A1 - Title and Approval
Quality Assurance Project Plan
Surface Gamma Scans and Down-hole Gamma Logs

West Lake Landfill OU1
Bridgeton, Missouri

August, 2012

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Appendix A
Field SOPs

A. Project Management

A3. Distribution List

This quality assurance project plan (QAPP) is prepared for the West Lake Landfill site in Bridgeton, Missouri, and is submitted as documentation of the protocols and procedures to be followed during collection of surface and down-hole gamma scans at the site. Distribution of this plan will be as follows:

Dan Gravatt, RPM, MOKS/SUPR, U.S. EPA Region 7
On-Scene Coordinators (OSCs) assisting with field data collection, U.S. EPA Region 7
Diane Harris, RQAM/ENSV, U.S. EPA Region 7

A4. Project/Task Organization

This project is being managed and administered by EPA Region 7 according to the responsibilities described below:

Dan Gravatt, RPM
Project Manager
MOKS Branch/SUPR Division (913) 551-7324
Responsibilities: Project Management; Field Team Leader; Field Data Collection Project Design and Implementation

OSCs (to be determined) and/or RPMs
MOKS Branch, ERNB and/or ERSB sections
Responsibilities: Field data collection

Tetra Tech (START Contractor)
Responsibilities: Field technical support for gamma scanning and figure preparation

A5. Problem Definition/Background

The purpose of this QAPP is to support the collection of surface and down-hole gamma scans. The objective of this work is to collect additional data on the distribution of radionuclides within Operable Unit 1 (OU1).

Surface gamma scans and down-hole gamma scans of boreholes were conducted as part of the Remedial Investigation (RI) for the site in the late 1990s, and the data was summarized in the RI Report (EMSI, April 2000). Work under this QAPP will re-scan the surfaces of both areas of OU1 for gamma emissions, as well as scanning all accessible monitoring wells at the site for gamma emissions. Some of the monitoring wells were previously scanned (as boreholes, prior to their completion as wells) during the RI, and some have never been scanned.

Gamma scanning field work will be performed by the RPM and OSCs using field-portable scanning instruments. No samples of any media will be collected.

A6. Project/Task Description

The objective of this study is to collect additional data on the distribution of radionuclides within OU1. This QAPP addresses field procedures to collect the surface and down-hole gamma scan data. The measurement and data acquisition methods specified below have been selected to meet this objective. Figure 1 illustrates the site layout and monitoring well locations for down-hole scans.

The data from this study will be assembled and provided to Dan Gravatt, RPM, MOKS/SUPR Division, U.S. EPA Region 7.

A6.1 Work to be performed

The scope of field activities to be performed for these gamma scans includes the following:

- Scanning the surface of OU1 with a Ludlum Model 2241-3 and NaI Tl detector; and

- Scanning all accessible and intact monitoring wells associated with OU1 and OU2 with a Ludlum Model 2241-3 and Ludlum 44-62 NaI probe to the maximum depth of the well or 150 feet, whichever is less.

(1) Measurements

(a) Areas and monitoring wells to be sampled

All accessible portions of the surface of OU1 will be scanned with the Ludlum Model 2241-3 and its NaI Tl detector. It is anticipated that vegetation or rubble piles may prevent scanning of portions of Area 2 of OU1. All accessible and intact monitoring wells on-site capable of passing the Ludlum 44-62 NaI down-hole probe will be scanned.

(b) Analyses

Both the Ludlum Model 2241-3 with NaI Tl detector and the Ludlum 2241-3 with 44-62 NaI probe will collect real-time data on gamma intensity. No laboratory samples will be collected or analyzed.

(2) Standards/Criteria

As gamma scanning is a semi-quantitative data collection technique that does not yield specific concentrations of any radioisotopes in environmental media, there are no applicable thresholds or criteria for determining whether a particular gamma count value is acceptable or

unacceptable. This data will be used to qualitatively update EPA's knowledge of the distribution of radionuclides at the site.

(3) Personnel/Equipment Requirements

All personnel performing activities covered by this QAPP shall comply with the Occupational Safety and Health Act, as well as EPA regulations for worker health and safety. Personnel requirements are discussed in Section A8. Level D PPE consisting of steel-toed boots, appropriate gloves, long pants and long-sleeved shirt at a minimum will be required for field personnel. Additional PPE for operating EPA's utility terrain vehicles will include full-face helmets and eye protection.

(4) Assessment Techniques

Field instrumentation will be calibrated and demonstrated to be working properly as described in B.7 below.

