL < BKG.

APPENDIX D

Volumetric Sample Analytical Results

TestAmerica

THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

TestAmerica Laboratories, Inc.
TestAmerica St. Louis
13715 Rider Trail North
Earth City, MO 63045
Tel: (314)298-8566

TestAmerica Job ID: 160-6528-1
Client Project/Site: Treasure Island

For:
Gilbane Federal
2730 Shadelands Drive Suite 100
Walnut Creek, California 94598

Attn: Ms. Kristen Carlyon

Authorized for release by:
6/16/2014 2:59:41 PM

Erika Gish, Project Manager II
(314)298-8566
erika.gish@testamericainc.com

LINKS

Review your project results through TotalAccess

Have a Question? Ask The Expert

Visit us at: www.testamericainc.com

This report has been electronically signed and authorized by the signatory. Electronic signature is intended to be the legally binding equivalent of a traditionally handwritten signature.

Results relate only to the items tested and the sample(s) as received by the laboratory.

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QC Association Summary 22
Tracer Carrier Summary 24

Job ID: 160-6528-1

Laboratory: TestAmerica St. Louis

Narrative

CASE NARRATIVE

Client: Gilbane Federal

Project: Treasure Island

Report Number: 160-6528-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

TestAmerica St. Louis attests to the validity of the laboratory data generated by TestAmerica facilities reported herein. All analyses performed by TestAmerica facilities were done using established laboratory SOPs that incorporate QA/QC procedures described in the application methods. TestAmerica's operations groups have reviewed the data for compliance with the laboratory QA/QC plan, and data have been found to be compliant with laboratory protocols unless otherwise noted below.

The test results in this report meet all NELAP requirements for parameters for which accreditation is required or available. Any exceptions to NELAP requirements are noted in this report. Pursuant to NELAP, this report may not be reproduced, except in full, without the written approval of the laboratory.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

All solid sample results for Chemistry analyses are reported on an "as received" basis unless otherwise indicated by the presence of a % solids value in the method header. All soil/sediment sample results for radiochemistry analyses are based upon sample as dried and disaggregated with the exception of tritium, carbon-14, and iodine-129 by gamma spectroscopy unless requested as wet weight by the client."

Reference the chain of custody and condition upon receipt report for any variations on receipt conditions and temperature of samples on receipt
Manual Integrations were performed only when necessary and are in compliance with the laboratory's standard operating procedure. Detailed information can be found in the raw data section of the level IV report.

The following clean-up methods for Organic analyses may have been used on the samples in this data set. Specific methods employed are documented on the batch extraction logs:

Method 3600C: Cleanup
Method 3620C: Florisil Cleanup
Method 3630C: Silica Gel Cleanup
Method 3640A: Gel-Permeation Cleanup
Method 3650B: Acid-Base Partition Cleanup
Method 3660B: Sulfur Cleanup
Method 3665A: Sulfuric Acid/Permanganate Cleanup

This laboratory report is confidential and is intended for the sole use of TestAmerica and its client.

Job ID: 160-6528-1 (Continued)

Laboratory: TestAmerica St. Louis (Continued)

RECEIPT

The samples were received on 5/7/2014 9:25 AM; the samples arrived in good condition, properly preserved and, where required, on ice. The temperature of the cooler at receipt was 18.0º C.

RADIUM-226 BY GAMMA SPEC (21 DAY INGROWTH)

Samples B233PH001 (160-6528-1), B233PH002 (160-6528-2), B233PH003 (160-6528-3), B233PH004 (160-6528-4), B233PH005 (160-6528-5), B233PH006 (160-6528-6), B233PH007 (160-6528-7), B233PH008 (160-6528-8), B233PH009 (160-6528-9), S12S6SS001 (160-6528-10), B3SD001 (160-6528-11), S32BM001 (160-6528-12), S32BM002 (160-6528-13), S32BM003 (160-6528-14), S32BM004 (160-6528-15), S32BM005 (160-6528-16) and B3SD002 (160-6528-17) were analyzed for Radium-226 by gamma spec (21 day ingrowth) in accordance with EPA 901.1. The samples were leached on 05/08/2014, prepared on 05/12/2014 and analyzed on 06/02/2014.

The reporting limit for Cs-137 analyzed by gamma spectroscopy was not met due to insufficient sample weight available for analysis. The data is reported with the MDC achieved: S32BM003 (160-6528-14).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

ISOTOPIC THORIUM (ALPHA SPECTROMETRY)

Samples B3SD001 (160-6528-11), S32BM001 (160-6528-12), S32BM002 (160-6528-13), S32BM003 (160-6528-14), S32BM004 (160-6528-15), S32BM005 (160-6528-16) and B3SD002 (160-6528-17) were analyzed for Isotopic Thorium (Alpha Spectrometry) in accordance with DOE A01R_Th. The samples were leached on 05/08/2014, prepared on 05/12/2014 and analyzed on 05/14/2014.

Samples contain rocks and are not homogeneous. Possible matrix interference. (160-6528-11 DU), B3SD001 (160-6528-11), B3SD002 (160-6528-17), S32BM001 (160-6528-12), S32BM002 (160-6528-13), S32BM003 (160-6528-14), S32BM004 (160-6528-15), S32BM005 (160-6528-16)

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

010534

ITSI Gilbane

2730 Shadelands Drive
Walnut Creek, California 94598
(925) 946-3100 (925) 256-8998 (fax)

Local Address: Treasure Island SF, CA

Chain-Of-Custody

Project Name and Number: Rad Scoping Survey, TI
Project Manager: John Baur
Site Location: Storm Water Waste Lines

Laboratory Name: Test America
Address: 13715 Rider Trail Contact Name: Erika Gish
Earth City, MO 63045 Phone: 314-287-8276

Date: 5/6/14
Page: 1 of 2

Sample I.D.	Date	Time	Sample Depth	No. of Containers	Sample Matrix	Analysis: 901.1 M Gamma A-01-R ISO-TH	Special Instructions/Comments
						Preservative: NA NA	
						Container Type: ZipLock	
B233 PH001	4/24/14	1000	4'	1	S	X	
B233 PH002		1005	4'	1	S	X	
B233 PH003		1430	3'	1	S	X	
B233 PH004		1435	3'	1	S	X	
B233 PH005		1540	4.5'	1	S	X	
B233 PH006		1545	4.5'	1	S	X	
B233 PH007		1600	5.0'	1	S	X	
B233 PH008	4/28/14	0930	5.2'	1	S	X	
B233 PH009	4/28/14	1305	8'	1	S	X	
~~B233 PH010 TR~~	~~4/28/14~~	~~1130~~	~~7'~~	~~1~~	~~S~~	~~X~~	~~TR~~

160-6528 Chain of Custody

Sampled By: T. Roha
Signature: Teresa Roha
Special Instructions:

Send Results to: Jbaure@gilbaneco.com
(w/fax #) Kcarlyon@gilbaneco.com
Turnaround Time: Standard

Sampler: TR

Courier/Airbill No.: 803407693515

Relinquished By/Affiliation:	Date:	Time:	Received By/Affiliation:	Date:	Time:
Teresa Roha	5/6/14	0600		5/7/14	0925

Original – Laboratory Yellow – Field/Office

Graphics/Stationery/chain_custody0513.ai

Page 5 of 24

6/16/2014

010533

ITSI Gilbane

2730 Shadelands Drive
Walnut Creek, California 94598
(925) 946-3100 (925) 256-8998 (fax)

Local Address: Treasure Island

Chain-Of-Custody

Project Name and Number: Rad Scoping Survey Treasure Isl. Laboratory Name: Test America Date: 5/6/14
Project Manager: John Baur Address: 13715 Rider Trail Contact Name: Erika Gish Page: 2 of 2
Site Location: Building 3 Stormwaste lines EarthCity, MO 63045 Phone: 314-287-8276

Sample I.D.	Date	Time	Sample Depth	No. of Containers	Sample Matrix	Analysis: 90.1/M Gamma	Analysis: A-01-R150-TH	Special Instructions/Comments
						Preservative: NA	NA	
						Container Type: Ziplock		
S125655001	4/22/14	1500	0.1"	1	S	X		
B3SD001	4/21/14	1330	0.5'	1	S	X	X	
S32BM001	4/28/14	1510	1.0"	1	S	X	X	
S32BM002	4/28/14	1600	1.0"	1	S	X	X	
S32 Bm 003	4/11/14	1320	1.0"	1	S	X	X	
S32 Bm 004	4/11/14	1405	1.0"	1	S	X	X	
S32 Bm 005	4/11/14	1445	1.0"	1	S	X	X	
B3SD002	4/28/14	1130	7'	1	S	X	X	
S32 BM006	4/10/14	1330	1.0"	1	S	X	X	HOLD
B3SD003	4/21/14	1000	1.0'	1	S	X	X	HOLD

Sampled By: T. Ruha
Signature: Teresa Ruha
Special Instructions:

Send Results to: Jbaur@gilbaneco.com
(w/fax #) Kcarlyon@gilbaneco.com
Turnaround Time: Standard

Sampler: TR

Courier/Airbill No.: 803407693515

Relinquished By/Affiliation:	Date:	Time:	Received By/Affiliation:	Date:	Time:
Teresa Ruha	5/6/14	0700	BD 5/7/14	5/7/14	0925

Original – Laboratory Yellow – Field/Office

Graphics/Stationery/chain_custody0513.ai

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6/16/2014

Login Sample Receipt Checklist

Client: Gilbane Federal

Job Number: 160-6528-1

Login Number: 6528

List Source: TestAmerica St. Louis

List Number: 1

Creator: Daniels, Brian J

Question	Answer	Comment
Radioactivity wasn't checked or is </= background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	True	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	N/A	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	True	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time.	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is <6mm (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	

Client: Gilbane Federal
Project/Site: Treasure Island

TestAmerica Job ID: 160-6528-1

Qualifiers

Rad

Qualifier	Qualifier Description
U	Undetected at the Limit of Detection.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
¤	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

Method Summary

Client: Gilbane Federal
Project/Site: Treasure Island

TestAmerica Job ID: 160-6528-1

Method	Method Description	Protocol	Laboratory
901.1	Radium-226 & Other Gamma Emitters (GS)	EPA	TAL SL
A-01-R	Isotopic Thorium (Alpha Spectrometry)	DOE	TAL SL

Protocol References:

DOE = U.S. Department of Energy

EPA = US Environmental Protection Agency

Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Sample Summary

Client: Gilbane Federal
Project/Site: Treasure Island

TestAmerica Job ID: 160-6528-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-6528-1	B233PH001	Solid	04/24/14 10:00	05/07/14 09:25
160-6528-2	B233PH002	Solid	04/24/14 10:05	05/07/14 09:25
160-6528-3	B233PH003	Solid	04/24/14 14:30	05/07/14 09:25
160-6528-4	B233PH004	Solid	04/24/14 14:35	05/07/14 09:25
160-6528-5	B233PH005	Solid	04/24/14 15:40	05/07/14 09:25
160-6528-6	B233PH006	Solid	04/24/14 15:45	05/07/14 09:25
160-6528-7	B233PH007	Solid	04/24/14 16:00	05/07/14 09:25
160-6528-8	B233PH008	Solid	04/28/14 09:30	05/07/14 09:25
160-6528-9	B233PH009	Solid	04/28/14 13:05	05/07/14 09:25
160-6528-10	S12S6SS001	Solid	04/22/14 15:00	05/07/14 09:25
160-6528-11	B3SD001	Solid	04/21/14 13:30	05/07/14 09:25
160-6528-12	S32BM001	Solid	04/28/14 15:10	05/07/14 09:25
160-6528-13	S32BM002	Solid	04/28/14 16:00	05/07/14 09:25
160-6528-14	S32BM003	Solid	04/11/14 13:20	05/07/14 09:25
160-6528-15	S32BM004	Solid	04/11/14 14:05	05/07/14 09:25
160-6528-16	S32BM005	Solid	04/11/14 14:45	05/07/14 09:25
160-6528-17	B3SD002	Solid	04/28/14 11:30	05/07/14 09:25

Client Sample ID: B233PH001

Lab Sample ID: 160-6528-1

Date Collected: 04/24/14 10:00

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.270	U	0.280	0.282		0.466	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Bismuth-212	0.338	U	0.869	0.870		1.51	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Bismuth-214	**0.633**		0.228	0.238		0.277	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Lead-210	1.74	U	1.23	1.24		2.11	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Lead-212	**0.326**		0.128	0.135		0.208	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Lead-214	**0.575**		0.178	0.188		0.226	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Potassium-40	**11.2**		1.90	2.22		1.82	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Radium-226	**0.633**		0.228	0.238	0.700	0.277	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Thallium-208	0.0429	U	0.115	0.115		0.161	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Thorium-234	0.767	U	0.722	0.726		2.07	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Uranium-235	0.0949	U	0.427	0.427		0.595	pCi/g	05/12/14 17:47	06/02/14 12:43	1
Cesium-137	0.0213	U	0.0873	0.0873	0.0700	0.152	pCi/g	05/12/14 17:47	06/02/14 12:43	1

Client Sample ID: B233PH002

Lab Sample ID: 160-6528-2

Date Collected: 04/24/14 10:05

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.359**		0.125	0.130		0.175	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Bismuth-212	0.457	U	0.428	0.431		0.681	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Bismuth-214	**0.777**		0.121	0.146		0.0922	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Lead-210	-0.196	U	1.26	1.26		1.57	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Lead-212	**0.328**		0.0646	0.0772		0.0815	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Lead-214	**0.827**		0.111	0.141		0.0819	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Potassium-40	**11.0**		1.17	1.63		0.449	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Radium-226	**0.777**		0.121	0.146	0.700	0.0922	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Thallium-208	**0.145**		0.0401	0.0429		0.0330	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Thorium-234	0.120	U	0.139	0.140		1.49	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Uranium-235	0.0750	U	0.179	0.179		0.293	pCi/g	05/12/14 17:47	06/10/14 19:11	1
Cesium-137	-0.00244	U	0.0307	0.0307	0.0700	0.0552	pCi/g	05/12/14 17:47	06/10/14 19:11	1

Client Sample ID: B233PH003

Lab Sample ID: 160-6528-3

Date Collected: 04/24/14 14:30

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.377**		0.127	0.133		0.0831	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Bismuth-212	0.138	U	0.413	0.413		0.737	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Bismuth-214	**0.157**		0.103	0.105		0.155	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Lead-210	-0.499	U	2.67	2.67		2.48	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Lead-212	**0.356**		0.0935	0.104		0.101	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Lead-214	**0.369**		0.0999	0.107		0.118	pCi/g	05/12/14 17:47	06/02/14 12:03	1

Client Sample ID: B233PH003 — **Lab Sample ID: 160-6528-3**
Date Collected: 04/24/14 14:30 — **Matrix: Solid**
Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS) (Continued)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Potassium-40	**7.09**		1.20	1.40		0.885	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Radium-226	**0.157**		0.103	0.105	0.700	0.155	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Thallium-208	**0.0955**		0.0460	0.0471		0.0537	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Thorium-234	0.194	U	0.415	0.415		1.41	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Uranium-235	0.122	U	0.154	0.155		0.272	pCi/g	05/12/14 17:47	06/02/14 12:03	1
Cesium-137	-0.000859	U	0.0332	0.0332	0.0700	0.0626	pCi/g	05/12/14 17:47	06/02/14 12:03	1

Client Sample ID: B233PH004 — **Lab Sample ID: 160-6528-4**
Date Collected: 04/24/14 14:35 — **Matrix: Solid**
Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.569**		0.125	0.137		0.0708	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Bismuth-212	0.433	U	0.337	0.340		0.518	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Bismuth-214	**0.362**		0.0874	0.0952		0.0876	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Lead-210	-0.281	U	1.14	1.14		1.52	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Lead-212	**0.383**		0.0898	0.103		0.0954	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Lead-214	**0.386**		0.0871	0.0959		0.0969	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Potassium-40	**10.2**		0.974	1.42		0.340	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Radium-226	**0.362**		0.0874	0.0952	0.700	0.0876	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Thallium-208	**0.162**		0.0510	0.0537		0.0507	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Thorium-234	0.133	U	0.368	0.368		1.13	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Uranium-235	0.0834	U	0.153	0.153		0.261	pCi/g	05/12/14 17:47	06/09/14 11:57	1
Cesium-137	0.00458	U	0.0233	0.0233	0.0700	0.0416	pCi/g	05/12/14 17:47	06/09/14 11:57	1

Client Sample ID: B233PH005 — **Lab Sample ID: 160-6528-5**
Date Collected: 04/24/14 15:40 — **Matrix: Solid**
Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.444**		0.105	0.115		0.0881	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Bismuth-212	0.260	U	0.272	0.273		0.438	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Bismuth-214	**0.281**		0.0684	0.0743		0.0893	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Lead-210	0.660	U	0.624	0.629		1.01	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Lead-212	**0.381**		0.0557	0.0744		0.0618	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Lead-214	**0.387**		0.0749	0.0850		0.0722	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Potassium-40	**11.8**		0.972	1.55		0.421	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Radium-226	**0.281**		0.0684	0.0743	0.700	0.0893	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Thallium-208	**0.187**		0.0381	0.0428		0.0253	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Thorium-234	0.693	U	0.605	0.609		0.981	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Uranium-235	0.126	U	0.104	0.105		0.187	pCi/g	05/12/14 17:47	06/09/14 11:56	1
Cesium-137	0.00163	U	0.0205	0.0205	0.0700	0.0370	pCi/g	05/12/14 17:47	06/09/14 11:56	1

Client Sample ID: B233PH006

Lab Sample ID: 160-6528-6

Date Collected: 04/24/14 15:45

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.242	U	0.134	0.136		0.276	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Bismuth-212	0.288	U	0.555	0.556		0.951	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Bismuth-214	**0.455**		0.125	0.133		0.130	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Lead-210	1.47	U	1.36	1.37		1.86	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Lead-212	**0.329**		0.0890	0.0987		0.106	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Lead-214	**0.574**		0.150	0.161		0.135	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Potassium-40	**9.41**		1.41	1.71		0.588	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Radium-226	**0.455**		0.125	0.133	0.700	0.130	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Thallium-208	0.0782	U	0.0599	0.0604		0.0852	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Thorium-234	0.874	U	0.464	0.473		1.30	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Uranium-235	0.121	U	0.212	0.212		0.339	pCi/g	05/12/14 17:47	06/09/14 12:05	1
Cesium-137	**0.155**		0.0512	0.0537	0.0700	0.0365	pCi/g	05/12/14 17:47	06/09/14 12:05	1

Client Sample ID: B233PH007

Lab Sample ID: 160-6528-7

Date Collected: 04/24/14 16:00

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.436**		0.121	0.129		0.104	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Bismuth-212	0.222	U	0.363	0.363		0.613	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Bismuth-214	**0.378**		0.102	0.110		0.0973	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Lead-210	0.472	U	0.744	0.746		1.24	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Lead-212	**0.311**		0.0871	0.0959		0.0857	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Lead-214	**0.399**		0.0807	0.0907		0.0833	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Potassium-40	**7.40**		0.985	1.24		0.509	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Radium-226	**0.378**		0.102	0.110	0.700	0.0973	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Thallium-208	**0.116**		0.0301	0.0324		0.0144	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Thorium-234	0.198	U	0.337	0.337		1.12	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Uranium-235	0.0968	U	0.161	0.162		0.240	pCi/g	05/12/14 17:47	06/02/14 13:00	1
Cesium-137	0.0164	U	0.0302	0.0302	0.0700	0.0515	pCi/g	05/12/14 17:47	06/02/14 13:00	1

Client Sample ID: B233PH008

Lab Sample ID: 160-6528-8

Date Collected: 04/28/14 09:30

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.428**		0.153	0.160		0.243	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Bismuth-212	0.193	U	0.488	0.488		0.856	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Bismuth-214	**0.444**		0.129	0.137		0.120	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Lead-210	-0.877	U	4.07	4.07		2.26	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Lead-212	**0.368**		0.111	0.121		0.122	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Lead-214	**0.479**		0.120	0.130		0.137	pCi/g	05/12/14 17:47	06/02/14 13:01	1

Client Sample ID: B233PH008

Lab Sample ID: 160-6528-8

Date Collected: 04/28/14 09:30

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS) (Continued)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Potassium-40	**11.6**		1.48	1.90		0.562	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Radium-226	**0.444**		0.129	0.137	0.700	0.120	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Thallium-208	**0.181**		0.0545	0.0577		0.0515	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Thorium-234	0.804	U	1.07	1.08		1.58	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Uranium-235	-0.0845	U	0.205	0.206		0.350	pCi/g	05/12/14 17:47	06/02/14 13:01	1
Cesium-137	0.00931	U	0.0325	0.0325	0.0700	0.0591	pCi/g	05/12/14 17:47	06/02/14 13:01	1