(5) Project Schedule

The anticipated schedule for this sampling effort will consist of one field scanning mobilization in August, 2012. The field work is anticipated to take one week.

(6) Documentation

Data collection activities will be documented with the following (more detailed descriptions of the documentation is provided in Sections A9, B10, and C2 of this QAPP):

Field records;
Data Summary tables; and
Data Summary figures.

A7. Quality Objectives and Criteria for Measurement Data

The purpose of this investigation is to obtain additional gamma scans of the surface and down-hole gamma logs of accessible monitoring wells. No samples of any media will be collected. As gamma scanning is a semi-quantitative data collection technique that does not yield specific concentrations of any radioisotopes in environmental media, the following quality objectives are generally in a narrative form.

Representativeness will be addressed by proper calibration and use of the gamma scan probes for the surface and down-hole measurements, so that the instrument readings correlate to the distribution of gamma-emitting radionuclides at the site.

Comparability expresses the confidence with which one set of analytical data may be compared with another. Comparability will be qualitatively addressed by comparing the results

of the surface gamma scan with the results of the previous RI surface gamma scan; however, due to differences in the methodologies used, differences in the two scan results will not necessarily indicate any change in conditions at the site

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. Field completeness is a measure of the amount of valid measurements obtained from the measurement taken in the project. The field completeness objective for this project will be 80%. 100% completeness is not required for the data to be useable for its intended purpose.

Accuracy and precision will be addressed by proper calibration and use of the gamma scan probes for the surface and down-hole measurements, so that the instrument readings accurately measure gamma emission rates at the site.

A8. Special Training Requirements/Certification

All personnel who will be on-site performing field activities associated with this investigation must have successfully completed an initial 40-hour hazardous waste operations training course and, thereafter, an annual 8-hour refresher course. The training must comply with Occupational Safety and Health Administration (OSHA) regulations found in 29 Code of Federal Regulations (CFR) 1910.120(e). Personnel must also have had advanced radiation safety training, and will be required to wear a thermoluminescent dosimeter and electronic personal dosimeter while on-site. Personnel must be trained and certified to operate EPA's utility terrain vehicles, which will be used for the surface gamma scan.

A9. Documentation and Records

The project manager will be responsible for ensuring the most current version of the QAPP is available and distributed to all involved parties, and that data collected during this field work is properly stored and reported to stakeholders.

B. Measurement/Data Acquisition

B1. Sampling Process Design

The surface gamma scan will be conducted with a Ludlum Model 2241-3, with a 3- by 3-inch NaI Tl scintillator probe. The scan will be conducted in a serpentine pattern across each area of OU1, with spacing between scan lines of 30 feet (the RI QAPP specified a 30' grid). A narrower spacing and/or scan lines at different angles may be used in areas exhibiting higher gamma counts to provide more detail, based on field observations. The detector will be held approximately twelve inches above the ground surface while the surveyor moves the detector at a constant speed approximating walking pace, and the system will collect a reading every two seconds. Global Positioning System (GPS) data will be simultaneously collected, and the resulting gamma results will be mapped. Prior to scanning the site, background gamma levels will be established at a nearby uncontaminated area (the RI QAPP specified "Local background

will be established by taking a measurement off-site on the open field east of the site and east of the St. Charles Rock Road entrance to the site").

The down-hole gamma scan will be conducted with a Ludlum Model 2241-3, with a 44-62 detector. The detector will be lowered to the bottom of each accessible well or to a maximum depth of 150 feet, whichever is less. The detector will then be raised in one-foot increments, and measurements will be recorded at each interval using the scaler set for a 6-second count.

Groundwater samples will not be collected during this work, though previously available analytical results from other studies may be used in interpreting the data from these down-hole gamma scans. Groundwater elevations within the wells will not be measured during this work, though previously available water level measurements from other studies may be used in interpreting the data from these down-hole gamma scans.

Wells PZ-103SS, PZ-104SS, PZ-105SS, PZ-108SS, PZ-111SD and PZ-116SS are designated as background wells to represent naturally-occurring gamma emissions in the subsurface geologic materials. These wells were selected for their depth (150 feet or more), their distance from the OU1 cells, and their lack of any historical detections of radionuclides in groundwater above applicable standards.

B2. Sampling Methods Requirements

Standard operating procedures for the gamma scanning instrument and detectors will be followed. These SOPs are included in Appendix A.