Client Sample ID: B233PH009

Lab Sample ID: 160-6528-9

Date Collected: 04/28/14 13:05

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.159	U	0.0779	0.0796		0.305	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Bismuth-212	0.000	U	0.544	0.544		0.715	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Bismuth-214	**0.388**		0.113	0.120		0.107	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Lead-210	**0.795**		0.489	0.498		0.761	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Lead-212	**0.305**		0.0663	0.0771		0.0880	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Lead-214	**0.483**		0.0934	0.106		0.0901	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Potassium-40	**10.0**		1.32	1.67		0.818	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Radium-226	**0.388**		0.113	0.120	0.700	0.107	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Thallium-208	**0.156**		0.0389	0.0422		0.0229	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Thorium-234	0.358	U	0.318	0.320		0.747	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Uranium-235	0.127	U	0.137	0.137		0.208	pCi/g	05/12/14 17:47	06/02/14 13:09	1
Cesium-137	0.0523	U	0.0438	0.0441	0.0700	0.0687	pCi/g	05/12/14 17:47	06/02/14 13:09	1

Client Sample ID: S12S6SS001

Lab Sample ID: 160-6528-10

Date Collected: 04/22/14 15:00

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.229	U	0.156	0.157		0.295	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Bismuth-212	0.176	U	0.610	0.611		1.10	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Bismuth-214	**0.254**		0.134	0.136		0.170	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Lead-210	1.80	U	1.58	1.59		2.22	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Lead-212	**0.328**		0.125	0.132		0.142	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Lead-214	**0.468**		0.126	0.135		0.0803	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Potassium-40	**7.42**		1.63	1.80		1.40	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Radium-226	**0.254**		0.134	0.136	0.700	0.170	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Thallium-208	**0.136**		0.0760	0.0773		0.102	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Thorium-234	0.181	U	0.611	0.611		2.09	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Uranium-235	0.165	U	0.225	0.226		0.373	pCi/g	05/12/14 17:47	06/02/14 13:19	1
Cesium-137	**0.482**		0.0951	0.107	0.0700	0.0345	pCi/g	05/12/14 17:47	06/02/14 13:19	1

Client Sample ID: B3SD001

Lab Sample ID: 160-6528-11

Date Collected: 04/21/14 13:30

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**1.16**		0.174	0.210		0.0981	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Bismuth-212	**0.992**		0.434	0.446		0.473	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Bismuth-214	**0.701**		0.114	0.135		0.104	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Lead-210	0.783	U	0.979	0.984		1.37	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Lead-212	**0.949**		0.0818	0.148		0.0781	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Lead-214	**0.825**		0.112	0.141		0.0983	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Potassium-40	**14.7**		1.15	1.89		0.580	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Radium-226	**0.701**		0.114	0.135	0.700	0.104	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Thallium-208	**0.284**		0.0494	0.0576		0.0459	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Thorium-234	0.616	U	0.382	0.388		1.41	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Uranium-235	0.0712	U	0.187	0.187		0.303	pCi/g	05/12/14 17:47	06/09/14 12:07	1
Cesium-137	0.00988	U	0.0251	0.0252	0.0700	0.0433	pCi/g	05/12/14 17:47	06/09/14 12:07	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	**0.810**		0.179	0.191	0.200	0.0296	pCi/g	05/12/14 13:27	05/14/14 17:14	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Thorium-229	*71.0*		*30 - 110*	*05/12/14 13:27*	*05/14/14 17:14*	*1*

Client Sample ID: S32BM001

Lab Sample ID: 160-6528-12

Date Collected: 04/28/14 15:10

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.184	U	0.245	0.246		0.406	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Bismuth-212	0.433	U	0.741	0.743		1.26	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Bismuth-214	**0.576**		0.240	0.247		0.269	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Lead-210	**3.26**		1.47	1.52		2.09	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Lead-212	**0.184**		0.130	0.132		0.183	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Lead-214	**0.571**		0.188	0.197		0.206	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Potassium-40	**5.99**		1.40	1.53		1.68	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Radium-226	**0.576**		0.240	0.247	0.700	0.269	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Thallium-208	0.00758	U	0.0740	0.0740		0.146	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Thorium-234	1.71	U	1.50	1.51		2.05	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Uranium-235	0.250	U	0.358	0.359		0.609	pCi/g	05/12/14 17:47	06/02/14 14:56	1
Cesium-137	**0.361**		0.114	0.120	0.0700	0.112	pCi/g	05/12/14 17:47	06/02/14 14:56	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	**0.230**		0.0913	0.0933	0.200	0.0541	pCi/g	05/12/14 13:27	05/14/14 17:14	1

Client Sample ID: S32BM001

Lab Sample ID: 160-6528-12

Date Collected: 04/28/14 15:10

Matrix: Solid

Date Received: 05/07/14 09:25

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	77.0		30 - 110	05/12/14 13:27	05/14/14 17:14	1

Client Sample ID: S32BM002

Lab Sample ID: 160-6528-13

Date Collected: 04/28/14 16:00

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.238	U	0.209	0.211		0.384	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Bismuth-212	0.230	U	0.729	0.730		1.29	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Bismuth-214	**0.325**		0.166	0.169		0.266	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Lead-210	**1.64**		1.06	1.08		1.63	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Lead-212	0.119	U	0.103	0.104		0.182	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Lead-214	**0.751**		0.187	0.203		0.169	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Potassium-40	**6.51**		1.49	1.64		1.63	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Radium-226	**0.325**		0.166	0.169	0.700	0.266	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Thallium-208	**0.188**		0.0896	0.0917		0.0873	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Thorium-234	0.616	U	0.651	0.654		1.53	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Uranium-235	0.223	U	0.282	0.283		0.464	pCi/g	05/12/14 17:47	06/02/14 14:55	1
Cesium-137	**0.117**		0.0767	0.0777	0.0700	0.114	pCi/g	05/12/14 17:47	06/02/14 14:55	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	**0.146**		0.0721	0.0732	0.200	0.0422	pCi/g	05/12/14 13:27	05/14/14 17:14	1

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	82.1		30 - 110	05/12/14 13:27	05/14/14 17:14	1

Client Sample ID: S32BM003

Lab Sample ID: 160-6528-14

Date Collected: 04/11/14 13:20

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.181	U	0.135	0.137		0.298	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Bismuth-212	0.351	U	0.597	0.598		1.01	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Bismuth-214	**0.419**		0.132	0.139		0.106	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Lead-210	0.416	U	0.574	0.576		0.935	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Lead-212	**0.252**		0.0893	0.0951		0.106	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Lead-214	**0.292**		0.0939	0.0987		0.116	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Potassium-40	**6.37**		1.40	1.54		1.56	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Radium-226	**0.419**		0.132	0.139	0.700	0.106	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Thallium-208	**0.0804**		0.0512	0.0519		0.0696	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Thorium-234	0.502	U	0.356	0.360		0.918	pCi/g	05/12/14 17:47	06/02/14 16:02	1
Uranium-235	0.192	U	0.149	0.150		0.273	pCi/g	05/12/14 17:47	06/02/14 16:02	1

Client Sample ID: S32BM003

Lab Sample ID: 160-6528-14

Date Collected: 04/11/14 13:20

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS) (Continued)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Cesium-137	0.00187	U	0.0468	0.0468	0.0700	0.0851	pCi/g	05/12/14 17:47	06/02/14 16:02	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	0.249		0.0957	0.0980	0.200	0.0276	pCi/g	05/12/14 13:27	05/14/14 17:14	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Thorium-229	*76.6*		*30 - 110*	*05/12/14 13:27*	*05/14/14 17:14*	*1*

Client Sample ID: S32BM004

Lab Sample ID: 160-6528-15

Date Collected: 04/11/14 14:05

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.171	U	0.289	0.289		0.576	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Bismuth-212	0.651	U	1.15	1.15		1.95	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Bismuth-214	0.137	U	0.266	0.266		0.440	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Lead-210	1.49	U	1.39	1.40		2.11	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Lead-212	0.122	U	0.138	0.139		0.256	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Lead-214	-0.0552	U	0.251	0.251		0.365	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Potassium-40	-1.04	U	2.47	2.47		3.44	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Radium-226	0.137	U	0.266	0.266	0.700	0.440	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Thallium-208	-0.106	U	0.164	0.164		0.236	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Thorium-234	0.349	U	0.538	0.539		2.02	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Uranium-235	0.421	U	0.395	0.397		0.633	pCi/g	05/12/14 17:47	06/02/14 12:45	1
Cesium-137	-0.00534	U	0.0943	0.0943	0.0700	0.169	pCi/g	05/12/14 17:47	06/02/14 12:45	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	0.0318	U	0.0505	0.0506	0.200	0.0875	pCi/g	05/12/14 13:27	05/14/14 17:14	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Thorium-229	*51.3*		*30 - 110*	*05/12/14 13:27*	*05/14/14 17:14*	*1*

Client Sample ID: S32BM005

Lab Sample ID: 160-6528-16

Date Collected: 04/11/14 14:45

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.344**		0.112	0.117		0.0938	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Bismuth-212	**1.05**		0.402	0.417		0.338	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Bismuth-214	**0.362**		0.0905	0.0980		0.0905	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Lead-210	0.595	U	0.853	0.856		1.26	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Lead-212	**0.242**		0.0553	0.0636		0.0773	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Lead-214	**0.373**		0.0779	0.0870		0.0761	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Potassium-40	**12.1**		0.994	1.59		0.363	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Radium-226	**0.362**		0.0905	0.0980	0.700	0.0905	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Thallium-208	**0.118**		0.0347	0.0368		0.0365	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Thorium-234	0.125	U	0.339	0.339		1.20	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Uranium-235	0.162	U	0.142	0.143		0.256	pCi/g	05/12/14 17:47	06/09/14 12:08	1
Cesium-137	0.00120	U	0.0264	0.0264	0.0700	0.0470	pCi/g	05/12/14 17:47	06/09/14 12:08	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	**0.356**		0.110	0.114	0.200	0.0412	pCi/g	05/12/14 13:27	05/14/14 17:14	1

Tracer	*%Yield*	*Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Thorium-229	*82.3*		*30 - 110*	*05/12/14 13:27*	*05/14/14 17:14*	*1*

Client Sample ID: B3SD002

Lab Sample ID: 160-6528-17

Date Collected: 04/28/14 11:30

Matrix: Solid

Date Received: 05/07/14 09:25

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	**0.241**		0.0782	0.0820		0.0468	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Bismuth-212	0.0818	U	0.208	0.208		0.370	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Bismuth-214	**0.153**		0.0613	0.0633		0.0778	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Lead-210	0.275	U	0.646	0.647		1.02	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Lead-212	**0.160**		0.0527	0.0566		0.0605	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Lead-214	**0.193**		0.0525	0.0562		0.0581	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Potassium-40	**2.86**		0.587	0.656		0.530	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Radium-226	**0.153**		0.0613	0.0633	0.700	0.0778	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Thallium-208	**0.0799**		0.0270	0.0282		0.0294	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Thorium-234	0.0936	U	0.219	0.219		0.740	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Uranium-235	0.0240	U	0.0789	0.0789		0.163	pCi/g	05/12/14 17:47	06/09/14 11:59	1
Cesium-137	0.00771	U	0.0260	0.0260	0.0700	0.0458	pCi/g	05/12/14 17:47	06/09/14 11:59	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	**0.112**		0.0663	0.0670	0.200	0.0462	pCi/g	05/12/14 13:27	05/14/14 17:14	1

Client: Gilbane Federal
Project/Site: Treasure Island

TestAmerica Job ID: 160-6528-1

Client Sample ID: B3SD002
Date Collected: 04/28/14 11:30
Date Received: 05/07/14 09:25

Lab Sample ID: 160-6528-17
Matrix: Solid

Tracer	%Yield	Qualifier	Limits	Prepared	Analyzed	Dil Fac
Thorium-229	72.0		30 - 110	05/12/14 13:27	05/14/14 17:14	1

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Lab Sample ID: MB 160-121588/1-A — **Client Sample ID: Method Blank**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 126371 — **Prep Batch: 121588**

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Ac-228	0.0004204	U	0.00133	0.00133		0.138	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Bismuth-212	0.0000	U	0.0498	0.0498		0.390	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Bismuth-214	-0.001581	U	0.0476	0.0476		0.0811	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Lead-210	-0.1517	U	0.689	0.689		1.01	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Lead-212	-0.003655	U	0.0339	0.0339		0.0507	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Lead-214	0.01247	U	0.0294	0.0294		0.0593	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Potassium-40	0.1489	U	0.236	0.236		0.402	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Radium-226	-0.001581	U	0.0476	0.0476	0.700	0.0811	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Thallium-208	0.0006760	U	0.00514	0.00514		0.0375	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Thorium-234	-0.1469	U	0.499	0.499		0.710	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Uranium-235	0.03087	U	0.0652	0.0652		0.115	pCi/g	05/12/14 17:47	06/11/14 13:45	1
Cesium-137	0.01005	U	0.0187	0.0187	0.0700	0.0324	pCi/g	05/12/14 17:47	06/11/14 13:45	1

Lab Sample ID: LCS 160-121588/2-A — **Client Sample ID: Lab Control Sample**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 124829 — **Prep Batch: 121588**

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	%Rec	%Rec. Limits
Americium-241	97.4	94.43		9.91		1.09	pCi/g	97	87 - 116
Cesium-137	31.1	29.89		3.19	0.0700	0.297	pCi/g	96	87 - 120
Cobalt-60	22.3	21.14		2.18		0.146	pCi/g	95	87 - 115

Lab Sample ID: 160-6528-2 DU — **Client Sample ID: B233PH002**
Matrix: Solid — **Prep Type: Total/NA**
Analysis Batch: 126195 — **Prep Batch: 121588**

Analyte	Sample Result	Sample Qual	DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit	RER	RER Limit
Ac-228	0.359		0.4333		0.106		0.157	pCi/g	0.31	1
Bismuth-212	0.457	U	0.5980		0.340		0.352	pCi/g	0.18	1
Bismuth-214	0.777		0.7796		0.152		0.103	pCi/g	0.01	1
Lead-210	-0.196	U	0.6652	U	0.954		1.46	pCi/g	0.39	1
Lead-212	0.328		0.3794		0.0785		0.0724	pCi/g	0.33	1
Lead-214	0.827		0.7633		0.129		0.0747	pCi/g	0.24	1
Potassium-40	11.0		9.440		1.37		0.376	pCi/g	0.53	1
Radium-226	0.777		0.7796		0.152	0.700	0.103	pCi/g	0.01	1
Thallium-208	0.145		0.1453		0.0429		0.0380	pCi/g	0	1
Thorium-234	0.120	U	0.5062	U	0.634		1.12	pCi/g	0.50	1
Uranium-235	0.0750	U	0.06876	U	0.163		0.275	pCi/g	0.02	1
Cesium-137	-0.00244	U	-0.01544	U	0.0307	0.0700	0.0520	pCi/g	0.21	1

Client: Gilbane Federal
Project/Site: Treasure Island

TestAmerica Job ID: 160-6528-1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Lab Sample ID: MB 160-121545/1-A
Matrix: Solid
Analysis Batch: 122088

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 121545

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	RL	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-232	0.008847	U	0.0177	0.0177	0.200	0.0265	pCi/g	05/12/14 13:26	05/14/14 17:14	1

Tracer	*MB %Yield*	*MB Qualifier*	*Limits*	*Prepared*	*Analyzed*	*Dil Fac*
Thorium-229	*79.9*		*30 - 110*	*05/12/14 13:26*	*05/14/14 17:14*	*1*

Lab Sample ID: LCS 160-121545/2-A
Matrix: Solid
Analysis Batch: 122089

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 121545

Tracer	*LCS %Yield*	*LCS Qualifier*	*Limits*
Thorium-229	*87.3*		*30 - 110*

Lab Sample ID: 160-6528-11 DU
Matrix: Solid
Analysis Batch: 122091

Client Sample ID: B3SD001
Prep Type: Total/NA
Prep Batch: 121545

Analyte	Sample Result	Sample Qual		DU Result	DU Qual	Total Uncert. (2σ+/-)	RL	MDC	Unit			RER	RER Limit
Thorium-232	0.810			0.9755		0.210	0.200	0.0287	pCi/g			0.41	1

Tracer	*DU %Yield*	*DU Qualifier*	*Limits*
Thorium-229	*72.3*		*30 - 110*

Rad

Leach Batch: 121037

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-6528-1	B233PH001	Total/NA	Solid	Dry and Grind	
160-6528-2	B233PH002	Total/NA	Solid	Dry and Grind	
160-6528-2 DU	B233PH002	Total/NA	Solid	Dry and Grind	
160-6528-3	B233PH003	Total/NA	Solid	Dry and Grind	
160-6528-4	B233PH004	Total/NA	Solid	Dry and Grind	
160-6528-5	B233PH005	Total/NA	Solid	Dry and Grind	
160-6528-6	B233PH006	Total/NA	Solid	Dry and Grind	
160-6528-7	B233PH007	Total/NA	Solid	Dry and Grind	
160-6528-8	B233PH008	Total/NA	Solid	Dry and Grind	
160-6528-9	B233PH009	Total/NA	Solid	Dry and Grind	
160-6528-10	S12S6SS001	Total/NA	Solid	Dry and Grind	
160-6528-11	B3SD001	Total/NA	Solid	Dry and Grind	
160-6528-11 DU	B3SD001	Total/NA	Solid	Dry and Grind	
160-6528-12	S32BM001	Total/NA	Solid	Dry and Grind	
160-6528-13	S32BM002	Total/NA	Solid	Dry and Grind	
160-6528-14	S32BM003	Total/NA	Solid	Dry and Grind	
160-6528-15	S32BM004	Total/NA	Solid	Dry and Grind	
160-6528-16	S32BM005	Total/NA	Solid	Dry and Grind	
160-6528-17	B3SD002	Total/NA	Solid	Dry and Grind	

Prep Batch: 121545

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-6528-11	B3SD001	Total/NA	Solid	ExtChrom	121037
160-6528-11 DU	B3SD001	Total/NA	Solid	ExtChrom	121037
160-6528-12	S32BM001	Total/NA	Solid	ExtChrom	121037
160-6528-13	S32BM002	Total/NA	Solid	ExtChrom	121037
160-6528-14	S32BM003	Total/NA	Solid	ExtChrom	121037
160-6528-15	S32BM004	Total/NA	Solid	ExtChrom	121037
160-6528-16	S32BM005	Total/NA	Solid	ExtChrom	121037
160-6528-17	B3SD002	Total/NA	Solid	ExtChrom	121037
LCS 160-121545/2-A	Lab Control Sample	Total/NA	Solid	ExtChrom	
MB 160-121545/1-A	Method Blank	Total/NA	Solid	ExtChrom	

Prep Batch: 121588

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-6528-1	B233PH001	Total/NA	Solid	Fill_Geo-21	121037
160-6528-2	B233PH002	Total/NA	Solid	Fill_Geo-21	121037
160-6528-2 DU	B233PH002	Total/NA	Solid	Fill_Geo-21	121037
160-6528-3	B233PH003	Total/NA	Solid	Fill_Geo-21	121037
160-6528-4	B233PH004	Total/NA	Solid	Fill_Geo-21	121037
160-6528-5	B233PH005	Total/NA	Solid	Fill_Geo-21	121037
160-6528-6	B233PH006	Total/NA	Solid	Fill_Geo-21	121037
160-6528-7	B233PH007	Total/NA	Solid	Fill_Geo-21	121037
160-6528-8	B233PH008	Total/NA	Solid	Fill_Geo-21	121037
160-6528-9	B233PH009	Total/NA	Solid	Fill_Geo-21	121037
160-6528-10	S12S6SS001	Total/NA	Solid	Fill_Geo-21	121037
160-6528-11	B3SD001	Total/NA	Solid	Fill_Geo-21	121037
160-6528-12	S32BM001	Total/NA	Solid	Fill_Geo-21	121037
160-6528-13	S32BM002	Total/NA	Solid	Fill_Geo-21	121037
160-6528-14	S32BM003	Total/NA	Solid	Fill_Geo-21	121037
160-6528-15	S32BM004	Total/NA	Solid	Fill_Geo-21	121037

Rad (Continued)

Prep Batch: 121588 (Continued)

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-6528-16	S32BM005	Total/NA	Solid	Fill_Geo-21	121037
160-6528-17	B3SD002	Total/NA	Solid	Fill_Geo-21	121037
LCS 160-121588/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-121588/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	

Tracer/Carrier Summary

Client: Gilbane Federal
Project/Site: Treasure Island

TestAmerica Job ID: 160-6528-1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Matrix: Solid **Prep Type: Total/NA**

		Percent Yield (Acceptance Limits)							
		Th-229							
Lab Sample ID	Client Sample ID	(30-110)							
160-6528-11	B3SD001	71.0							
160-6528-11 DU	B3SD001	72.3							
160-6528-12	S32BM001	77.0							
160-6528-13	S32BM002	82.1							
160-6528-14	S32BM003	76.6							
160-6528-15	S32BM004	51.3							
160-6528-16	S32BM005	82.3							
160-6528-17	B3SD002	72.0							
LCS 160-121545/2-A	Lab Control Sample	87.3							
MB 160-121545/1-A	Method Blank	79.9							

Tracer/Carrier Legend

Th-229 = Thorium-229

APPENDIX E

Avenue M Storm Sewer Line Survey Data

Gilbane

RADIOLOGICAL SURVEY FORM

CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	ITSI GILBANE PROJECT NO:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

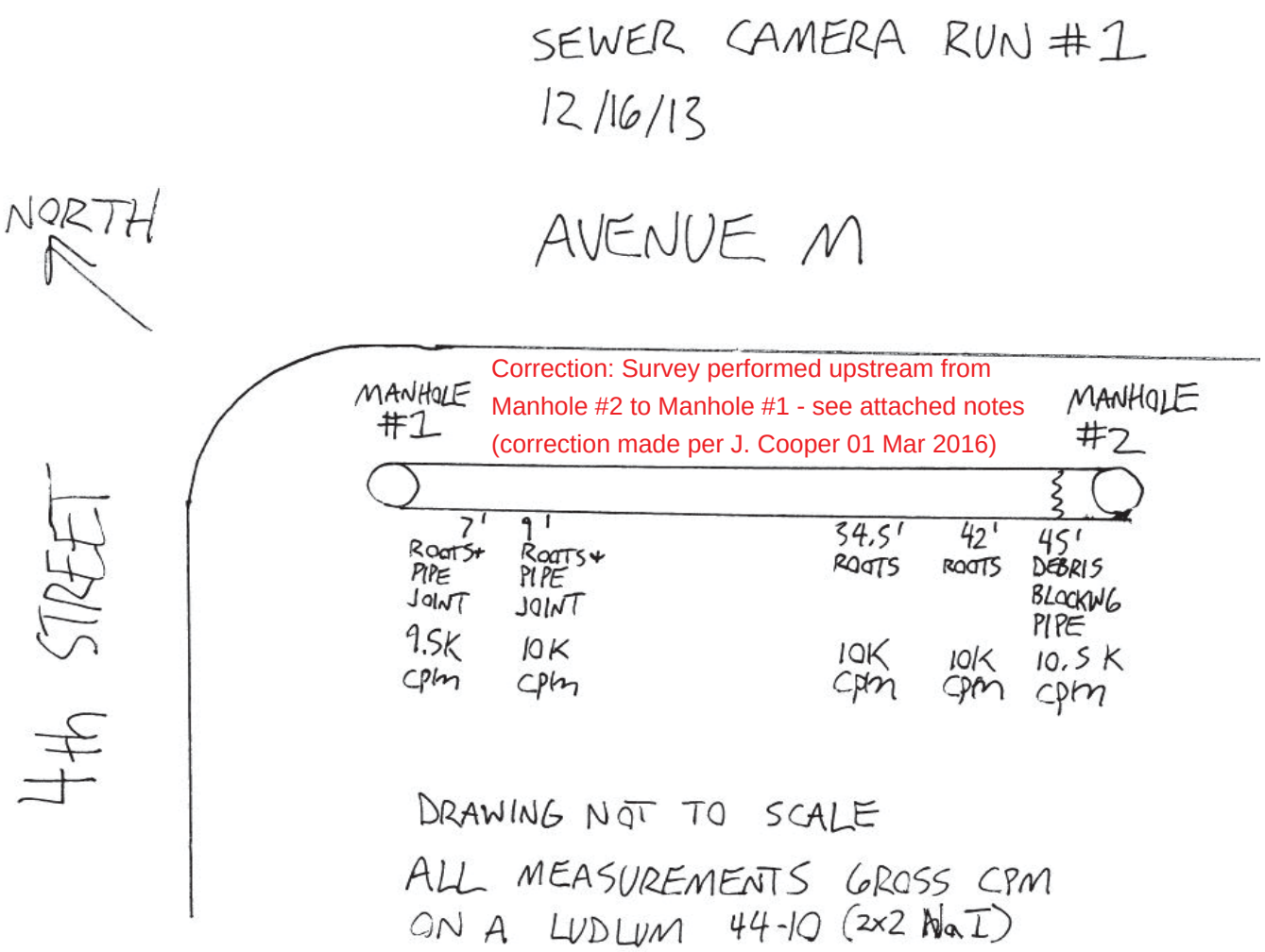
Survey No.: 06-03-170	Date: 12/16/13	Location: SE Storm Sewer	Survey Type: Scoping
Matt Cushman		Jerry Cooper	Digitally signed by Jerry Cooper, CHP DN: cn=Jerry Cooper, CHP, o, ou, email=jerrycooper@comcast.net, c=US Date: 2014.05.28 07:48:13 -07'00'
Tech Printed Name	Signature	RSOR Printed Name	

Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µR/hr	Eff. α	Eff. β
2221	147502	08/29/14	44-10	PR150787	08/29/14	N/A	N/A	N/A	N/A	N/A	N/A
N/A											
N/A											

Survey Description / Map /Photo

Storm Sewer Survey #1
Manhole #1 - Manhole #2



Correction: Survey performed upstream from Manhole #2 to Manhole #1 - see attached notes (correction made per J. Cooper 01 Mar 2016)

Comments: readings in gross cpm (or counts) unless otherwise noted

ITSI Gilbane

Daily Activity Report (DAR)

Project Name: Radiological Scoping Survey, Treasure Island, San Francisco, CA | Page 1 of 1

Project No./Task Code: 07204.0006 / 0054002 | Date: 12/16/13

Description of Work: VIDEO & SURVEY OF 24" STORM SEWER ALONG AVENUE M

Visitors / Subcontractors: TTA, Envira Chem, SUBTRONICS

Weather: Cool, Overcast/sunny.

Description of Field Activities

8:00 SUBTRONICS field Crew @ Gilbane trailer to review AHA #8 & #9 as well as Initial phase Meeting.

10:15 Subtronics @ Manhole 1 on Avenue M and 11th St. on 24" opened manhole notice very light to put large transporter in due to step ladder. Moved setup to Manhole 2 downstream (brick square MH) began video & scan moving up stream towards MH1.

12:07 @ approximately 45' going upstream from MH2 to MH1 on 24" along Avenue M encountered debris; unable to proceed further Subtronics

1:00 Set up @ MH1 on 24" along Avenue M w/ modified setup to video equipment (cable to fit) began video & scan downstream toward MH2.

2:20 After approximately 25' of video from MH1 to MH2 encountered debris. Unable to go further. Noted approximately 20' section pipe (24" between MH1 and MH2 along Avenue M) is filled with debris. No contamination or pipe failures encountered in portions of pipe scans between MH1 & MH2.

12:38 Began video & Scan From MH2 to downstream MH 3 (approximately) 172 LF of 24" along Avenue M no contamination of pipe failures encountered.

Approximate Total LF of 24" Scan & videoed = 342 LF

Correction: 242 LF

(45 ft + 25 ft + 172 ft = 242 ft)

Prepared by: ASHISH MOGERA | Signature: Ashish Mogera

DAR 031411

Gilbane

RADIOLOGICAL SURVEY FORM

CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	ITSI GILBANE PROJECT NO:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

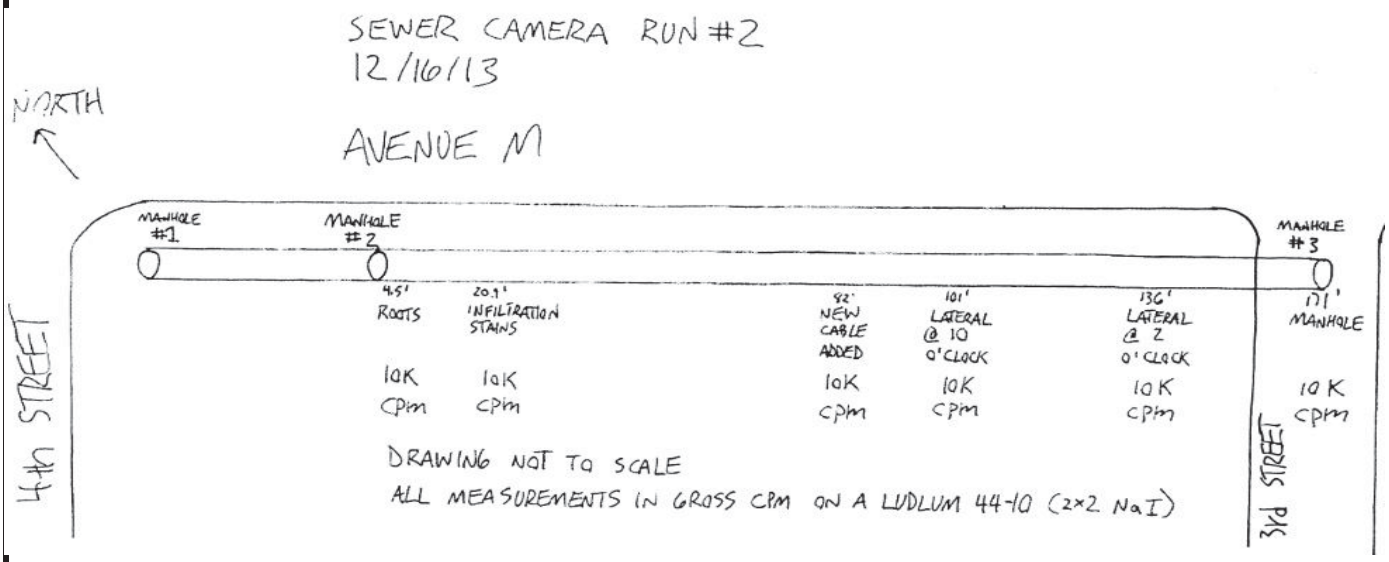
Survey No.: 06-03-171	Date: 12/16/13	Location: SE Storm Sewer	Survey Type: Scoping
Matt Cushman	Matt	Jerry Cooper	Digitally signed by Jerry Cooper, CHP DN: cn=Jerry Cooper, CHP, o, ou, email=jerrycooper@comcast.net, c=US Date: 2014.05.28 07:50:57 -07'00'
Tech Printed Name	Signature	RSOR Printed Name	

Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µR/hr	Eff. α	Eff. β
2221	147502	08/29/14	44-10	PR150787	08/29/14	N/A	N/A	N/A	N/A	N/A	N/A
N/A											
N/A											

Survey Description / Map /Photo

Storm Sewer Survey #2
Manhole #2 - Manhole #3



Comments: readings in gross cpm (or counts) unless otherwise noted

Gilbane

RADIOLOGICAL SURVEY FORM

CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	ITSI GILBANE PROJECT NO:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

Survey No.: 06-03-172	Date: 12/16/13	Location: SE Storm Sewer	Survey Type: Scoping
Matt Cushman	Matt	Jerry Cooper	Digitally signed by Jerry Cooper, CHP DN: cn=Jerry Cooper, CHP, o, ou, email=jcooper@gilbane.com, c=US Date: 2014.05.28 07:54:13 -07'00'
Tech Printed Name	Signature	RSOR Printed Name	

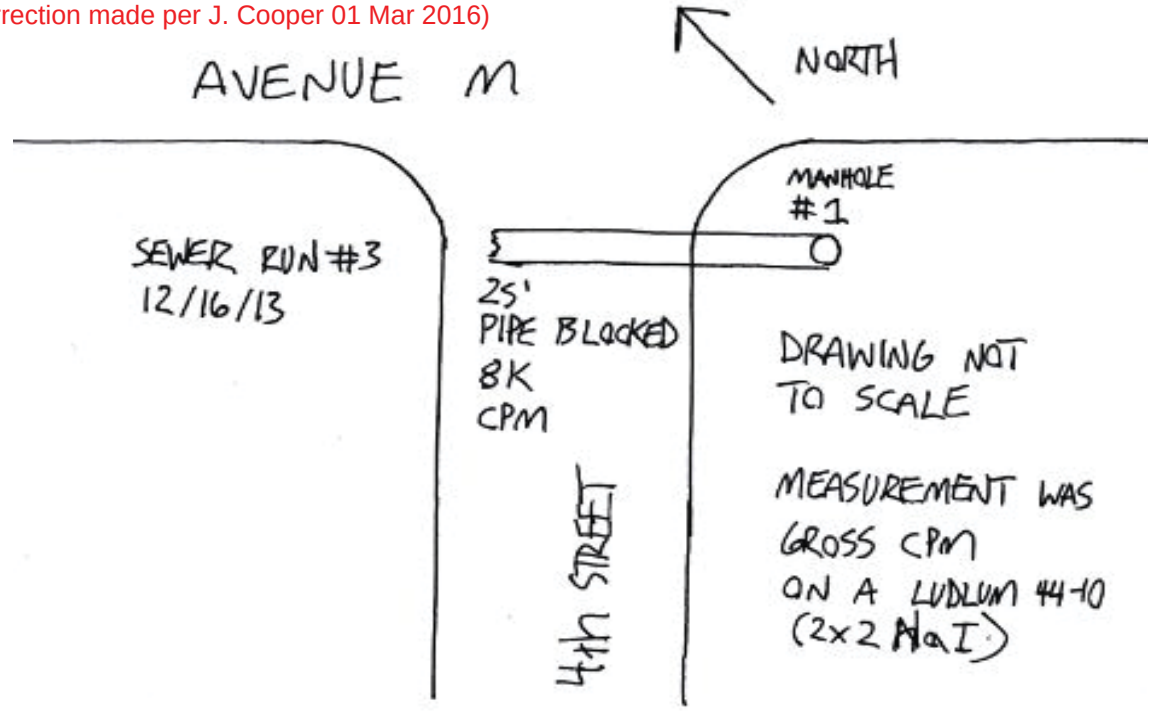
Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µR/hr	Eff. α	Eff. β
2221	147502	08/29/14	44-10	PR150787	08/29/14	N/A	N/A	N/A	N/A	N/A	N/A
N/A											
N/A											

Survey Description / Map /Photo

Storm Sewer Survey #3
Manhole #1 - to blockage

Correction: Survey performed downstream from Manhole #1 toward Manhole #2 until blockage encountered at 25 ft - see attached notes (correction made per J. Cooper 01 Mar 2016)



Comments: readings in gross cpm (or counts) unless otherwise noted

ITSI Gilbane

Daily Activity Report (DAR)

Project Name: Radiological Scoping Survey, Treasure Island, San Francisco, CA	Page 1 of 1
Project No./Task Code: 07204.0006 / 0054002	Date: 12/16/13

Description of Work: VIDEO & SURVEY OF 24" STORM SEWER ALONG AVENUE M

Visitors / Subcontractors: TTA, Envira Chem, SUBTRONICS

Weather: Cool, Overcast/sunny.

Description of Field Activities

8:00 SUBTRONICS field Crew @ Gilbane trailer to review AHA #8 & #9 as well as Initial phase Meeting.

10:15 Subtronics @ Manhole 1 on Avenue M and 11th St. on 24" opened manhole notice very light to put large transporter in due to step ladder. Moved setup to Manhole 2 downstream (brick square MH) began video & scan moving up stream towards MH1.

12:07 @ approximately 45' going upstream from MH2 to MH1 on 24" along Avenue M encountered debris; unable to proceed further

1:00 Subtronics Set up @ MH1 on 24" along Avenue M w/ modified setup to video equipment (cable to fit) began video & scan downstream toward MH2.

2:20 After approximately 25' of video from MH1 to MH2 encountered debris. Unable to go further. Noted approximately 20' section pipe (24" between MH1 and MH2 along Avenue M) is filled with debris. No contamination or pipe failures encountered in portions of pipe scans between MH1 & MH2.

12:18 Began video & Scan From MH2 to downstream MH 3 (approximately) 172 LF of 24" along Avenue M no contamination of pipe failures encountered.

Approximate Total LF of 24" Scan & videoed = 347 LF

Correction: 242 LF

(45 ft + 25 ft + 172 ft = 242 ft)

Prepared by: ASHISH MOGERA Signature: Ashish Mogera

DAR 031411

Gilbane

RADIOLOGICAL SURVEY FORM

CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	ITSI GILBANE PROJECT NO:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

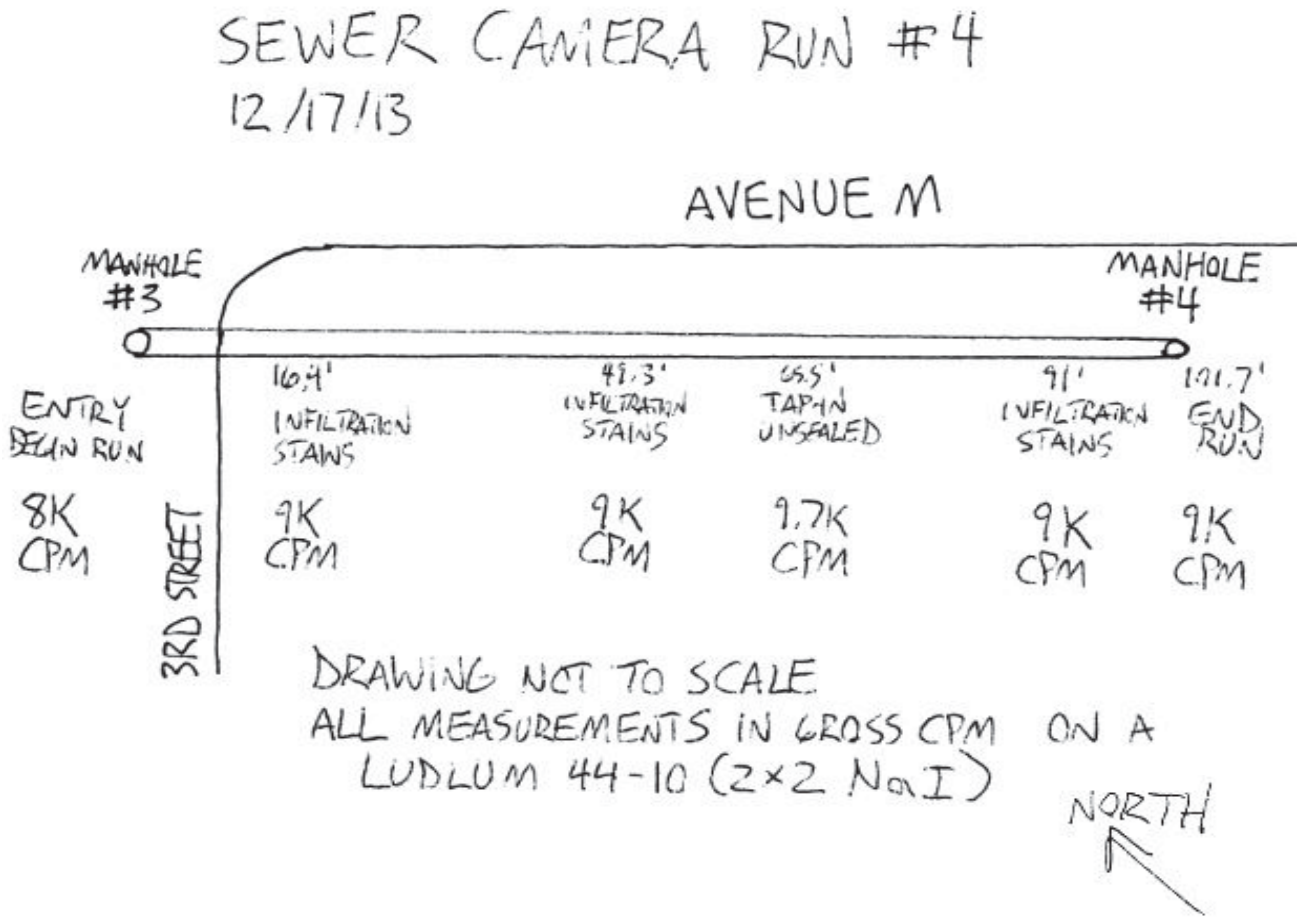
Survey No.: 06-03-173	Date: 12/17/13	Location: SE Storm Sewer	Survey Type: Scoping
Matt Cushman		Jerry Cooper	Digitally signed by Jerry Cooper, CHP DN: cn=Jerry Cooper, CHP, o, ou, email=jcooper@gilbane.com, c=US Date: 2014.05.28 07:59:18 -07'00'
Tech Printed Name	Signature	RSOR Printed Name	

Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µR/hr	Eff. α	Eff. β
2221	147502	08/29/14	44-10	PR150787	08/29/14	N/A	N/A	N/A	N/A	N/A	N/A
N/A											
N/A											

Survey Description / Map /Photo

Storm Sewer Survey #4
Manhole #3 - Manhole #4



Comments: readings in gross cpm (or counts) unless otherwise noted

Gilbane

RADIOLOGICAL SURVEY FORM

CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	ITSI GILBANE PROJECT NO:
N62473-10-D-0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

Survey No.: 06-03-174	Date: 12/17/13	Location: SE Storm Sewer	Survey Type: Scoping
Matt Cushman		Jerry Cooper	Digitally signed by Jerry Cooper, CHP DN: cn=Jerry Cooper, CHP, o, ou, email=jcooper@gilbanecorp.com, c=US Date: 2014.05.28 08:01:15 -07'00'
Tech Printed Name	Signature	RSOR Printed Name	