The utility terrain vehicle will be driven at a speed appropriate to generate a thorough density of data points and to minimize the generation of dust.

The EPA field team leader will determine the need for any change in sampling method or locations, if field personnel note difficult site conditions. Any corrective actions required during the implementation of field sampling activities will be documented by the field team leader.

B3. Description of Decontamination Procedures for Sampling Equipment

The down-hole gamma probe shall be decontaminated prior to logging the first well and between each well by washing with a soap solution (such as Alconox) and rinsing with potable water. Previous analytical results for these wells indicate that several metals and volatile organic compounds are present in some wells above their maximum contaminant levels, including arsenic, lead, and benzene. Concentrations of these contaminants are not high enough to warrant additional PPE or more stringent decontamination methods. The rinse water will be poured onto the ground away from the well after use.

The surface gamma scan instrument does not contact the land surface and does not require decontamination.

The utility terrain vehicles, field personnel boots, and any other equipment potentially contaminated by soil will be decontaminated by dry brushing to remove the material. Equipment will then be scanned with a Ludlum Model 44-9 Geiger-Muller "pancake probe" to ensure that any radioactive contamination has been removed down to a level of three times the background count rate with the pancake probe.

Any solid investigation-derived waste such as gloves or paper towels will be bagged, surveyed with the "pancake probe" to ensure that radiation levels do not exceed three times the background count rate, and disposed of at the solid waste transfer facility on-site.

B4. Sample Handling and Custody Requirements

No samples of any media will be collected during this work.

B5. Analytical Methods Requirements

No analytical methods will be used for this work.

B6. Quality Control Requirements

Quality control will be maintained during the field work by operating the instruments in accordance with the manufacturer's instructions and EPA's SOPs.

B7. Instrument/Equipment Testing, Inspection, and Maintenance Requirements

The field equipment testing, inspection, and maintenance will be performed in accordance with the manufacturer's recommendations.

B8. Instrument Calibration and Frequency

Field equipment calibrations will be performed in accordance with the manufacturer's recommendations prior to mobilization.

B9. Inspection/Acceptance Requirements for Supplies and Consumables

No supplies or consumables will be required for this work.

B10. Data Acquisition Requirements

Data acquired from the surface gamma scan instrument and its GPS tracker will be downloaded to EPA computer systems and mapped as necessary to support program goals. Data from the down-hole gamma scanner will be recorded by hand in field logbooks and transcribed into an EPA computer system, or entered directly into an EPA laptop in the field in real time.

B11. Data Management

Data will be stored and backed up on EPA computer systems, filed in the Records Center, and distributed to stakeholders as needed. Documents filed in the Records Center are stored according to standard records retention schedules.

C. Assessment/Oversight

C1. Assessments and Response Actions

The EPA QA manager or their designee may conduct an audit of the field activities for this project if requested by the EPA project manager. The EPA QA manager will have the authority to issue a stop work order upon finding a significant condition that would adversely affect the quality and usability of the data. The EPA project manger will have the responsibility for initiating and implementing response actions associated with findings identified during the on-site audit. Once the response actions have been implemented, the EPA QA manger will perform a follow-up audit to verify and document that the response actions were implemented effectively.

C2. Reports to Management

A report of the field work and analytical results will be prepared by the project manager and copies shared with the state and other stakeholders. This report will also include information on any performance evaluations, audits, and significant QA problems, as applicable.

D. Data Validation and Usability

D1. Data Review, Validation, and Verification Requirements

The EPA Project manager will be responsible for overall validation and final approval of the data in accordance with project purpose and use of the data.

D2. Validation and Verification Methods

As the data collected by the planned field work is semi-quantitative, no additional data validation or verification methods are planned.

D3. Reconciliation with User Requirements

Once the data results are compiled, the EPA project manager will review the data results to determine if they fall within the acceptance limits as defined in this QAPP. Completeness will be evaluated to determine if the completeness goal for this project has been met. If the completeness objective has not been met, the EPA project manager will determine an appropriate course of action. Failure to meet the completeness objective will not necessarily require re-sampling.

Upon compilation of the data, the RPM will review the data in relation to the quality objectives and criteria for measurement, to identify any limitations on the use of the data. The RPM will evaluate data to ensure the information sufficiently characterizes the distribution of gamma-emitting radionuclides at the site, and assess the degree to which the Quality Objectives in A.7 and the Quality Control measures in B.6 have been met. If the RPM determines data quality indicators do not meet the project requirements, then the data may have to be discarded and re-sampling may be required.

Abbreviations and Acronyms

CFR	Code of Federal Regulations
EPA	U.S. Environmental Protection Agency
GPS	Global Positioning System
OSC	On-scene commander
OSHA	Occupational Safety and Health Administration
OU	operable unit
PPE	personal protective equipment
PRP	potentially responsible party
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RI	remedial investigation
RPM	Remedial project manager
RQAM	regional quality assurance manager
SAP	sampling and analysis plan
SOP	standard operating procedure
SOW	statement of work

Figure

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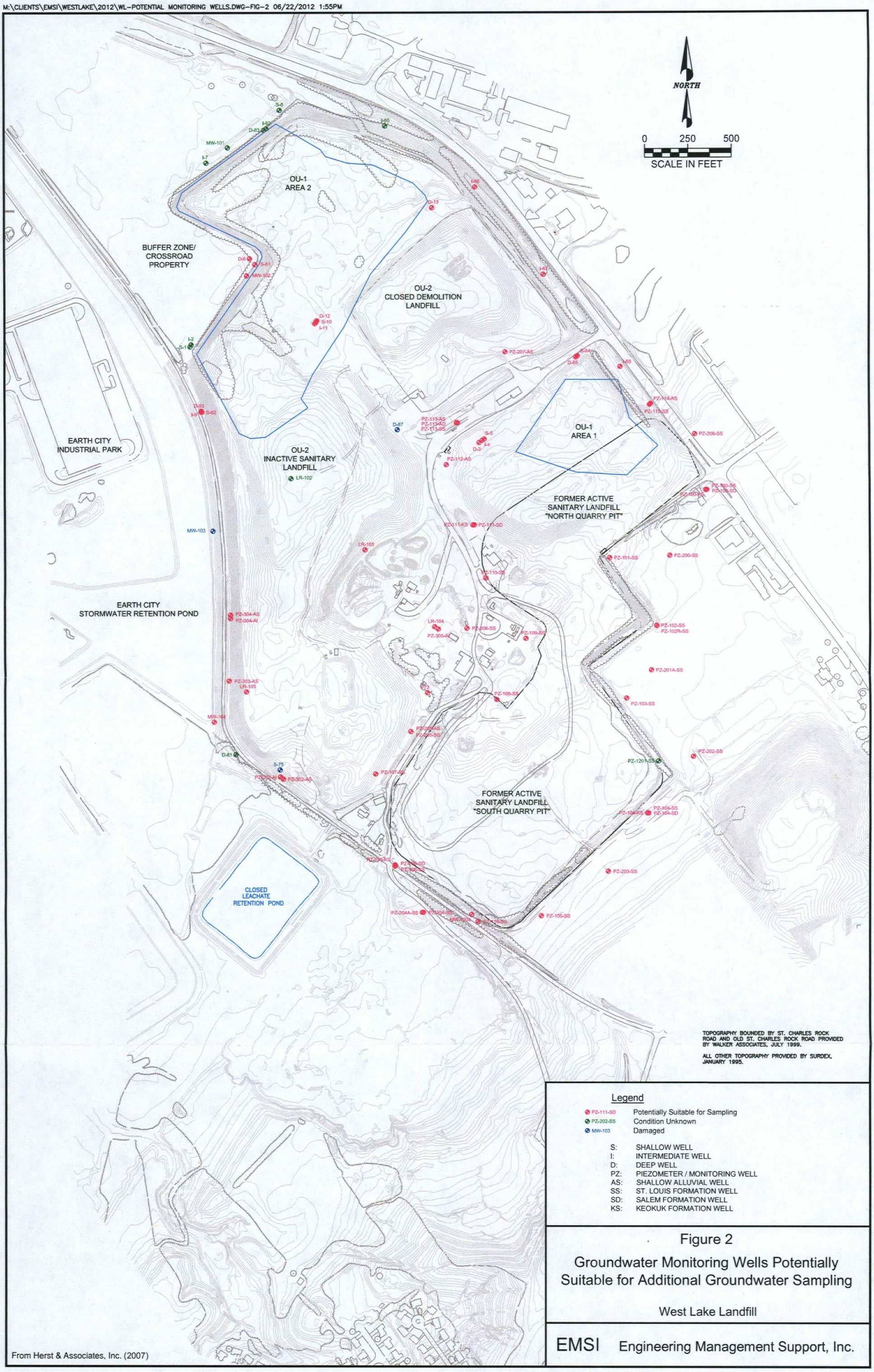


Figure 2

Groundwater Monitoring Wells Potentially Suitable for Additional Groundwater Sampling

West Lake Landfill

EMSI Engineering Management Support, Inc.