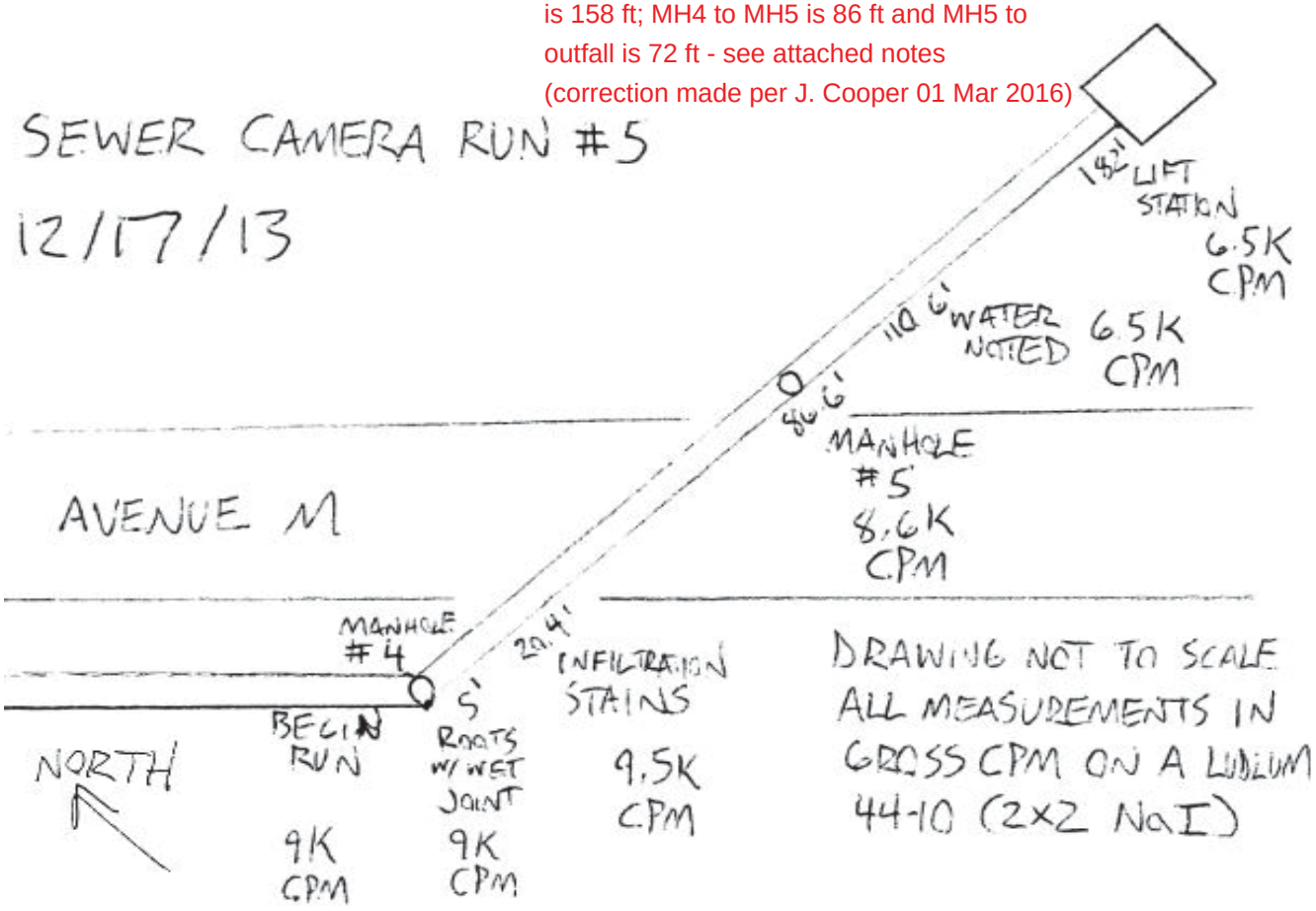
Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µR/hr	Eff. α	Eff. β
2221	147502	08/29/14	44-10	PR150787	08/29/14	N/A	N/A	N/A	N/A	N/A	N/A
N/A											
N/A											

Survey Description / Map /Photo

Storm Sewer Survey #5
Manhole #4 - Lift Station

Correction: Total length from MH4 to outfall is 158 ft; MH4 to MH5 is 86 ft and MH5 to outfall is 72 ft - see attached notes (correction made per J. Cooper 01 Mar 2016)



Comments: readings in gross cpm (or counts) unless otherwise noted

ITSI Gilbane

Daily Activity Report (DAR)

Project Name: Radiological Scoping Survey, Treasure Island, San Francisco, CA	Page 1 of 1
Project No./Task Code: 07204.0006 / 0054002	Date: 12-17-13

Description of Work: Video & radiological survey Storm water line Along Ave, Site 12 Surveys

Visitors / Subcontractors: TTA, Envira Chem Subtronic

Weather: Sunny

Description of Field Activities

0700: Tailgate with rad techs for clean up surveys in site 12 See Teresa Ruha Daily Activity report (DAR) for site 12 survey details

0800: Subtronic ONsite. Held tail gate for Subtronic, weatover safety around manholes, Need one to enter manhole, proper lifting.

0815: Head out to manholes along ave M. (24" on west side).

0830: Begin camera set @/across from Ave M & 2nd st manhole.

0845: Matt out with radiological equipment for waste water survey.

1000 Surveyed video'd 101.5' of 24" storm drain. Connector to GPS broke on rad equipment Matt to get another meter. Gary & Dave Navy RICC onsite.

1100: New meter onsite, sending camera and rad meter under Ave M towards lift station. From Corner to manhole Ave M in middle of street (Ave M) 86'.

1130: 71.4 from manhole in center of Ave M to lift station. pipes look good Nothing above background in entire storm water line. 24" line does vary from figure @ Ave N.

1200: Lunch

1315: investigate lines in front of (North) of bldg. 3. Found manhole by sump No 5.

1400: Lowered camera into manhole to look @ waste water lines, lines are severly corroded. will have to bring a mini cam out next week. Only one manhole found as access point for waste water lines @ bldg 3.

See radiological DAR for more details about radiological findings of lack there of in pipe.

1430: Subtronic offsite. Will be back after the new year to finish the waster water lines.

Prepared by: Tony Olmstead

Signature:

DAR 031411

Gilbane

RADIOLOGICAL SURVEY FORM

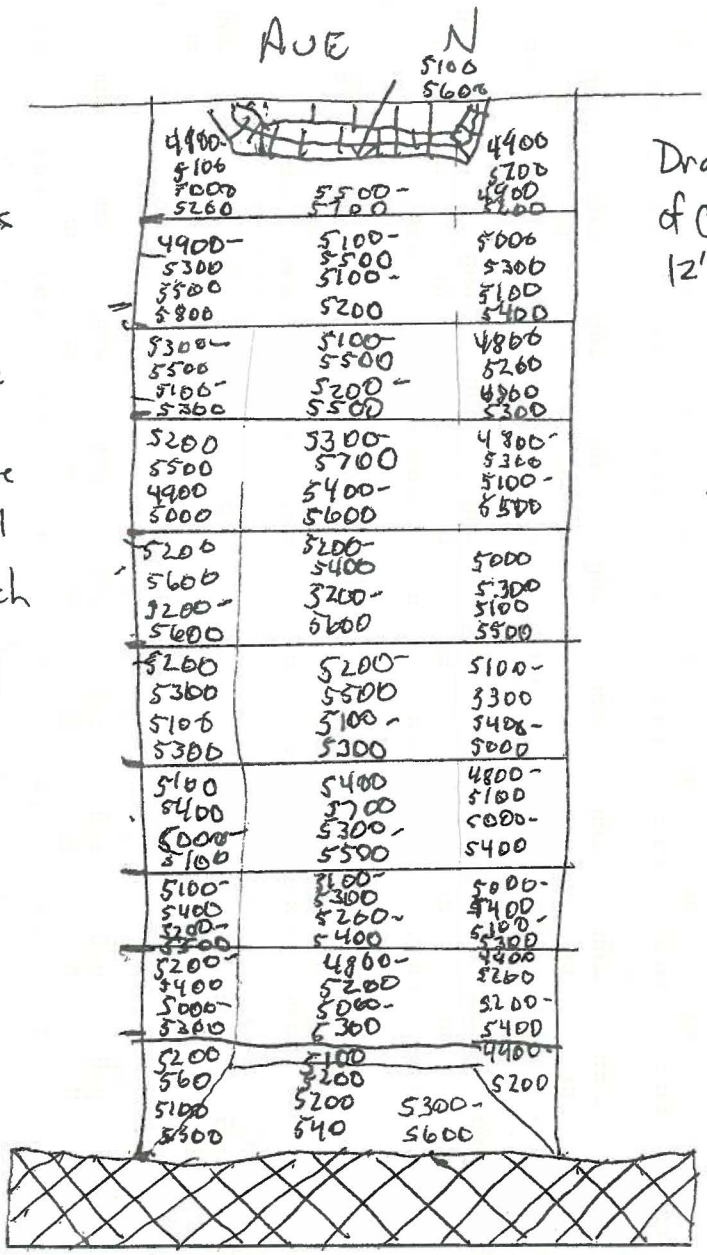
CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	GILBANE PROJECT NO:
N62473-10-D0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

Survey No.: 06-03-175	Date: 10/08/2014	Location: Ave M Drainage Ditch	Survey Type: Characterization
Jamie Pena	Jamie Pena	Jerry Cooper	Jerry Cooper
Tech Printed Name	Signature	RSOR Printed Name	Signature

Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µr/Hr	Eff. α	Eff. β
2221	144871	10/13/14	44-10	RN21186	10/13/14	N/A	N/A	N/A	N/A	N/A	N/A

Survey Description / Map /Photo



Comments: All readings in gross cpm; readings collected based on gamma scan methodology

Gilbane

RADIOLOGICAL SURVEY FORM

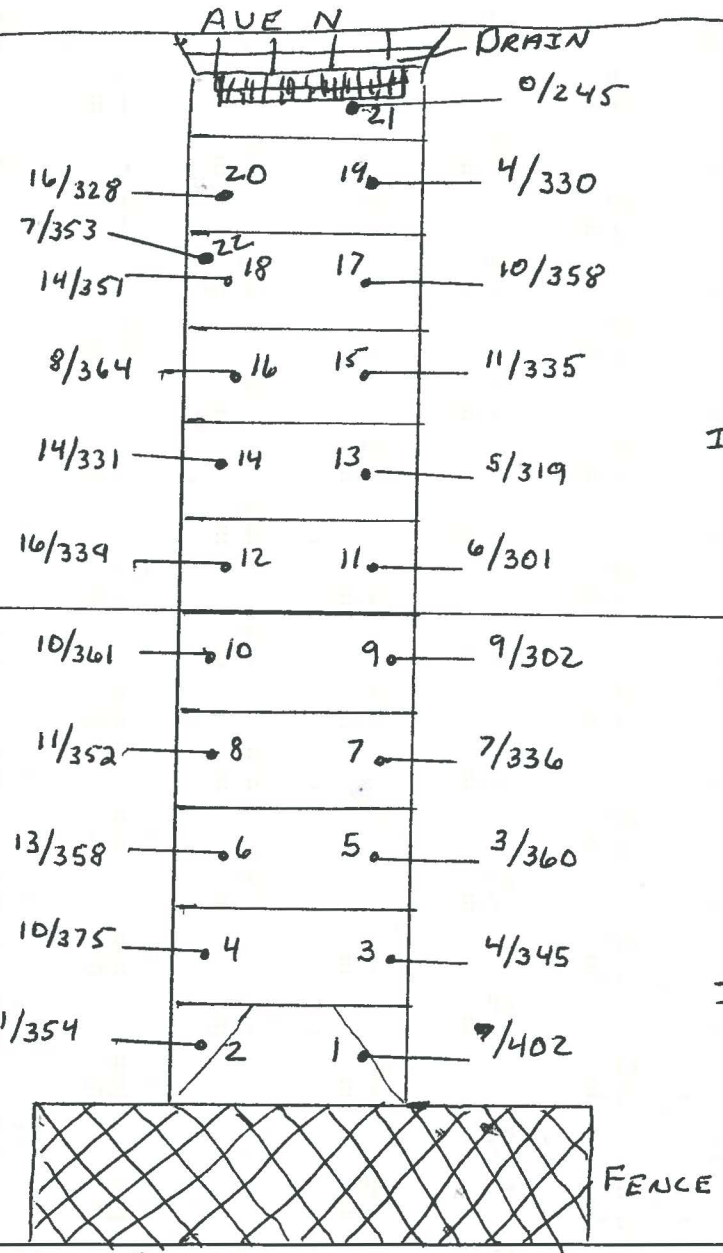
CONTRACT NO / TO NO:	PROJECT TITLE / LOCATION:	GILBANE PROJECT NO:
N62473-10-D0808 / 0006	Rad Scoping Surveys / Treasure Island, Ca	07204-0006

Survey No.: 06-03-176	Date: 10/08/2014	Location: Ave M Drainage Ditch	Survey Type: Characterization
Jamie Pena	Jamie Pena	Jerry Cooper	Jerry Cooper
Tech Printed Name	Signature	RSOR Printed Name	Signature

Instrument(s)

Model	Serial	Cal Due Date	Probe Model	Probe Serial	Cal Due Date	BKG α	BKG β	BKG γ	BKG µr/Hr	Eff. α	Eff. β
2360	297800	18-AUG-15	43-93	32666	18AUG-15	0.1	93.8	N/A	N/A	0.0843	0.1007
2360	178154	24-JUL-15	43-93	311168	24-JUL-15	1.0	105.5	N/A	N/A	0.0836	0.1055

Survey Description / Map /Photo



Comments: STATIC CTS ARE 2 MIN. α/β-

09085100
10/9/2014 6:36:28 AM
Routine 1 Smears Batch ID: 06-03-176

Alpha MDA = 15.37 dpm Beta MDA = 14.97 dpm

ALPHA BKGD = 0.10 BETA BKGD = 1.00
ALPHA EFF. = 0.1653 BETA EFF. = 0.3200
ALPHA F = 1.00 BETA F = 1.00
Count Time = 2.00 mins BKGND Count Time = 2.00 mins

SEQ. NUM.	SC#	ID	ALPHA CPM	BETA CPM	ALPHA DPM	BETA DPM
1	1	Sample1	0.000	2.000	-0.605	3.125
2	2	Sample2	0.000	2.000	-0.605	3.125
3	3	Sample3	0.000	1.500	-0.605	1.563
4	4	Sample4	0.000	2.500	-0.605	4.688
5	5	Sample5	0.000	0.500	-0.605	-1.563
6	6	Sample6	0.000	0.000	-0.605	-3.125
7	7	Sample7	0.000	2.500	-0.605	4.688
8	8	Sample8	0.000	3.500	-0.605	7.813
9	9	Sample9	0.000	2.000	-0.605	3.125
10	10	Sample10	0.000	2.500	-0.605	4.688
11	11	Sample11	0.000	2.500	-0.605	4.688
12	12	Sample12	0.000	3.000	-0.605	6.250
13	13	Sample13	0.000	1.000	-0.605	0.000
14	14	Sample14	0.500	0.000	2.420	-3.125
15	15	Sample15	0.500	2.000	2.420	3.125
16	16	Sample16	0.000	2.000	-0.605	3.125
17	17	Sample17	0.000	0.000	-0.605	-3.125
18	18	Sample18	0.000	2.000	-0.605	3.125
19	19	Sample19	0.000	1.500	-0.605	1.563
20	20	Sample20	0.000	0.000	-0.605	-3.125
21	21	Sample21	0.000	3.000	-0.605	6.250
22	22	Sample22	0.000	1.500	-0.605	1.563

Counted By: Quanell Bryson 10-9-14 Reviewed By: _____ Date: _____

APPENDIX F

Response to Comments

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
	CDPH-EMB Comments Dated 12 Feb 2016 - General Comments	
1	Please note that CDPH-EMB utilizes Section 30256 in Title 17 of the California Code of Regulations (17 CCR 30256) to render a decision to concur with an unrestricted release. As a result, CDPH-EMB requires a final status survey report that compares the distribution of data from the downstream wastewater lines with applicable reference area datasets. Background reference areas were not presented nor applied in this Draft Report Scoping Survey of Wastewater Lines Downstream From Former Building 233. This represents a significant departure from the standard practices embodied in Multi-Agency Radiation Survey and Site Investigation Manual, (MARSSIM) NUREG-1575, Revision 1. August 1997. Additionally, Section 3.6 APPLICATION OF RADIOLOGICAL SCREENING CRITERIA, page 11 of the ITSI Gilbane Final Radiological Management Plan Former Naval Station Treasure Island San Francisco, California, (July 2013), states the following, "The criteria provided in Table 3.1 are NOT intended to be used as the principal means of radiologically clearing buildings, structures, and land areas for unrestricted use. The survey data will be statistically compared to background to determine if residual radioactivity levels are indistinguishable from background." Finally, the Final Task-Specific Plan Radiological Survey of Building 3 and Impacted Wastewater Drains Naval Station Treasure Island San Francisco, California; Section 1.4 RADIOLOGICAL SCREENING CRITERIA, page seven, paragraph two, sentence one, states, "The survey data will be statistically compared to background to determine if residual radioactivity levels are indistinguishable from background." Please include a comparison of the distribution of data from the surveyed site(s) with applicable reference area datasets.	This is a not a final status survey report, but is a scoping survey report whose objective is to present the radiological data that support the Navy's finding of no further action warranted. Background reference areas are not required or necessary for a scoping survey. In addition, they are not practical in wastewater lines due to the difficulty of finding or reproducing a comparable reference configuration. A scoping survey provides site-specific information based on a limited number of measurements and is used to augment the HRA for sites with potential residual contamination. The radiological screening criteria were simply used as the threshold at which additional investigation and/or data collection was performed. No indications were found suggesting other than background radioactivity. The scoping survey did not find any indications of residual radioactivity (i.e. radioactivity other than background) suggesting the need for a background comparison. Therefore, none was performed. Additional discussion will be added to Sections 5.0 and 6.0 of the report to better illustrate the absence of indications suggesting the need for additional investigation and/or data collection.

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
2	Radiation Work Instructions (RWIs), Task Specific Plans (TSPs) and Field Change Requests (FCNs) are not being communicated clearly and in a timely manner. The Navy has previously committed to timely disclosure in, "Response to Comments on the Draft Radiological Work Plan Radiological Surveys at Various Areas, Former Naval Station Treasure Island, San Francisco, California issued December 24, 2014"; "During project execution, CDPH will be briefed on project status, including deviations from the Work Plan, during regularly scheduled BCT meetings." Please ensure that in the future changes to the original document; which was used to garner CDPH-EMB's approval, are promptly conveyed to CDPH-EMB.	The Navy apologizes for this oversight and will ensure that future project-related documents are provided for timely review and/or information.
3	All the graphs are of low resolution and cannot be read.	Report figures will be replaced with graphics with higher resolution.
	CDPH-EMB Comments dated 12 Feb 2016 - Specific Comments	
4	EXECUTIVE SUMMARY, page one, paragraph two, sentence one, "The Historical Radiological Assessment- Supplemental Technical Memorandum, Naval Station Treasure Island, San Francisco, California (HRASTM) identified the former Building 233 sewer drain and the Avenue M storm sewer line downstream from the former Building 233 as radiologically impacted (TriEcoTt, 2014)." There appears to be no radiological investigation of the two storm lines which exit the westerly border of Building Site 233 at Northing 2127364.27/Easting 6022996.1 and at Northing 2127271.73/Easting 6023042.79 adjacent to Avenue M. Prior to remediation these storm lines had 20.8 picocurie per gram (pCi/g) Radium 226 (Ra-226) of internal sediment and 123.0 pCi/g Ra-226 of excavation soil respectively. Please explain.	The cited storm lines that exit the westerly border of the Building 233 site are addressed in the Building 233 FSSR prepared as part of a separate project performed by a different Navy contractor (CB&I). A summary of the investigation results is attached as information. The two samples (TIB233-SOILPIPECHAR-103-0912, Ra-226 = 20.8 pCi/g and TIB233-SOILPIPECHAR-115-1012, Ra-226 = 123 pCi/g) were removed as part of the Building 233 demo work in 2010-2011. The Navy received release of this area from DTSC in a letter dated Nov 11, 2015.
5	EXECUTIVE SUMMARY, page one, paragraph three, sentence two, "The radiological scoping survey objective was to collect data from the wastewater lines and determine if radioactivity is present that exceeds the radiological screening criteria of: • picocurie per gram (pCi/g) of volumetric radioactivity above	There was no deviation from the original work plan. As noted in Section 3.5 of the ITSI Gilbane Final Radiological Management Plan (RMP), the radiological screening criteria "*…represent the concentration of residual radioactivity*

Item	Review Comment	Proposed Response
	background, • 100 disintegrations per minute per 100 square centimeters (dpm/100 cm^2) of total surface radioactivity above background". These values are in fact the exact radiological criteria from Table 3.1 of the ITSI Gilbane Final Radiological Management Plan Former Naval Station Treasure Island San Francisco, California, (July 2013), which are NOT intended to be used as the principal means of radiologically clearing buildings, structures, and land areas for unrestricted use. (Emphasis in the original text) Please explain the deviation from the original work plan which was reviewed and approved by CDPH-EMB.	*distinguishable from background radiation at which additional data will be collected to ensure a complete understanding of radiological conditions, particularly of those areas where radioactivity may exceed background levels*." Consequently, values above the radiological screening criteria trigger additional investigation and/or data collection. There were no values that triggered additional investigation and/or data collection. This supports the Navy's finding of no further action warranted.
6	EXECUTIVE SUMMARY, page one, paragraph three, sentence two, "Wastewater lines downstream of Building 233 were designated as Class 3 survey units based on their low potential for residual radioactivity above the radiological screening criteria." Radiological survey results documented in the Final Status Survey Report Building 233 Site Former Naval Station Treasure Island San Francisco, California, (CBI, 2014) Figure 7, Utility Lines at the Building 233 Site Elevated Sample Results, record 40.8 pCi/g Ra-226 excavation soil within two feet of the man hole located at Northing 2127259.17/Easting 6023136.39 which is located between potholes numbers one and two as represented in this text's, "Figure 5-3 Building 233 Sewer Drain Access Points." While no legend of scale is presented in Figure 5-3 Building 233 Sewer Drain Access Points, these previous radiological survey results seem to clearly fall within the survey boundary presented in this text. Due to the presence of 40.8 pCi/g Ra-226 in the nearby soils previously documented, the survey unit should have been classified as Class 1 and surveyed accordingly. Additionally, the Final Task-Specific Plan Radiological Survey of Building 3 and Impacted Wastewater Drains Naval Station Treasure Island San	The sentence in the report is incorrect. It will be corrected to state the wastewater lines downstream of Building 233 were classified as Class 1 or Class 3 survey units based on their potential for residual radioactivity above the radiological screening criteria.

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
	Francisco, California; Section 2.0 SURVEY DESIGN, page nine, Table 4 - Survey Units, Wastewater Drains (Class 1 Area) - designates as a Class 1 Area, "Gravity-fed wastewater pipes (below grade) and associated manholes which drained former (demolished) Buildings 7 and 233 to pump station 6 (5- and 6-inch diameter pipe)". Finally, the Final Task-Specific Plan Radiological Survey of Building 3 and Impacted Wastewater Drains Naval Station Treasure Island San Francisco, California; Section 2.1 CLASSIFICATION, page 10, paragraph one, sentence four states, "The existing gravity-fed wastewater drain piping running downstream from Building 3 and from the former Buildings 7 and 233 is designated a Class 1 area, as it has been identified as having a reasonable potential for residual radioactivity from historical activities." Please justify the less stringent classification of the survey unit.	
7	EXECUTIVE SUMMARY, page two, paragraph two, sentence one, "Radiological survey data results were below the screening criteria, and there were no indications of radioactive contamination based on field observations." Please see comment one.	The absence of any indications suggesting the presence of contamination is the basis for this statement. This supports the Navy's finding of no further action warranted.
8	Section 1.1 Objective and Scope, page three, paragraph one, sentence one "The objective of the radiological scoping survey was to collect data from the wastewater lines to determine if radioactivity is present that exceeds the radiological screening criteria." Please see comment one.	There were no data that exceeded the radiological screening criteria, which represent concentrations of radioactivity that may be considered distinguishable from background. This fact supports the Navy's finding of no further action warranted.
9	Section 1.4 Radiological Screening Criteria, page six, Table 1-1 Radiological Screening Criteria. Footnote "C", "An arbitrary value of 20% of the radiological screening criteria was used to compare smear sample results; for conservative simplicity in execution, alpha activity was assumed to be Ra-226." Does this mean that 20% smear dpm/100 cm^2 values are assumed to be the result of alpha contamination? Please clarify.	No. Smear sample (i.e., removable radioactivity) results above 20% of the radiological screening criteria for total surface radioactivity would trigger investigation and/or additional data collection. See response to Comment #5.

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
10	Section 1.5.1 Step 1 - Statement of the Problem, page six, paragraph one, sentence two, "The Navy's objective is to obtain radiological clearance of the wastewater lines downstream from Building 233. Radiological data were needed to determine if radioactivity exceed the radiological screening criteria." Please see comment one.	A focus of the scoping survey was to survey and sample specific areas most likely to be contaminated as well as random areas. In neither instance was radioactivity found above the radiological screening criteria, which supports the Navy's finding of no further action warranted.
11	Section 1.5.2 Step 2 - Decision Statement, page seven, paragraph one, sentence two, "The principal study question was: "Is radioactivity present that exceeds the radiological screening criteria?" Please see comment one.	Since the radiological screening criteria represent the concentrations of radioactivity that may be considered distinguishable from background, the absence of radioactivity above the screening criteria suggests no further investigation and/or data collection is needed. Therefore, none was performed.
12	Table 1-2 Decision Rules, page eight, column four, 'ELSE", "Compare data to background". Please explain which background data is referred to in this comment; and supply this data as a part of the document along with a description of the data analysis which would be employed in making the comparison.	The 'ELSE' column of the table was included inadvertently. It will be removed.
13	Section 2.3.1 Number of Measurements, page ten, paragraph one, sentence one, "A minimum of 20 static measurements were collected per survey unit. This number of static measurements were developed using the MARSSIM process and is based on the design goals and constraints of the RMP (Attachment 1; ITSI Gilbane, 2013a)." Please supply the worked out equation which determined this value.	RMP Section 6.5, 2nd paragraph, states: "*A minimum number of 20 fixed point measurements will be collected per survey unit. This number of measurements was developed using the MARSSIM process and is based on the design goals and constraints described in Attachment 1 of this RMP*." The referenced attachment explains how the method in MARSSIM Section 5.5.2.2 was used and states the assumptions that were applied, and shows the results calculated using the equations.
14	Section 3.0 DATA COLLECTION, page 11, paragraph one, sentence three, "Radiation work instructions (RWIs) were developed to supplement	Since the TSP and RWIs are finalized documents, they will be included as attachments rather than

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
	guidance provided in the RMP and Wastewater Drains TSP (ITSI Gilbane, 2013a and 2013b, respectively)." Please provide the Radiation Work Instructions and Wastewater Drains TSP as appendix(s) to this document.	appendices to the report.
15	Table 3-2 Detection Sensitivities, page 13, footnote, "d", states "4π detection efficiency assumed". The Model 43-1 0-1 Alpha/Beta Sample Counter November 2015 product manual details steps to calculate the 4rr detection efficiency for this model. Therefore why is the 4rr detection efficiency assumed and not calculated?	The note is misleading and will be deleted. The counting efficiency of the Ludlum Model 2929, as used on this project, is based on the surface emission rate multiplied by surface efficiency (0.25 for alpha; 0.5 for beta)
16	Section 4.0 DATA ANALYSIS, page 16, paragraph one, sentence two, "Static measurement and volumetric sample data from a laboratory were analyzed quantitatively for direct comparison to the radiological screening criteria, and radiological scan data were analyzed qualitatively to determine whether further investigation was necessary." Please see comment one.	This comparison was performed to ensure a sound understanding of radiological conditions, particularly of those areas where radioactivity may exceed background levels. Additional discussion will be added to Sections 5.0 and 6.0 of the report to better illustrate the absence of indications suggesting the need for additional investigation and/or data collection.
17	Section 5.1 Survey Unit, Figure 5-1, page 17, Building 233 Sewer Drain Map; the piping within the scope of the radiological surveys presented in this map appear to conflict with the boundaries shown in Figure 5-3, page 19, Building 233 Sewer Drain Access Points. Please explain.	Figure 5-1 will be corrected to reflect the same scope as Figure 5-3.
18	Section 5.2 DATA COLLECTION, page 18, paragraph two, sentence five, "Since the Building 233 sewer drain is no longer in service, the backhoe bucket was used to remove a small segment of intact pipe at an access point in lieu of the surveyor entering the excavation." Please clarify at which access point(s) (pot holes) segments of intact pipes were removed.	Figure 5-3 identifies the locations where the sewer drain line was accessed via potholes and a piping segment removed.
19	Section 5.2 DATA COLLECTION, page 18, paragraph two, sentence six, "A field change request was prepared to document this modified approach (Field Change Request 03, dated 28 April 2014; Appendix A)." Please see comment number two.	The Navy apologizes for this oversight and will ensure that future project-related documents are provided for timely review and/or information.
20	Section 5.2 DATA COLLECTION, page 19, paragraph two, sentence one, "A	Due to the condition of the pipe and its depth, a

Item	Review Comment	Proposed Response
	series of three manholes and four potholes was used to gain access to the pipe and soil surrounding the Building 233 sewer drain." CDPH-EMB strongly believes that due to the presence of 40.8 pCi/g Ra-226 in the nearby excavation soils previously documented in the Final Final Status Survey Report Building 233 Site Former Naval Station Treasure Island San Francisco, California, (CBI, 2014) Figure 7, Utility Lines at the Building 233 Site Elevated Sample Results; as being between potholes one and two; that more comprehensive , Class 1, surveying of the soils adjacent to this line, from origin to terminus, are mandated to demonstrate that the adjacent soils are in fact free of Ra-226.	survey of increased intensity would simply mean accessing the pipe via more frequent potholing.
	Additionally, please note that Final Task-Specific Plan Radiological Survey of Building 3 and Impacted Wastewater Drains Naval Station Treasure Island San Francisco, California, Section 3.3 IMPACTED WASTEWATER DRAIN SURVEYS, page 17 paragraph two, sentence seven, requires that, "Soil samples will be collected adjacent to and/or beneath drain piping at random locations and, if evident, where cracked or broken piping may have leaked." Localized excavation (e.g., pot holing), direct push (e.g., Geoprobe), directional soil boring, or similar methods can be used to collect soil samples without entry into an excavation; please explain why no random soil samples were collected adjacent and/or beneath drain piping at random locations.	The pothole method used to access the pipe itself via piping segment removal also allowed sampling of the material immediately beneath the pipe. This was done at each pothole location. The spacing of the potholes themselves served effectively as a random-start systematically spaced pattern which is suitable for use in lieu of a purely random method.
21	Sections 5.3 Gross Gamma Scans, page 20, paragraph one, sentence one, and Section 5.5 Data Assessment, page 21, paragraph one, sentence five; both address the same subject, "The pipe and manhole readings were approximately 7 to 10 times the instrument background readings; these data are reasonable as naturally occurring radioactivity is found in clay pipe and brick". Please supply supporting data which demonstrates the reasonability of the increased manhole and pipe readings.	A comparative discussion of radioactivity in clay pipe, brick, and concrete will be added to better explain the variation in radiation levels among the material types.
22	Section 6.2 DATA COLLECTION, page 23, paragraph two, sentence two, "A combination of video inspection, gross gamma scans, and alpha/beta static	The video will be provided to CDPH for their review.

Item	Review Comment	Proposed Response
	measurements were collected to determine the radiological condition of the storm sewer line." Please provide CDPH-EMB an opportunity to review video inspection records and images.	
23	Section 6.2 DATA COLLECTION, page 24, paragraph two, sentence four, "No soil sample adjacent to and/or beneath the drainpipe were collected as visual inspection indicated that no leakage had occurred." Please note that Final Task-Specific Plan Radiological Survey of Building 3 and Impacted Wastewater Drains Naval Station Treasure Island San Francisco, California, Section 3.3 IMPACTED WASTEWATER DRAIN SURVEYS, page 17 paragraph two, sentence seven, requires that, "Soil samples will be collected adjacent to and/or beneath drain piping at random locations and, if evident, where cracked or broken piping may have leaked." Please explain why random soil samples were not collected.	This sentence will be clarified to read: "*No soil samples adjacent to and/or beneath the drain piping were collected as the video inspection and scan survey revealed a pipe in good condition with no suspect integrity or contamination issues*." The Avenue M sewer drain line survey was added work beyond the original scope that the TSP addressed. Since the line is active with no suspect integrity or contamination issues, the risk of damaging it by sampling beneath it was deemed unacceptable.
24	Appendix A, Field Change Request 03, page one, Recommended Solution, paragraph two, sentence two, "To eliminate the difficulties in trying to access the buried section of pipe, removing it from service, and having the surveyor enter the excavation, it is recommended that the piping upstream, i.e., vertical drain lines accessible from the roof and/or within the building, be surveyed and a sediment sample be collected at the downstream manhole next to the lift station." Building 233 was demolished and removed January, 2011; please explain how, " ... piping upstream, i.e., vertical drain lines accessible from the roof and/or within the building ... " will be surveyed.	Paragraph two under Recommended Solution of the referenced field change request addresses the Building 3 piping. The first paragraph addressed the drain piping downstream of Building 233.
25	Appendix A, Field Change Request 03, page two, this page apparently has not been completed. There are no signatures for the Gilbane Technical Reviewer or for the Gilbane Project Manager. None of the check boxes have been completed so it is impossible to determine whether or not the Gilbane Technical Reviewer and the Gilbane Project Manager have rejected or approved the Field Change Request. Sections three, four and five of the form have no entries; so that Client Approval, Final Resolution, and	An approved copy of the field change request will placed in Appendix A.

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
	Verification of Approved Changes Have Been Implemented; have not been addressed. Please present to CDPH-EMB the completed form or explain how this Field Change Request could have been implemented in the absence of a signed, verified, completed form.	
	CDPH-EMB Comments dated 27 May - Specific Comments	
1	Please readdress Section 2.3.1 Number of Measurements, page ten, paragraph one, sentence one, "A minimum of 20 static measurements were collected per survey unit. This number of static measurements were developed using the MARSSIM process and is based on the design goals and constraints of the RMP (Attachment 1; ITSI Gilbane, 2013a)." CDPH-EMB notes RMP (Attachment 1; ITSI Gilbane, 2013a) is a generalized format on how the apply number of measurements equations. Please note this issue was brought up as Specific Comment number 13 of CDPH-EMB's comments of April 4, 2016. Please supply the specific worked out equation which determined the value used in this document.	Assuming a relative shift of 3.0 and acceptable alpha and beta decision error rates of 0.05, MARSSIM Table 5.1 gives a Pr of 0.983039. Using MARSSIM Equation 5-1, the minimum number of measurements is then calculated as: $$N = \left\{ \frac{\left(Z_{1-\alpha} + Z_{1-\beta}\right)^2}{3\left(P_r - 0.5\right)^2} \right\} = \left\{ \frac{\left(1.645 + 1.645\right)^2}{3\left(0.983039 - 0.5\right)^2} \right\} = 15.5$$
2	Please note that CDPH-EMB utilizes Section 30256 in Title 17 of the California Code of Regulations (17 CCR 30256) to render a decision to concur with a Radiological Unrestricted Release Recommendation or to issue a finding of no further action. CDPH-EMB notes that the Wastewater Lines Downstream from Former Building 233 covered in this document are immediately downstream from catch basins 505, 441, 439, 440, 438, and 437 and their associated piping. These structures are impacted in the Final Historical Radiological Assessment Supplemental Technical Memorandum, Naval Station Treasure Island, San Francisco, California (2014a) and their radiological survey results are detailed in a separate document not yet reviewed by CDPH-EMB. CDPH-EMB reserves to itself the right to re-assess any recommendation stemming from this document upon the review of the radiological survey results of the catch basins mentioned above.	Comment acknowledged.
3	Section 3.1.2 Instrument Response, page 14, paragraph one, sentence two, "Instrument response was checked before each day data were collected."	Survey instrumentation data are provided in Appendix B. This is stated in Section 3.1. Appendix

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
	Please include in the Final Status Survey Report (FSSR) logs of the Quality Assurance (QA) and Quality Control (QC) records, Certificates of Calibrations for the radiological instruments and sources, along with the chi-squared calculations when appropriate; for the radiological instruments used in this document.	B survey instrumentation data include instrument set-up sheets, certificates of calibration, and daily QC results.
4	Figure 5-3 Building 233 Sewer Drain Access Points with Gamma Scan Results, page 21, a manhole appears to be located between potholes numbers one and number two; this manhole is not numbered on the map and there seems to be no results listed in Table 5-2, "Building 233 Drain Gross Gamma Data Summary", or in Table 5-3, "Building 233 Sewer Drain Sample Data Summary". Please explain.	The manhole noted on Figure 5-3 was not surveyed or sampled because of the locations both immediately upstream and downstream that were surveyed and sampled, as noted in the figure.
5	Section 6.2 DATA COLLECTION, page 28, paragraph two, sentence four, "The video inspection revealed points of root intrusion into the pipe at pipe joints. No soil samples adjacent to and/or beneath the drain piping were collected as overall, the video inspection had indicated that and scan survey revealed a pipe in good condition with no suspect integrity or contamination issues." How can a line with root intrusion be considered in overall good condition, with no suspected integrity issues? Please explain.	Some studies classify the degree of root intrusion in sewer systems as Class 1: small and few roots in pipe but no water leakage evident; Class 2: coarse roots penetrate further into pipe and are in water flow; and Class 3 large roots or numerous roots at one site. Using this type of classification, the video inspection suggests a Class 1 root intrusion with the pipeline in overall good condition.
	DTSC Comments dated 13 Feb 2016	
1	Section 1.2-Site Description and Background. The site description discussion is related to the Building 233 site that includes the building footprint and a buffer zone around the building including segments of sewer lines. The study area, which is the subject of the Report, includes the sewer line drainage downstream of the Building 233 site. Please clarify the boundaries of the Building 233 site and the study area.	The following statement will be added to Section 1.2 to clarify the scope of work performed: "*The Navy demolished Building 233 and remediated an area around the building that likely would have been established as a radiologically controlled area boundary during the clean-up of the 1950 spill. The area included a storm drain inlet that was found to be contaminated as well as sanitary sewer and storm drain lines leading from the building. That work was performed earlier by a separate Navy*

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
		contractor. Figure 1-2 shows the radiological investigations that have been performed in and around the Building 233 footprint." As noted, a new Figure 1-2 also will be added to the report.
2	Figure 1-1 - Impacted Wastewater Lines. The HRASTM identified the wastewater lines from Building 3 and Building 233 to the Waste Water Treatment Plant as radiologically impacted. Please show the impacted waste water lines according the HRASTM and label the line segment(s) addressed in the Report. The Building 233 site with the sewer lines within its boundaries, and the sewer lines and lift stations in the study area should also be shown in a new figure that clearly indicates where the sewer remediation stopped within the Building 233 site.	Figure 1-1 shows the scope of work addressed by the report. A new Figure 1-2 will be added to the report that shows the radiological investigations that have been performed in and around the Building 233 footprint.
3	Section 1.5.1-Step 1 - Statement of Problem, Page 6. This section should discuss the cause of the problem or possible radiological contamination in sewer lines downstream from Building 233 which was the Radium-223 spill in the 1950s.	The following sentence will be added to Section 1.5.1: "*Radiological contamination may have occurred as a result of the 1950 spill of Ra-226 that occurred in Building 233.*"
4	Section 1.5.4-Step 4 - Boundaries of the Study, Page 7. This section states "The spatial boundaries constitute the potential radiologically impacted areas from the site and/or building activities." Please clarify that the cited site is the Building 233 site that has been remediated and the study area includes the sewer lines downstream from the Building 233 site.	The sentence will be modified as follows: "*The spatial boundaries constitute the potential radiologically impacted media in and around the wastewater lines downstream of Building 233*."
5	Figure 5-1 Building 233 Sewer Drain Map, Page 7, Figure 5-3 Building 233 Sewer Drain Access Points, Page 19, and Figure 6-1 Avenue M Storm Sewer In-Ground Segments, Page 22. Please show in these figure the boundaries of Buildings 233 site with the remediated sewer lines and the drainage lines that are addressed in the Report.	A new Figure 1-2 will be added to the report that shows the radiological investigations that have been performed in and around the Building 233 footprint. To facilitate data presentation, gross gamma scan results will be added to Figures 5-3, 6-1, and 6-2, which show the wastewater lines that were surveyed.
6	Figure 5-1 Building 233 Sewer Drain Map, Page 19. Please discuss why the scoping survey ended at Lift Station 1 and where this lift station is	The work scope included the sewer drain line running from the site of the former Building 233 to

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
	connected for discharge to the waste water treatment plant.	the lift station.
7	Figure 6-2 Avenue M Storm Sewer Above-Ground Segment, Page 23. Please discuss the ongoing removal action in this segment of the storm sewer line called Avenue N Wood Stave Pipe Removal Action. Portions of this above-ground storm drain line have been removed to access the underground wood stave pipe that was previously used as storm drain.	The scope of this project did not include Avenue N and that work is being performed by another contractor. Results will be provided in the report for that project.
	TIDA Comments dated 28 Jan 2016	
1	Section 6.2, Data Collection: In the last paragraph on page 24, please include some discussion or explanation for the roots noted on some of the radiological survey forms provided in Appendix E.	A sentence will be added noting, "*The video inspection revealed points of root intrusion into the pipe at pipe joints*."
2	Section 6.4.1, Box and Whisker Plot: In the first sentence, was "beta distribution" intended to read "data distribution"? Please revise to avoid confusion with the Beta Distribution that is sometimes used in statistical analyses.	The sentence will be revised as follows: "*Box and whisker plots provide insight into the location, shape, and spread of the data. These plots identify the outlier on the lower end of the beta static measurement data distribution*."
3	Section 6.4.1, Box and Whisker Plot: In the last sentence, please reword or clarify what was meant by "… and only the minimum value are plotted."	The referenced sentence will be reworded as follows: "*Maximum or minimum values outside that range are shown as outliers. While there may be multiple outliers, only the outlier representing the maximum or minimum value is plotted.*"
	TICD Comments dated 01 Feb 2016	
1	Section 2.1, third sentence – Please clarify that "Class 1" indicates the highest potential for residual radioactivity above the radiological screening criteria, and "Class 3 survey unit" indicates the lowest potential.	A sentence will be added stating, "*Class 1 indicates the highest potential for residual radioactivity above the radiological screening criteria, while Class 3 indicates the lowest potential*."
2	Section 5.4, second paragraph, first sentence – Text states concentrations ranged from 0.16 to 0.77 pCi/g, but table indicates range is 0.16 to 0.78 pCi/g. Also the sentence refers to "Section 2.6" but there is not a Section 2.6 included in the report.	The referenced sentence will be corrected to state 0.78 pCi/g. The reference to Section 2.6 will be deleted.
3	Section 6.4, text and Table 6-3:. Radiological screening criteria is stated as	The last sentence of the 2nd paragraph of Section

NAVY RESPONSE TO COMMENTS

Review Comments for the DRAFT Report Scoping Survey of Wastewater Lines Downstream from Former Building 233, Former Naval Station Treasure Island, San Francisco, California. Issued December 30, 2015.