Table

Table 3: List of Monitoring Wells Potentially Available for Sampling, West Lake Landfill OU-1 and OU-2

Well Number	General Location	Inspected?	Condition
D-12	Radiological Area 2	Yes	Okay
D-13	Radiological Area 2	Yes	Okay
D-3	Radiological Area 1	Yes	Okay
D-6	Radiological Area 2	Yes	Okay
D-85	Radiological Area 1	Yes	Okay
I-11	Radiological Area 2	Yes	Okay
I-4	Radiological Area 1	Yes	Okay
I-66	Radiological Area 2	Yes	Okay
I-67	Closed Demolition Landfill	Yes	Okay
I-68	Radiological Area 1	Yes	Okay
I-73	Concrete/Asphalt Plants	Yes	Okay
LR-103	Inactive Landfill	Yes	Okay
LR-104	Concrete/Asphalt Plants	Yes	Okay
LR-105	Inactive Landfill	Yes	Okay
MW-102	Radiological Area 2	Yes	Okay
MW-104	Inactive Landfill	Yes	Okay
MW-1204	South Quarry	Yes	Okay
PZ-100-KS	North Quarry	Yes	Okay
PZ-100-SD*	North Quarry	Yes	Okay
PZ-100-SS*	North Quarry	Yes	Okay
PZ-101-SS	North Quarry	Yes	Okay
PZ-102R-SS	North Quarry	Yes	Okay
PZ-102-SS	North Quarry	Yes	Okay
PZ-103-SS	South Quarry	Yes	Okay
PZ-104-KS	South Quarry	Yes	Okay
PZ-104-SD*	South Quarry	Yes	Okay
PZ-104-SS*	South Quarry	Yes	Okay
PZ-105-SS*	South Quarry	Yes	Okay
PZ-106-KS	South Quarry	Yes	Okay
PZ-106-SD*	South Quarry	Yes	Okay
PZ-106-SS*	South Quarry	Yes	Okay
PZ-107-SS	Inactive Landfill	Yes	Okay
PZ-108-SS*	South Quarry	Yes	Okay
PZ-109-SS*	South Quarry	Yes	Okay
PZ-110-SS*	North Quarry	Yes	Okay
PZ-111-KS	North Quarry	Yes	Okay
PZ-111-SD*	North Quarry	Yes	Okay
PZ-112-AS	Radiological Area 1	Yes	Okay
PZ-113-AD	Closed Demolition Landfill	Yes	Okay
PZ-113-AS	Closed Demolition Landfill	Yes	Okay
PZ-113-SS	Closed Demolition Landfill	Yes	Okay
PZ-114-AS*	North Quarry	Yes	Okay
PZ-115-SS*	North Quarry	Yes	Okay
PZ-116-SS	South Quarry	Yes	Okay
PZ-200-SS	North Quarry	Yes	Okay

Table 3: List of Monitoring Wells Potentially Available for Sampling, West Lake Landfill OU-1 and OU-2

Well Number	General Location	Inspected?	Condition
PZ-201A-SS*	South Quarry	Yes	Okay
PZ-202-SS	South Quarry	Yes	Okay
PZ-203-SS	South Quarry	Yes	Okay
PZ-204A-SS	South Quarry	Yes	Okay
PZ-204-SS	South Quarry	Yes	Okay
PZ-205-AS	South Quarry	Yes	Okay
PZ-205-SS*	South Quarry	Yes	Okay
PZ-206-SS	Concrete/Asphalt Plants	Yes	Okay
PZ-207-AS	Closed Demolition Landfill	Yes	Okay
PZ-208-SS	North Quarry	Yes	Okay
PZ-302-AI	Inactive Landfill	Yes	Okay
PZ-302-AS	Inactive Landfill	Yes	Okay
PZ-303-AS	Inactive Landfill	Yes	Okay
PZ-304-AI	Inactive Landfill	Yes	Okay
PZ-304-AS	Inactive Landfill	Yes	Okay
PZ-305-AI	Concrete/Asphalt Plants	Yes	Okay
S-10	Radiological Area 2	Yes	Okay
S-5	Radiological Area 1	Yes	Okay
S-61	Radiological Area 2	Yes	Okay
S-82	Radiological Area 2	Yes	Okay
S-84	Radiological Area 1	Yes	Okay
D-93	Radiological Area 2	Yes	Okay - may be incorrectly labelled
I-9	Radiological Area 2	Yes	Okay - may be incorrectly labelled
D-81	Inactive Landfill	No - area overgrown	Unknown
D-83	Radiological Area 2	No - area overgrown	Unknown
I-62	Radiological Area 2	No - area overgrown	Unknown
I-65	Radiological Area 2	No - area overgrown	Unknown
I-7	Radiological Area 2	No - area overgrown	Unknown
MW-101	Radiological Area 2	No - area overgrown	Unknown
S-1	Radiological Area 2	No - area overgrown	Unknown
S-8	Radiological Area 2	No - area overgrown	Unknown
LR-102	Inactive Landfill	Yes	Unknown - beneath soil stockpile
PZ-1201-SS	South Quarry	Yes	Unknown - buried beneath soil
D-94	Radiological Area 2	No - area overgrown	Unknown-previous report - damaged
I-2	Radiological Area 2	No - area overgrown	Unknown-unable to locate previously
S-75	Inactive Landfill	Yes	Casing damaged/obstructed
D-87	Closed Demolition Landfill	Yes	Casing obstructed
MW-103	Inactive Landfill	Yes	Casing damaged/obstructed