Item	Review Comment	Proposed Response
	100 dpm/100 cm^2 on page 1 of the report. In Table 6-3, for the static beta activity there is a maximum measurement of 905 dpm/100 cm^2 (and minimum detectable concentration of 477 dpm/100 cm^2). Section 6.5, last paragraph states that all data were below the radiological screening criteria. It is unclear whether the screening criteria is applied to both alpha and beta scans or if there is a separate beta criteria.	6.4 will be modified as follows: "*The alpha and beta static measurements are graphed on Figures 6-4, 6-5, and 6-6. The alpha static measurements are below the radiological screening criteria. There are no radiological screening criteria for beta static measurements*."

ATTACHMENTS

Attachment 1 Task-Specific Plan: Radiological Survey of Impacted Wastewater Drains

ATTACHMENT 1

Task-Specific Plan: Radiological Survey of Impacted Wastewater Drains

FINAL
TASK-SPECIFIC PLAN
RADIOLOGICAL SURVEY OF
BUILDING 3 AND IMPACTED WASTEWATER DRAINS
Naval Station Treasure Island
San Francisco, California

Prepared under:

Contract Number N62473-10-D-0808
Contract Task Order 0006
Document Control Number: ITSI-0808-0006-0016

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October 2013 **ITSI Project No. 07204.0006**

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LIST OF ACRONYMS AND ABBREVIATIONS

CDPH	California Department of Public Health
cm	centimeter(s)
cm^2	square centimeter
cm/s	centimeters per second
cpm	counts per minute
CoC	chain of custody
CSO	NSTI Caretaker Site Office
DoD	United States Department of Defense
dpm	disintegrations per minute
DQO	data quality objective
HRA	historical radiological assessment
IDW	investigation-derived waste
ITSI Gilbane	ITSI Gilbane Company
LBGR	lower bound of gray region
LLRW	low-level radioactive waste
m	meter(s)
m^2	square meter(s)
m/s	meters per second
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MDC	minimum detectable concentration
mg/cm^2	milligram per square centimeter
min	minute(s)
N/A	not applicable
NAD	North America Datum
NaI(Tl)	sodium iodide (thallium-activated)
Navy	United States Department of the Navy
NRC	United States Nuclear Regulatory Commission
NSTI	Naval Station Treasure Island
pCi/g	picocuries per gram
QA	quality assurance
QC	quality control
Ra-226	radium-226
RASO	Naval Sea Systems Command Detachment, Radiological Affairs Support Office
ROC	radionuclide of concern
ROICC	Resident Officer in Charge of Construction
RMP	NSTI Basewide Radiological Management Plan
RPM	Remedial Project Manager
RPP	Radiation Protection Plan
SAP	Sampling and Analysis Plan
Th-232	thorium-232
TriEco-Tt	Tri-Eco and Tetra Tech EMI Joint Venture
TSP	task-specific plan

UBGR	upper bound of gray region
USA	Underground Service Alert
Weston	Weston Solutions, Incorporated
WRS	Wilcoxon Rank Sum
WWII	World War II
ZnS(Ag)	zinc sulfide (silver-activated)

1.0 INTRODUCTION

This task-specific plan (TSP) provides information and details for the radiological survey of Building 3 and impacted wastewater drains at the former Naval Station Treasure Island (NSTI) in San Francisco, California. The impacted wastewater drains include existing gravity-fed wastewater drain piping that extends from Building 3, and from beneath the footprint of the former Buildings 7 and 233, and continues to downstream pumping stations. Survey data will be collected and analyzed to determine if residual radioactivity requiring remediation is present. If remediation is required, the Navy will be consulted. If no remediation is required, the survey data will provide the suitable technical basis to clear the building and wastewater collection system radiologically for unrestricted use.

This TSP was prepared by the ITSI Gilbane Company (ITSI Gilbane) for the United States Department of the Navy (Navy) Base Realignment and Closure Program Management Office West under Radiological Environmental Multiple Award Contract N62473-10-D-0808, Contract Task Order 0006, with the Naval Facilities Engineering Command Southwest, based on the Statement of Work submitted by the Navy on July 12, 2012, and amended on August 17, 2012, and August 23, 2012.

1.1 SITE DESCRIPTION AND SUMMARY

The *Final Treasure Island Naval Station Historical Radiological Assessment, Former Naval Station Treasure Island, California* (HRA; Weston Solutions, Incorporated [Weston], 2006), provides a comprehensive history of radiological operations conducted by the Navy and its contractors at the former NSTI. No radiological investigations of Building 3 or of the impacted wastewater drains have been performed.

1.1.1 Building 3

Building 3 is located in the southeastern corner of NSTI, as shown on Figure 1 (found at end of document). It is a large hangar surrounded by an attached two-story-high structure on three sides. The building covers approximately 145,000 square feet (13,500 square meters [m^2]), and is one of the original buildings constructed on Treasure Island for the 1939 Golden Gate International Exposition. Figure 2 shows views of Building 3.

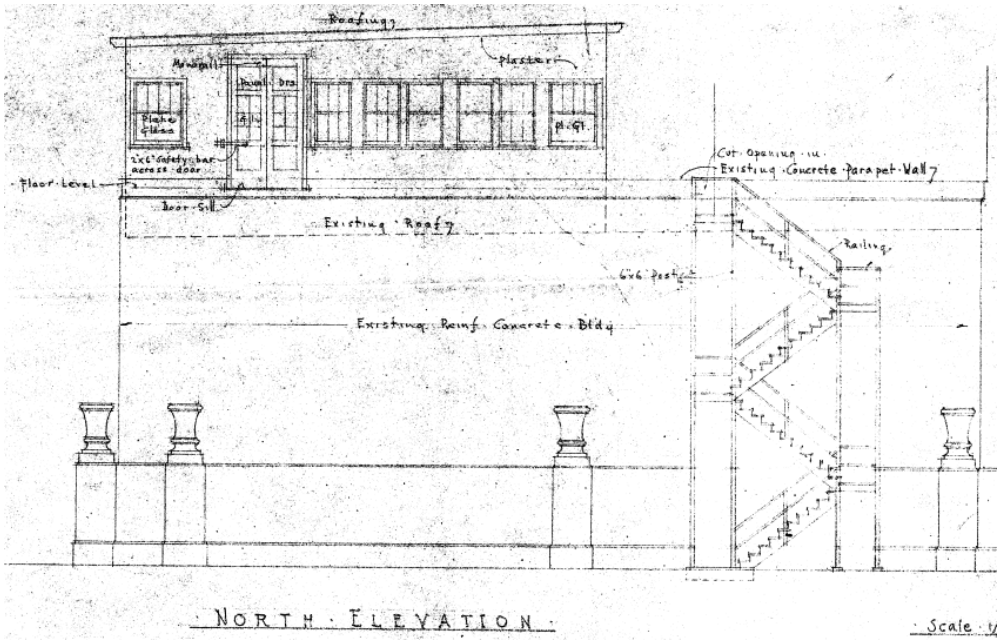
Figure 2 - Views of Building 3

View of East Side (Looking West)

Aerial View From the South

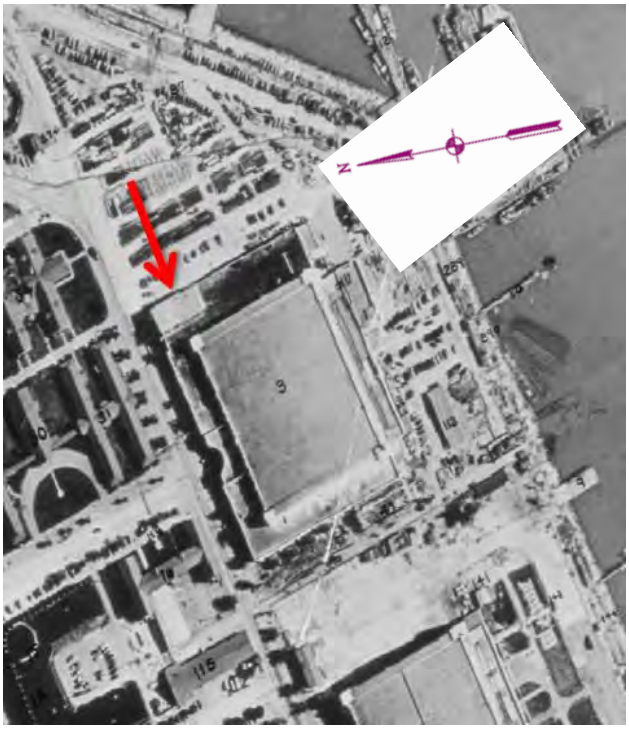
Extensive ship repair activities occurred at the former NSTI during World War II (WWII). Building 3 was configured to conduct significant inside shop work associated with ship repair activities. The building is considered to be radiologically impacted due to the potential for those repair activities to have involved radioactive material, such as radioactive deck markers found on hull plating or radioluminescent gauges associated with ship repair activities. Research also identified the presence of an optical shop (now demolished) in the northeastern corner of the roof (see Figures 3 and 4).

Figure 3 – Elevation View of Optical Shop on Building 3 Roof (Looking South)

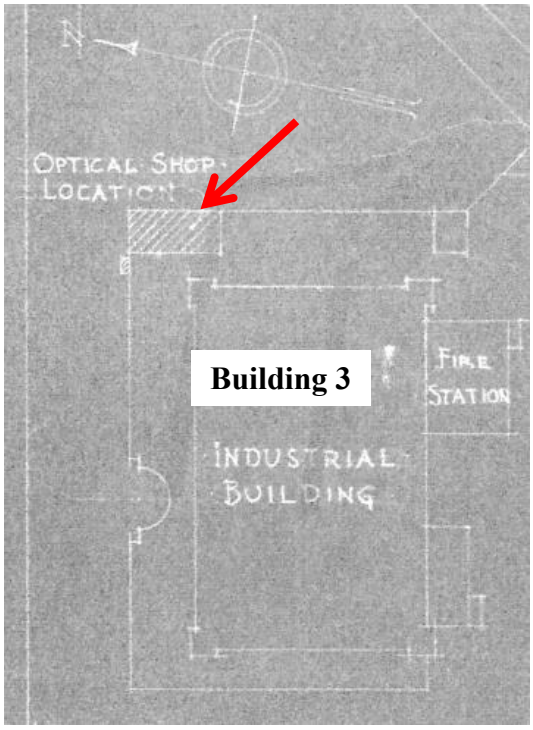


(Source: Treasure Island D.P.W Drawing No. DB-33.486 [Navy, 1944])

Figure 4 – Photo and Drawing Showing Location of Optical Shop on Building 3



(Source: Draft HRA – Supplemental Technical Memorandum [TriEco-Tt, 2012], circa 1945)



(Source: Treasure Island D.P.W Drawing No. DB-33.486 [Navy, 1944])

The optical shop was 91 feet (28 meters [m]) long by 40 feet (12 m) wide, and was built on a platform above the Building 3 roof nearly flush with the top of the concrete parapet walls (see Figure 3). The presence of an optical shop is notable, as these shops on other bases historically have been found to have radium and thorium contamination associated with their operations. Radium and thorium were used for their radioluminescent properties in gauges, deck markers, optical sighting devices, and range-finders during the WWII period.

1.1.2 Impacted Wastewater Drains

Radioactive material may have been discarded down wastewater drains in buildings where activities involving radioactive materials occurred. The optical shop on the roof of Building 3 was a possible source of contamination. The plan elevation and details show the presence of sinks and drains in the optical shop. The optical shop was demolished in 1969, and part of the drain line serving the shop was removed along with the shop. The remaining drain lines, highlighted on Figure 5, are considered impacted from the point of origin in the shop to the pump station. The 6-inch sanitary sewer line shown on Figure 5 was added sometime after 1943, as it

is not shown in earlier drawings and, therefore, may have been added in association with the construction of the optical shop. The system from the Building 3 drains by gravity into Sump No. 5, as shown in Figure 5.

Activities involving radioactive materials occurred in the former (now demolished) Buildings 7 and 233. Early on, Building 7 was used for radiation safety training. In 1950, a significant radium spill occurred in Building 233. The wastewater collection systems from the former Buildings 7 and 233 join and drain by gravity to Sump No. 6, as shown in Figure 6.

1.2 SCOPE

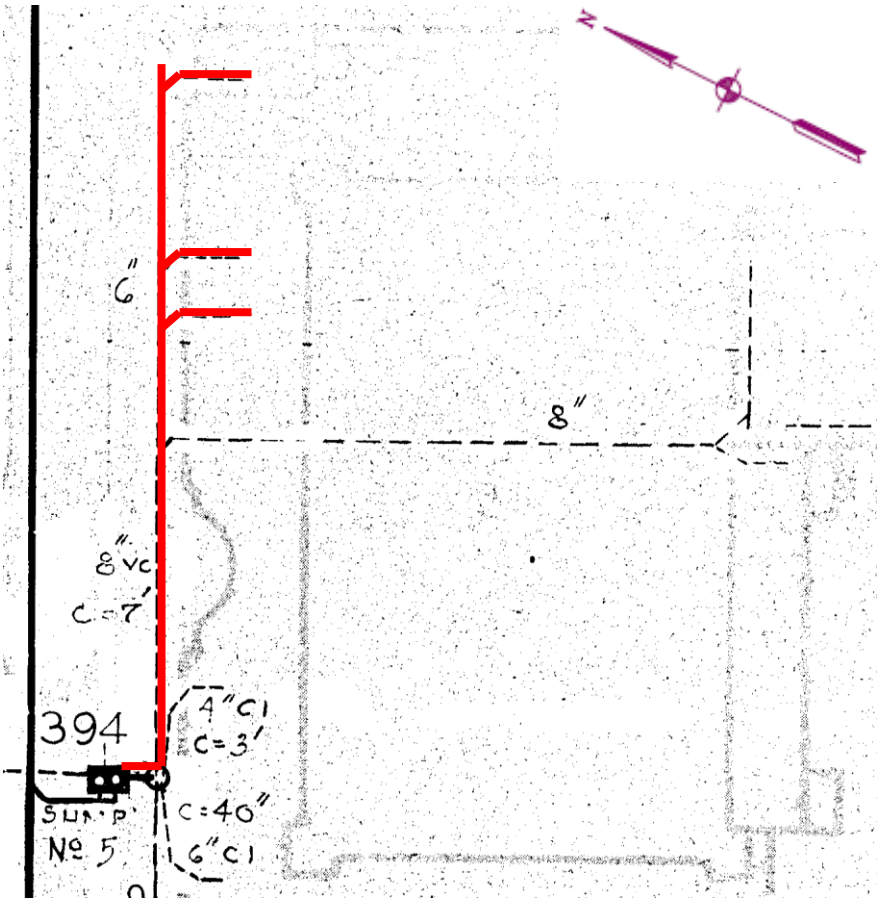
Building 3 was used for ship repair activities during WWII, and these activities may have involved radioactive materials. Therefore, the entire building will require radiological evaluation. A primary area of concern at Building 3 is the northeastern corner of the roof, where the optical shop was located, and the sanitary sewer pipe (drains and standpipe) that drains the roof area. In addition to the building proper, the radiological evaluation will include the ground surface for a 2-m width around the perimeter of the building, with a focus on the roof storm drain outfalls and building entryways.

The radiological survey will include the portions of the wastewater collection system from buildings in which activities involving radioactive materials occurred. Specifically, this includes the gravity-fed wastewater pipes and manholes that drain the northeastern corner of Building 3 to Sump No. 5 (see Figure 5) and the gravity-fed wastewater pipes and manholes that drained former buildings 7 and 233 to Sump No. 6 (see Figure 6). The upstream piping shown in Figure 6 has been removed. The piping downstream of the sumps, which is outside the survey scope, subsequently is connected to the force main to the treatment plant. A summary of system components within the survey scope, based on a 1972 drawing (Drawing No T.I. SE-121), is provided in Table 1.

1.3 GUIDING DOCUMENTS

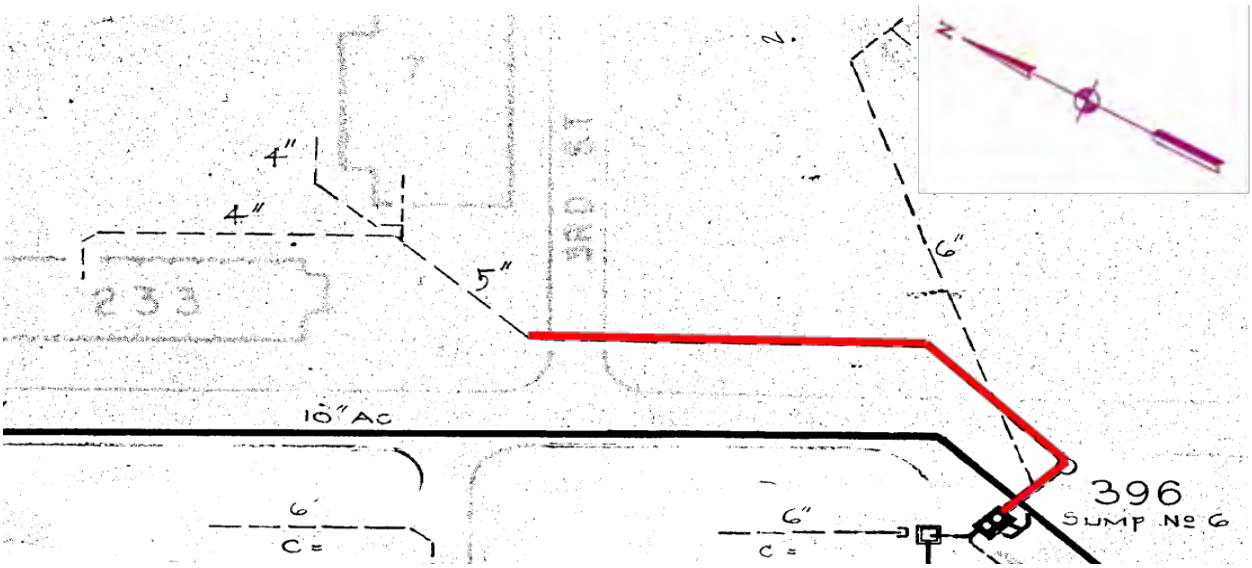
Where not otherwise specified in this TSP, work activities will be accomplished in accordance with the procedures and methodologies detailed in the *Basewide Radiological Management Plan, Naval Station Treasure Island, San Francisco, California* (RMP; ITSI Gilbane, 2013). Supporting documents guiding work activities are appended to the RMP.

Figure 5 – Wastewater Collection System Draining, Northeastern Corner of Building 3



(Source: Drawing No. T.I. SE-121; piping within scope denoted in red)

Figure 6 – Wastewater Collection System Draining, Former Buildings 7 and 233



(Source: Drawing No. T.I. SE-121; piping within scope denoted in red)

Table 1 – Summary of Wastewater Collection System Components

Impacted System/ Pipe Diameter	Wastewater Pipes (Estimated Length)				No. of Manholes	No. of Pump Stations
	5-inch	6-inch	8-inch	Total		
Building 3	--	105 m	45 m	150 m	1	1
Buildings 7 and 233	15 m	105 m	--	120 m	2	1

Source: Drawing No. T.I. SE-121, Treasure Island Sanitary Sewer System, dated August 1972
m - meters

1.3.1 Qualty Assurance/Quality Control

Quality assurance (QA) and quality control (QC) activities will be implemented and maintained in accordance with the Contractor Quality Control Plan and the Sampling and Analysis Plan (SAP) provided as Appendices A and B, respectively, to the RMP (ITSI Gilbane, 2013).

1.3.2 Radiation Protection

Radiation protection measures will be implemented and maintained in accordance with the Radiation Protection Plan (RPP) provided in Appendix C to the RMP (ITSI Gilbane, 2013).

1.3.3 Environmental Protection

Environmental protection will be implemented and maintained in accordance with the Waste Management Plan, the Storm Water Pollution Prevention Plan, and the Dust Control Plan provided in Appendices D through F, respectively, to the RMP (ITSI Gilbane, 2013).

1.3.4 Health and Safety

Health and safety measures will be implemented and maintained in accordance with the Health and Safety Plan, which includes an Accident Prevention Plan, Site Safety and Health Plan, and an Activity Hazard Analysis. The Health and Safety Plan is provided in Volume II of the RMP (ITSI Gilbane, 2013).

1.4 RADIOLOGICAL SCREENING CRITERIA

The radiological screening criteria are listed in Table 2. The radionuclides of concern (ROCs) are radium-226 (Ra-226) and thorium-232 (Th-232). There are no chemicals of concern.

The survey data will be statistically compared to background to determine if residual radioactivity levels are indistinguishable from background. Depending on the data collected, sites will be recommended for unrestricted release, further characterization, or remediation. The

data collected are anticipated to be sufficient for unrestricted release, assuming that no radiological contamination is found.

Table 2 - Radiological Screening Criteria[a]

Radionuclide of Concern	Surface Residual Radioactivity (dpm/100 cm^2)[b]	Soil (or Volumetric) Residual Radioactivity (pCi/g)[c]
Ra-226	100	1.0
Th-232	100	N/A[d]

Notes:

a. Source: Table 3.1, RMP (ITSI Gilbane, 2013).
b. Values are net (i.e., above background) concentrations, in disintegrations per minute per 100 square centimeters (dpm/100 cm^2).
c. Values are concentrations above background, in picocuries per gram (pCi/g).
d No screening criteria have been established at NSTI for Th-232.

Instrument-specific detection sensitivities based on actual field conditions will be used to establish *a priori* minimum detectable concentrations (MDCs) prior to instrument use. The nominal detection sensitivities should be no more than 0.5 times the radiological screening criteria.

1.5 DATA QUALITY OBJECTIVES

The data quality objectives (DQOs) for the radiological survey of Building 3 and impacted wastewater drains are defined in the SAP and summarized in Table 3 (found at end of document).

2.0 SURVEY DESIGN

The outputs from the DQO process and guidance from MARSSIM (DoD, 2000) were used to develop a survey design for data collection. The survey design integrates both probability-based (random and random-start/systematic) and judgmental (biased) data collection methods to achieve the project DQOs. Table 4 lists the survey units and the key design parameters.

Table 4 – Survey Units

Survey Unit Description	Estimated Area (m^2)	Surface Material(s)
Building 3 Optical Shop Roof Area (Class 1 Area)		
Optical shop roof area – north section	100	concrete[a]
Optical shop roof area – center section	100	
Optical shop roof area – south section	100	
Optical shop roof area – buffer area on west side	100	
Optical shop roof area – buffer area on south side	80	
Balance of Building 3 (Class 3 Area)		
Balance of lower roof	5,350	tar, gravel
Main hangar roof	7,750	asphalt shingle
Main hanger area (ground floor)	7,750	concrete
Offices and support areas (ground floor)	5,750	concrete, floor tile
Offices and support areas (other than ground floor)	TBD	TBD
Ground surface perimeter (2-m width) around building, including roof storm drain outfalls and building entry ways	1,050	asphalt, concrete
Wastewater Drains (Class 1 Area)		
Sanitary sewer pipe (drains and standpipes above grade) that drain northeast corner of the Building 3 roof (5- and 6-inch-diameter pipe)	45[b]	metal,adjacent building materials
Gravity-fed wastewater pipes (below grade) and associated manholes which drain northeast corner of Building 3 to pump station 5 (6- and 8-inch-diameter pipe)	105[b]	clay, concrete, soil
Gravity-fed wastewater pipes (below grade) and associated manholes which drained former (demolished) Buildings 7 and 233 to pump station 6 (5- and 6-inch-diameter pipe)	120[b]	clay, concrete, soil

Notes:

a. roofing material to be removed prior to radiological survey and disposed as investigation-derived waste.
b. linear length, in meters.

TBD – to be determined

2.1 CLASSIFICATION

A primary area of concern at Building 3 is the northeastern corner of the roof where the optical shop was located. The optical shop roof area, including a buffer area around it, is designated a Class 1 area. The balance of Building 3 is designated a Class 3 area. There are no Class 2 areas associated with Building 3. The existing gravity-fed wastewater drain piping running downstream from Building 3 and from the former Buildings 7 and 233 is designated a Class 1 area, as it has been identified as having a reasonable potential for residual radioactivity from historical activities.

2.2 SURVEY UNITS

Building 3 is divided into five Class 1 survey units (optical shop roof area) and six Class 3 survey units (balance of building). Class 1 survey units are limited in size of floor area to approximately 100 m^2. No floor area size restriction is imposed on Class 3 survey units. The survey units consist of the exposed interior surfaces (i.e., floors, lower walls, doorways, and entry/exit points), including access points to floor and roof drains, in areas where activities involving radioactive material may have occurred. The impacted media are the concrete, floor tile, masonry, and plasterboard found on exposed interior building surfaces, primarily the floor and lower walls; and the tar, gravel, and asphalt roofing on the roof.

The impacted wastewater drains are divided into three Class 1 survey units. The impacted media are the clay, concrete, and metal internal surfaces of the drain system components and, in the event a leak occurred, the surrounding soil or building material.

Data analysis will be performed and a separate decision will be made for each survey unit as to its suitability for radiological clearance (see Section 5.0).

2.3 SURFACE SCAN MEASUREMENTS

Scan measurements of Class 1 survey units will be performed over 100 percent of the accessible and suitable surface areas. Scan measurements will be performed over up to 25 percent of the surface areas of each Class 3 survey unit. The areas of highest potential for elevated residual radioactivity (e.g., corners, ditches, and drains) will be selected based on professional judgment. This provides a qualitative level of confidence that no areas of elevated residual radioactivity will be missed by the static measurements and that there were no errors made in the classification

of the survey unit. If the entire survey unit has an equal probability for areas of elevated residual radioactivity, systematic scans will be performed along transects of the survey unit or of randomly selected grid blocks.

Two types of scan measurements will be performed. The scan measurement methods are described in Section 4.2. A gross gamma scan will be performed of Class 1 areas, including wastewater drain piping whose surfaces may be inaccessible or difficult to measure directly using field survey detectors and established techniques. The gross gamma scan will be performed to locate radiation anomalies (i.e., irregularities) that might indicate areas of volumetric or subsurface residual radioactivity not readily detectable by the alpha/beta surface scan, but that warrant further investigation.

An alpha/beta surface scan will be performed of structure surfaces, including accessible wastewater drain piping. The alpha/beta surface scan will be performed to detect small areas of elevated surface residual radioactivity that may not be detected by static measurements using a random-start systematic pattern (Class 1 areas) or a random pattern (Class 3 areas).

Where alpha/beta surface scans cannot be performed because of surface or other conditions (e.g., Building 3 exposed concrete roof area), a series of "rolling" static measurements may be performed in lieu of surface scan measurements resulting in similar coverage and detection sensitivity as would be achieved by scanning. The manner in which these "rolling" static measurements will be performed is described in Section 4.2.

2.4 STATIC MEASUREMENTS

Static measurements of alpha- and beta-emitting surface residual radioactivity will be collected from accessible and suitable structure surfaces. The static measurements will provide a quantitative measure of the radioactivity present at the location measured for comparison to the radiological screening criteria. The static measurement method is described in Section 4.2.

2.4.1 Number of Measurements

A minimum of 20 static measurements will be collected per survey unit. This number of measurements was developed using the MARSSIM process and is based on the design goals and constraints described in Attachment 1 of the RMP (ITSI Gilbane, 2013).

2.4.2 Measurement Locations

A random-start systematic square grid pattern will be used to identify measurement locations in Class 1 survey units. The starting point will be determined by a random selection process, and successive measurement locations will be distributed around the starting point in a systematic pattern across the survey unit. The physical spacing of the measurement locations, L, was determined as follows (MARSSIM [DoD, 2000], Equation 5-6):

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

where n is the number of measurements (20) and A is the total surface area of the survey unit. The measurement locations will be identified around the starting point at radial intervals of 90 degrees and spaced from each other at a distance of L. This process will be repeated at successive points to identify the pattern of measurement locations throughout the survey unit. For wastewater drain piping, the random-start systematic pattern will applied in a linear fashion.

Measurement locations in Class 3 survey units will be generated using a random number generator or other random selection method. Random means that each measurement location in the survey unit had an equal probability of being selected.

Measurement locations that do not fall within the survey unit area or that cannot be surveyed due to site conditions, including health and safety considerations, will be replaced with other measurement locations determined using the random selection process.

Measurement locations selected on the basis of professional judgment violate the assumption of unbiased measurements used to develop the statistical tests and will not be used in the statistical evaluation.

2.4.3 Location Identification

Measurement locations within each survey unit will be identified clearly and documented to ensure that they can be relocated if necessary. Actual measurement locations will be marked with flags, stakes, notations on survey maps, or equivalent methods. Each measurement location will be identified by a unique identification code or number to allow the survey data to be

referenced to specific measurement locations identified on the photographs, drawings, or maps of the survey unit. The measurement numbering scheme to be used is described in the SAP.

2.5 SUPPLEMENTAL SAMPLES

Supplemental samples such as soil, bulk material, and smear samples may be collected for laboratory analysis where residual radioactivity is suspected to be present and additional qualitative information regarding its form and/or isotopic composition is desired. Supplemental sampling methods are described in Section 4.4.

2.6 DATA INVESTIGATION

While measurements above the radiological screening criteria are not necessarily unexpected for a Class 1 survey unit, any scan or static measurement exceeding the radiological screening criteria will be investigated. In addition, areas identified by scan measurements whose readings exceed the mean plus three standard deviations (3σ) of the collected data set will be investigated. Readings above this value indicate a probability greater than 99% that the data point does not belong to the same population as the rest of the data set (i.e., potentially represents contamination rather than background radioactivity) and should be investigated.

2.6.1 Investigation

Locations identified by scan or static measurements with residual radioactivity that exceeds the radiological screening criteria will be marked and investigated. The elevated survey measurement will be confirmed to verify that it actually exceeds the radiological screening criteria. The area around the elevated measurement will be investigated to determine the extent of the elevated residual radioactivity and to provide reasonable assurance that adjacent undiscovered areas of elevated residual radioactivity do not exist.

Static measurements above the radiological screening criteria that should have been identified by scan measurements, but were not, may indicate that the scanning method is inadequate. In that case, the scan method will be evaluated and appropriate corrective actions will be taken and documented. Corrective actions may include rescanning the survey unit.

Depending on the results of the investigation, the survey unit may require remediation, resurvey, or reclassification (Class 3 to Class 1). The Navy will be consulted to provide that direction.

2.6.2 Remediation

Areas of elevated residual radioactivity that exceed the radiological screening criteria will be remediated to reduce elevated residual radioactivity to acceptable levels. Based on the survey data, all or a portion of a survey unit may be remediated. Remediation may include removal of materials such as asphalt applied over soil, concrete, and/or piping; removal of localized hotspots or commodities; soil excavation; and surface decontamination. If soil contamination extends deeper than 15 centimeters (cm) below the drain piping, the Navy will be notified and, following Navy direction, the contamination will be remediated.

Remedial action support surveys will be conducted to assess the effectiveness of remedial action and to guide the remediation in real time. Radiation protection measures, including radioactive material and contamination control, will be instituted as described in the RPP.

2.6.3 Resurvey

If remediation activities are performed, then a resurvey will be performed. Where a small fraction of the area of the survey unit is remediated, a resurvey of only the remediated area will be performed. Scan measurements will be performed over 100 percent of the remediated area. Biased static measurements will be collected in and around the remediated area to ensure the efficacy of the remedial action. Replacement (post-remediation) static measurements will be collected within the remediated area at the same systematic measurement locations.

2.6.4 Reclassification

If survey measurements in a Class 3 survey unit exceed the radiological screening criteria or suggest that there may be a reasonable potential that residual radioactivity is present in excess of the radiological screening criteria, the survey unit will be reclassified as a Class 1 survey unit. A Class 3 survey unit that is remediated will be reclassified as a Class 1 survey unit.

Due to size restrictions and other considerations, a reclassified survey unit may be divided into two or more survey units. The extent of the elevated residual radioactivity (and corresponding remediation) relative to the total area of the original survey unit will be considered.

2.7 BACKGROUND REFERENCE AREA

Representative measurements of background may be collected from one or more reference areas for comparison with scan measurements, static measurements, and/or volumetric samples. If

used, reference areas will be selected from non-impacted areas that have radiological, chemical, and physical characteristics similar to the survey unit with which their measurements will be compared. The measurements will be distributed randomly within the reference area, as recommended by MARSSIM (DoD, 2000), Section 5.5.2.5. The same number and type of measurements will be collected in the reference area as in the corresponding survey unit.

2.8 REFERENCE COORDINATE SYSTEM

A reference coordinate system will be used to facilitate the selection of measurement locations and to provide a mechanism for referencing a measurement to a specific location. Scale drawings, maps, or photographs of the survey area will be prepared and oriented according to the reference coordinate system. Where not otherwise specified, the state plane coordinates for the California State Plane Zone 3, North American Datum (NAD) 1927, will be used.

3.0 FIELD IMPLEMENTATION

Field implementation activities will be performed in accordance with the RMP, Section 7.0.

3.1 NOTIFICATIONS

Table 5 summarizes the events for which notifications will be made and the persons and/or agencies to which the notifications will be made.

Table 5 – Notifications

Notification Event	Navy RPM	RASO	ROICC	CSO	CDPH	USA
Mobilization	✓	✓	✓	✓		
License implementation	✓				✓	
Soil excavation	✓					✓
Significant event[a]	✓	✓	✓	✓		
Schedule change	✓	✓	✓	✓		
Demobilization	✓	✓	✓	✓		

Notes:
[a] See definition in the RMP, Section 7.1.2.
Navy RPM – Navy Remedial Project Manager
RASO – Naval Sea Systems Command Detachment, Radiological Affairs Support Office
ROICC – Resident Officer in Charge of Construction (Navy)
CSO – NSTI Caretaker Site Office
CDPH – California Department of Public Health
USA – Underground Service Alert

3.2 BUILDING 3 SURVEYS

Building 3 surveys generally will be performed in a top-down and inside-out manner. Roof areas will be surveyed first, followed by building areas above the ground floor, and then the ground floor areas inside the building.

The first survey to be performed will be of the roof areas where the optical shop was located. A gross gamma surface scan will initially be performed. The roofing material will be removed and stockpiled in such a manner that its location on the roof can be determined. An alpha/beta surface scan then will be performed, followed by the collection of static measurements in accordance with the survey design. Locations with readings above the radiological screening criteria will be investigated (see Section 2.6).

The removed roofing material will be treated as investigation-derived waste (IDW) and segregated as either low-level radioactive waste (LLRW) or non-LLRW. Where residual radioactivity above the radiological screening criteria is detected in the roofing material itself or on the surface beneath it, the material will be deemed LLRW and turned over to the Navy's waste contractor for disposal as such. The Building 3 roof will be returned to its pre-survey condition.

3.3 IMPACTED WASTEWATER DRAIN SURVEYS

Wastewater drain surveys generally will be performed in a top-down, upstream-downstream manner. The Building 3 above-grade drains and standpipes will be surveyed before the below-grade drain piping. Surveys will be performed starting at the upstream end of the wastewater drain piping and working toward the downstream terminus. If not already present, an opening will be created by excavation to verify that piping is present and can be followed from the point of origin. In the event that no line features are present, excavator potholing may be used to verify the presence or absence of drain piping.

As a general rule, access to internal surfaces will be created (i.e., the soil will be excavated and the piping cut or broken into) approximately every 15 m to facilitate data collection. Alpha/beta static measurements will be taken at these points. A visual inspection of the pipe internals will be performed by running a camera through the pipe to identify sediment, debris, and cracked or broken piping where leakage may have occurred. Gross gamma surface scan measurements will be taken between access points by pushing or pulling the detector through the piping in a controlled manner. Inaccessible or difficult-to-measure internal surfaces will be assumed to have the same level of residual radioactivity as that found on accessible internal surfaces. Scale and sediment samples of residual material will be collected. Soil samples will be collected adjacent to and/or beneath drain piping at locations where cracked or broken piping may have leaked. Localized excavation (e.g., pot holing), direct push (e.g., Geoprobe), directional soil boring, or similar methods will be used to minimize the extent of soil disturbance.

A combination of visual inspection, gross gamma surface scan measurements, alpha/beta static measurements at accessible locations, samples of residual material inside the pipe, and samples

of soil adjacent to and/or beneath the pipe at points of possible leakage will be used to determine the radiological condition of the drain piping and the surrounding soil.

Loose material generated during excavation will remain at the point of excavation and returned to the hole once the survey is complete. In the event that water accumulates in an excavation cavity and/or impedes survey activities, it will be managed in a manner similar to decontamination water and stormwater runoff. Removed water will be pumped into a holding tank. It will be filtered, sampled, and analyzed to verify compliance with the radiological screening criteria prior to discharge.

4.0 DATA COLLECTION

Survey data will be collected by trained individuals using calibrated instruments as prescribed by Section 4.2 and Section 8.1 of the RMP (ITSI Gilbane, 2013).

4.1 INSTRUMENTATION AND METHODS

Survey measurements will be performed using the instrumentation and methods described below. Typical survey instrumentation is shown in Table 6. Where the indicated instrumentation is unavailable or is unsuitable to field conditions, an equivalent instrument will be used. Changes made to the survey methods, including any field adjustments made to surface-to-detector distance, scan rate, or count time, will be documented.

Table 6 - Typical Survey Instrumentation

Measurement Type	Detector Type	Effective Detector Area and Window Density	Instrument Model	Detector Model
Gross Gamma Scan	NaI(Tl) scintillation	5.1 cm diameter/length (2x2-inch) N/A	Ludlum 2221	Ludlum 44-10
		40 cm x 10 cm x 10 cm (4L) N/A	RSX-1	RS-700
Alpha/Beta Scan/Static	Gas flow proportional	584 cm^2 3.4 mg/cm² aluminized Mylar	Ludlum 2360	Ludlum 43-37
	Dual phosphor scintillation	100 cm^2 1.2 mg/cm² aluminized Mylar	Ludlum 2360	Ludlum 43-93
Alpha/Beta Smears	Gas flow proportional	5.1 cm diameter 0.08 mg/cm^2	Protean WPC-9550	N/A
	Dual phosphor scintillation	5.1 cm diameter 0.4 mg/cm²	Ludlum 2929	Ludlum 43-10-1

Notes:
cm^2 – square centimeter
cm – centimeter
mg/cm^2 – milligrams per square centimeter
NaI(Tl) – sodium iodide (thallium activated)
N/A – not applicable

Nominal detection sensitivities of typical survey instrumentation are shown in Table 7. The results shown are based on representative count times, background counts, and instrument efficiencies. Instrument-specific values based on actual field conditions will be used to establish *a priori* MDC values before an instrument is used, to ensure that the instrument is capable of detecting radiation at or below the radiological screening criteria.

Table 7 - Typical Detection Sensitivities

Detector Model	Radiation of Interest	Count Time (min)	Back-ground (cpm)	Total Efficiency[a] (cpm/dpm)	Scan MDC[b] (dpm/100 cm^2)	Static MDC[c] (dpm/100 cm^2)
Ludlum 43-37	Alpha	2	10	0.09	N/A	23
Ludlum 43-37	Beta	2	600	0.15	390[d]	67
Ludlum 43-93	Alpha	2	1	0.19	N/A	25
Ludlum 43-93	Beta	2	140	0.12	N/A	340
Protean WPC-9550	Alpha	1	0.05	0.42[e]	N/A	10
Protean WPC-9550	Beta	1	0.4	0.43[e]	N/A	14
Ludlum 43-10-1	Alpha	1	0.6	0.35[e]	N/A	19
Ludlum 43-10-1	Beta	1	40	0.16[e]	N/A	200
RSX-1	Gamma	N/A	100,000	N/A	0.9 pCi/g[f]	N/A
Ludlum 44-10	Gamma	N/A	160	N/A	2.8 pCi/g[f]	N/A

Notes:

a. Total efficiency equals instrument efficiency multiplied by surface efficiency.
b. Scan MDC is calculated per *MARSSIM* (DoD, 2000) Equation 6-10 and assumes a surveyor efficiency of 0.5, and a value of 1.38 for acceptable false indications.
c. Static MDC is calculated per *MARSSIM* (DoD, 2000) Equation 6-7.
d. Scan MDC assumes an observation interval of 1 second, which results from a scan speed of 15 cm (approximately one detector width) per second.
e. 4π detection efficiency assumed
f. Scan MDC is based on detection of Ra-226 and is calculated using the approach described in Section 6.8.2 of NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (United States Nuclear Regulatory Commission [NRC], 1998a).

min – minute
cpm – counts per minute
dpm – disintegrations per minute
cm^2 – square centimeter(s)

4.2 SCAN MEASUREMENTS

The two types of scan measurements to be performed are gross gamma surface scans and alpha/beta surface scans.

4.2.1 Gross Gamma Surface Scan

Gross gamma scans will be performed using the Radiation Solutions, Inc. (RSI) RS-700 self-contained mobile gamma ray detection system. The RS-700 consists of an integrated controller and data acquisition system, a digital gamma ray spectrometer/multi-channel analyzer, and a data controller coupled to sodium iodide (thallium activated) ([NaI(Tl)]) gamma scintillation detector. Pre-set multiple independent regions of interest within the energy spectrum will be programmed into the RS-700 to identify and track specific gamma radiation emissions from gamma-emitting ROCs. The RS-700 system will be mounted on a mobile platform, such as a hand pushcart. For areas where the hand pushcart cannot go, surface scan measurements will be performed using a Ludlum Model 44-10 2-inch by 2-inch (5.1 cm) NaI(Tl) gamma scintillation detector with a Ludlum 2221 rate meter/scaler (or equivalent).

The detector will be maintained at a height of approximately 0.1 m above the ground and moved over the surface at a speed of 0.5 meters per second (m/s), with each pass spaced 0.5 m (more or less based on detector field of view) from the previous pass to achieve 100 percent coverage of the area being surveyed. For scans inside drain piping, the detector will be moved through the piping at a speed of 0.5 m/s or less. No attempt will be made to orient the detector relative to the inside of the pipe. Moving the detector through the pipe along the bottom, where residual radioactivity is more likely to accumulate, will conservatively bias the scan results high. Changes to scan height and speed may be made to optimize detection response while accommodating field conditions.

4.2.2 Alpha/Beta Surface Scan

The alpha/beta surface scan will be performed using a Ludlum Model 43-37 584-square-centimeter (cm^2) large-area gas-flow proportional detector with a Ludlum Model 2360 alpha/beta data logger. Scan measurements will be performed by moving the detector approximately 1 cm above the surface of interest at a scan rate acceptable to the Navy. For alpha scan purposes, a count time interval will be calculated in accordance with Attachment 3 of the RMP (ITSI, 2013). The audible indication of the data logger will be used to alert the surveyor to stop scanning whenever an alpha count is registered. The surveyor will pause at the location where the alpha count was registered for the required time interval to allow the detector to register one or more additional counts that may represent residual radioactivity. The scan rate may be adjusted

depending on the expected detector response. The Ludlum Model 43-93 100-cm^2 zinc sulfide (silver activated) (ZnS(Ag)) dual phosphor scintillation detector with a Ludlum Model 2360 alpha/beta data logger will be used for surface scan measurements of small areas.

Where "rolling" static measurements are performed in lieu of surface scan measurements, the surface measurements will be performed by placing the detector on the surface to be measured, audibly noting the number of alpha counts experienced by the detector. If more than a pre-determined number of counts are detected during the count time interval, a static measurement will be performed at the location. Otherwise, the detector will be moved one detector-width away from the previous measurement location and the process repeated until "rolling" static measurements have been performed over the scan coverage area. The method for pre-determining the number of counts and the count time interval for the "rolling" static measurements is found in Attachment 1.

4.3 STATIC MEASUREMENTS

Static measurements of alpha/beta surface residual radioactivity will be performed using a Ludlum Model 43-37 584-cm^2 large-area gas-flow proportional detector with a Ludlum Model 2360 alpha/beta data logger, or a Ludlum Model 43-93 100-cm^2 ZnS(Ag) dual phosphor scintillation detector with a Ludlum Model 2360 alpha/beta data logger. Surface measurements will be performed by placing the detector on the surface to be measured, taking a two-minute (or longer) scaler count, and recording the reading.

4.4 SUPPLEMENTAL SAMPLING METHODS

The two types of supplemental samples that will be collected are bulk material and smear samples. Each sample will be labeled and assigned a unique sample identification number. The sample identification number, sample location, date and time of sample collection and the name of the sample collector will be recorded. The sample numbering scheme to be used is described in the SAP.

4.4.1 Soil and Bulk Material Samples

Samples of soil and bulk material such as asphalt, concrete, or other material will be representative of the sampled media and will be of sufficient size to allow laboratory analysis to achieve the desired detection level. Methods appropriate to the type of material being sampled

(e.g., scraping chipping, boring, etc.) will be used to collect the sample. Suitable controls will be used to prevent cross-contamination of the sample media. Sampling equipment (e.g., hand and power tools, mixing utensils, and homogenizing bowls) will be decontaminated (using dry methods) between samples.

As a general rule, approximately 1,000 grams of material, if available, will be collected per sample. A smaller sample volume may suffice depending on the laboratory analysis to be performed. Visually identifiable foreign objects and debris will be separated manually in the field. Bulk material samples will be size-reduced in the field to the extent possible.

Samples will be double bagged in one-gallon resealable plastic bags, numbered, logged, and sent for laboratory analysis. Samples will be stored in a secure facility or will remain under positive control of the person collecting the sample until it is time to transfer custody or ship the samples. When custody is transferred (e.g., when samples are sent for laboratory analysis), a chain-of-custody (CoC) record will accompany the samples for tracking purposes. Any special handling requirements identified in the field will be communicated to the laboratory performing the analysis using the sample CoC record. The samples will be packed properly to ensure their safe arrival at the analytical laboratory.

Samples will be analyzed in accordance with the project DQOs. Samples will be prepared by drying, grinding, mixing, sifting, and weighing as appropriate prior to analysis. The samples will be prepared and analyzed in accordance with the laboratory's approved procedures.

Samples will be analyzed by gamma spectroscopy for Ra-226 (using the in-growth method). Additional analyses to detect and quantify fission, transuranic, and source material, including any tests specifically required for waste management, will be performed based on the results of the above analysis and/or discussions with the Navy's waste contractor.

4.4.2 Smear Samples

Smear samples will be collected over approximately 100 cm^2 and analyzed for alpha and beta radioactivity using a Protean WPC-9550 gas-flow proportional alpha/beta counting system (or equivalent), using a count time of one minute or longer to meet the required MDC. Field

counting of samples may be performed using a Ludlum Model 43-10-1 ZnS(Ag) dual phosphor alpha/beta scintillation detector with a Ludlum Model 2929 alpha/beta scaler.

5.0 DATA EVALUATION

The survey data collected according to project DQOs will be both quantitative and qualitative in nature. Data will be analyzed quantitatively for direct comparison to the radiological screening criteria and reviewed qualitatively to determine whether further investigation is appropriate. Static measurements will be used as quantitative inputs. Scan measurements, bulk material samples, and smear samples will be used as qualitative inputs. While those measurements and samples will provide quantitative results, those results will be used in a qualitative manner as there are no quantitative criteria with which to meaningfully compare them. Where analytical laboratory and field measurement results disagree, the analytical laboratory results will be used to support the decision.

5.1 DATA VALIDATION AND VERIFICATION

Survey data will be reviewed to verify that they are authentic, appropriately documented, and technically defensible. The review criteria for data acceptability are as follows:

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

Where one or more of the criteria are not met, the discrepancy will be reviewed, and the reasons for acceptability of the data or the corrective actions taken to restore data acceptability will be documented.

5.2 DATA ANALYSIS

Survey data will be analyzed to identify distribution trends and potential outliers. Data analysis will include visual inspection of measurement results using posting plots, cumulative frequency

distributions, histograms, etc., as required, and calculation of statistical quantities including mean, median, standard deviation, and range. Data analysis of survey results for each survey unit will be performed in the field, as necessary, to evaluate whether an investigation or additional survey data collection is warranted. Data analysis will include investigation of spatial or temporal distribution, outliers, and data population distributions.

5.3 DATA INTERPRETATION

The results of the data analysis will allow one of two conclusions to be drawn. The first conclusion is that the survey data are sufficient to recommend radiological clearance for unrestricted use. The second conclusion is that the survey data are not sufficient to recommend radiological clearance for unrestricted use and further characterization and /or remediation is warranted. Where the survey data are found to represent residual radioactivity statistically distinguishable from background, an assessment of incremental dose to future land users will be prepared.

6.0 DATA REPORTING

Data will be reported to the Navy on a daily basis as it is generated and summarized in a report at the completion of work activities.

6.1 DAILY FIELD REPORTING

Data will be compiled and submitted to the Navy as it is generated in the field to document that field work is being completed as expected. Daily radiological and field reports will be completed throughout the time of the field work performance. The daily reports will include:

- A description of work completed;
- Any deviations from project plans and the reason for these changes;
- The work that is planned to be accomplished during the week of the report;
- Any complications that are identified in the field, how the complications will be resolved, and if they will affect the schedule; and
- A summary of the data that was collected the previous day.

The reports will be submitted electronically to the Navy.

6.2 SURVEY REPORT

A survey report will be prepared to summarize the work performed. Survey data will be reported along with conclusions and recommendations. The results of the analysis and interpretation of survey data will be summarized, and conclusions regarding the radiological status of Building 3 and the impacted wastewater drains will be documented.

Specifically, the report will include:

- A description of the field work and the results of analysis.
- A preliminary screening evaluation of the analytical results collected during the field work.
- Discussion of the results, including interpretation of survey results, an assessment of the data (and whether the data meet the project DQOs), descriptions of data uncertainties, and other information required to support the conclusions and recommendations offered.
- Conclusions and recommendations based on the technical evaluation of the data collected.

A technical summary will be prepared that summarizes the results of the analysis and interpretation of the FSS data, and conclusions regarding the radiological status. The summary will address California Code of Regulations, Title 17, Section 30256(k), which, when satisfied, authorizes CDPH concurrence for release for unrestricted use. The summary will be designed such that it can be used as an attachment to the Navy's request to CDPH for such concurrence.

7.0 REFERENCES

DoD, 2000. Department of Energy, Nuclear Regulatory Commission, and U.S. Environmental Protection Agency. *Multi-Agency Radiation Survey and Site Investigation Manual*, NUREG-1575, Revision 1. August.

ITSI Gilbane, 2013. *Basewide Radiological Management Work Plan, Naval Station Treasure Island, San Francisco, California.* Internal Draft. January.

Navy, 1944. *Optical Shop Plan Elevations and Details, U.S. Naval Frontier Base, Treasure Island, San Francisco Bay*, D.P.W. Drawing No. DB-33.486, approved 26 Sep 1944.

NRC, 1998a. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG-1507. January.

Weston, 2006. *Final Treasure Island Naval Station Historical Radiological Assessment, Former Naval Station Treasure Island, California*. February.

ATTACHMENTS

Attachment 1 – "Rolling" Static Measurement Count Time Interval and Maximum Number of Background Counts

"Rolling" Static Measurement Count Time Interval and Maximum Number of Background Counts

The MDC for static measurements is calculated using MARSSIM (DoD, 2000) Equation 6-7:

$$MDC_{static} = \frac{3 + (4.65)\sqrt{B}}{(E_i)(E_s)(A/100)(t)}$$

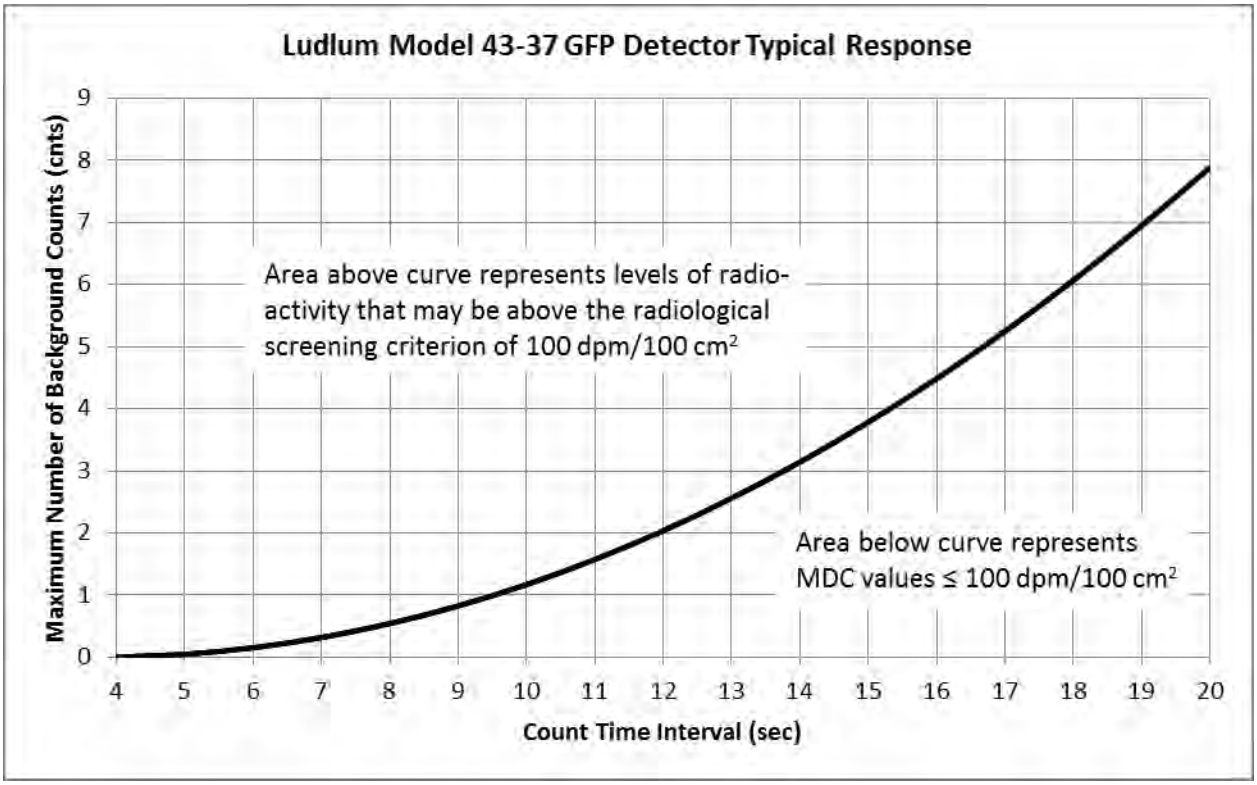
where:

MDC_{static}	=	minimum detectable concentration for static counting (dpm/100 cm^2)
B	=	background counts during count time interval t (cnts)
E_i	=	instrument efficiency for emitted radiation (cpm/dpm)
E_s	=	surface efficiency for emissions/disintegration
A	=	area of detector (cm^2)
t	=	count time interval (min)

"Rolling" static measurements are simply short-counts where, at the 95% probability, if activity is present above the level of interest (i.e., radiological screening criterion) it would be apparent by the number of counts. Assuming a Ludlum Model 43-37 584 cm^2 large-area GFP detector is used with an instrument background (B) of 3 counts, an instrument efficiency (E_i) of 0.33 cpm/dpm, a surface efficiency (E_s) of 0.25, and a count time interval (t) of 0.25 min, the MDC_{static} for the instrument used in this example is then calculated as:

$$MDC_{static} = \frac{3 + (4.65)\sqrt{3}}{(0.33)(0.25)(584/100)(0.25)} = 92\ dpm/100\ cm^2$$

The MDC_{static} equation can be solved for the count time interval, t, and the maximum number of background counts, B, that the detector can experience during the count time interval to ensure an MDC_{static} no higher than the radiological screening criterion of 100 dpm/100 cm^2. Assuming the E_i and E_s values are the same as those used above, the figure on the following page illustrates the relationship between the count time interval, t, and the maximum number of background counts, B, that may be experienced during the count time interval to ensure an MDC_{static} no higher than the radiological screening criterion of 100 dpm/100 cm^2. Where more than this number of counts is detected during the count time interval, radioactivity above the radiological screening criterion of 100 dpm/100 cm^2 may be present and a static measurement is performed.



Instrument-specific *a priori* values for the count time interval, t, and the maximum number of background counts, *B*, that may be experienced during the count time interval will be determined to ensure that an MDC_{static} of equal to or less than 100 dpm/100 cm^2.

FIGURES

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ITSI Gilbane

Radiological Scoping Surveys
Department of the Navy
Naval Station Treasure Island
San Francisco, California

FIGURE 1
NSTI Site Layout Map and Survey Locations

TABLES

Table 3 – Summary of Data Quality Objectives

STEP 1 Statement of Problem	STEP 2 Decisions	STEP 3 Inputs to the Decisions	STEP 4 Boundaries of the Study	STEP 5 Decision Rules	STEP 6 Limits on Decision Errors	STEP 7 Optimizing the Sampling Design
The Navy would like to clear the following radiologically for unrestricted use: Building 3 and existing gravity-fed wastewater pipes that extend from Building 3, and from beneath the footprint of the former Buildings 7 and 233, and continue to downstream pumping stations. Radiological data are needed to determine if residual radioactivity requiring remediation is present. If remediation is required, the Navy will be consulted. If no remediation is required, the data will provide a suitable technical basis for clearing the building and wastewater collection system radiologically for unrestricted use.	The principal study question is: "Is residual radioactivity requiring remediation present in Building 3 and in the impacted wastewater drains?" Total and removable surface contamination measurements will be used to answer the question quantitatively. The following alternative actions will result from resolution of the principal study question: • If the levels of residual radioactivity meet the radiological screening criteria, then the building and drains are suitable to clear radiologically for unrestricted use. • If the levels of residual radioactivity do not meet the radiological screening criteria, then the building and drains are not suitable to clear radiologically for unrestricted use. Based on the principal study question and the alternative actions listed above, the decision statement is: "Determine whether or not the levels of residual radioactivity meet the radiological screening criteria." The decision is formulated into statistical hypotheses. The state that is presumed to exist in reality is expressed as the null hypothesis (denoted by H_o): • H_o: The levels of residual radioactivity do not meet the radiological screening criteria. For the given null hypothesis, the alternative hypothesis (denoted as H_a), which is an expression of what is believed to be the state of reality if the null hypothesis is not true, is: • H_a: The levels of residual radioactivity meet the radiological screening criteria. As the null and alternative hypotheses are applied here, Building 3 and the impacted wastewater drains will not be considered suitable to clear radiologically for unrestricted use unless the survey data show that the levels of residual radioactivity meet the radiological screening criteria.	The ROCs are Ra-226 and Th-232. There are no chemicals of concern. The impacted media are building materials found on exposed interior building surfaces, primarily the floor and lower walls; the former location of the optics shop (northeastern corner of roof) and the sanitary sewer pipe that leaves the area; and wastewater pipes that drained the northeastern corner of Building 3 and the former Buildings 7 and 233. For surfaces, beta surface scan measurements and alpha/beta static measurements will be used as quantitative inputs. Samples of removable surface residual radioactivity (smears) analyzed for gross alpha/beta radioactivity may be used as qualitative inputs. For volumes, volumetric samples analyzed by gamma and/or alpha spectroscopy will be used as quantitative inputs. Gross gamma scan measurements may be used as qualitative inputs. Measurements above the radiological screening criteria will trigger further evaluation of identified areas of elevated residual radioactivity.	The target population is surface and volumetric residual radioactivity concentrations of the ROCs on and/or in the impacted media. The spatial boundaries are the exposed interior surfaces (i.e., floors, lower walls, doorways, entry/exit points), including access points to floor and roof drains, in areas where activities involving radioactive material may have occurred, and from internal surfaces of gravity-fed wastewater pipes. These surfaces constitute impacted areas, which are considered to have been susceptible to radioactive contamination from building activities. Decisions will be made on three fundamental scales: • Localized areas:-The decision to collect additional data will be made for discrete areas with measurement results that exceed the radiological screening criteria. • Survey unit: Building 3 and the impacted wastewater drains will be divided into survey units based on similar physical characteristics and potential for residual radioactivity. A decision will be made for each survey area as to its suitability for radiological clearance or, alternatively, its need for remediation and/or additional data collection. • Entire building or wastewater collection drain: Survey data will be evaluated on a building or wastewater drain-wide basis and used to support decisions made by the primary decision maker regarding suitability for radiological clearance.	The following decision rules will be used to collect data. Parameter of Interest: <u>Scan Measurements</u> Perform scan measurements (gross gamma or beta) over 100% (Class 1) or 10% (Class 3) of surface area. **IF** areas identified with measured radioactivity above mean + 3σ … **THEN** investigate to determine area of elevated residual radioactivity, remediate, and resurvey; **ELSE** collect static measurements. Parameter of Interest: <u>Static Measurements</u> Collect static measurements (alpha/beta surface measurements) from random-start, systematic (Class 1) or random (Class 3) locations. **IF** static measurements exceed radiological screening criteria… **THEN** investigate to determine area of elevated residual radioactivity, remediate if appropriate, and resurvey Parameter of Interest: <u>Statistical Test</u> Perform statistical test if one or more static measurements exceed the radiological screening criteria. **IF** null hypothesis rejected … **THEN** conclude survey unit is acceptable to be radiologically cleared for unrestricted use; **ELSE** investigate failure, remediate, and resurvey.	To ensure data quality, data will be reviewed, verified, and validated in accordance with the SAP. To ensure usability of laboratory data, appropriate laboratory methods have been selected to provide the necessary laboratory detection limits. The two principal decision errors, based on the principal study question, are: • deciding the levels of residual radioactivity meet the radiological screening criteria when, in fact, they do not (referred to as a false negative or Type I decision error); and • deciding the levels of residual radioactivity do not meet the radiological screening criteria when, in fact, they do (referred to as a false positive or Type II decision error). Neither type of decision error is desirable. A Type I decision error is defined as the probability of passing a survey unit that should fail. The consequence of a Type I decision error is that material with elevated residual radioactivity is not remediated properly. A Type II decision error is defined as the probability of failing a survey unit that should pass. The consequences of a Type II decision error are the collection of additional data and/or unnecessary remediation. A decision error rate of 0.05 (5%) will be applied for both Type I and Type II errors for the statistical test. Decision error rates associated with the calculation of instrument MDCs and the number of static measurements also will be set at 0.05 (5%).	A resource-effective design for collecting data sufficient to fulfill study objectives developed in Steps 1 through 6 of the DQO process is described in SAP.