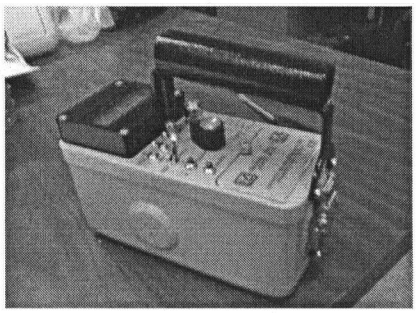
* Included in monitoring program for the permitted solid waste landfill.

Appendix A

Ludlum Scaler/Ratemeter—Model 2241-3

Ludlum Measurements, Inc., Model 2241-3
Region 7 EPA Equipment #1499
Homeland Security #N/A
RCMS #N/A
October 2008 (Region 7)

NOTE: Guides are to be used by trained personnel only and ARE NOT TO REPLACE THE MANUFACTURER'S OPERATIONS OR TECHNICAL MANUALS. These guides were developed by field personnel for utilization by EPA and its contractors, and are helpful in quick startup and operations. Various limitations have been identified through the experience of the development group. Different makes, models, and updates to this equipment may change the limitations. Calibration, maintenance, and use should be recorded in a logbook. If you have any changes or revisions, please email kroone.janice@epa.gov.



Uses:

The Model 2241-3 is a portable, microprocessor-based, digital scaler/ratemeter designed for use with scintillation, Geiger-Mueller (G-M), and proportional-type detectors for measurement of ionizing radiation. The instrument is typically used for general-purpose surveying and gross counting. As currently configured with the Ludlum Model 44-62 Gamma Scintillator detector (see Photo 1), the instrument is primarily suited for detecting gamma radiation.

Quick Start-up and Operation:

Connecting the Ludlum Model 44-62 Gamma Scintillator Detector:

Connect the detector to the Model 2241-3 using the cable provided with the instrument. For each connection, firmly push the connectors together while twisting clockwise (1/4 turn) until the connection is secured.

Note: Because each instrument must be calibrated to a specific detector (or detectors), the detectors are not interchangeable.

CAUTION: The rotary selector switch on the Model 2241-3 should be in the OFF position before connecting or disconnecting the cable or detector, as a mild electric shock may occur if contact is made with the center pin of the free connector when the cable is connected to the instrument (if it is turned on).

Photo 1

Operational Check:

To ensure that the survey meter is functioning properly, perform an operational check as follows before using the instrument:

1. Move the detector selector switch on the 2241-3 to "DET 2" (see Photo 2).

2. Place the SCA/RATE (scaler/ratemeter) toggle switch in the RATE position. The display will go through an initialization process, described in Steps 3 to 5.

3. The Liquid Crystal Display (LCD) should display the firmware number in the format P-XX, where "XX" is the firmware number. Smaller digits at the lower right-hand corner of the display indicate the firmware version.

4. The minimum displayable value will be shown; when switched to SCA, a single "0" should be displayed.

5. The display will auto range to the current radiation level. Background readings with the Model 44-62 detector are typically 8-15 microroentgens per hour (μR/hr).

6. Read the check source mounted on the side of the 2241-3 with the detector to check for a positive response on the LCD display.

7. Switch the AUD ON/OFF switch to the ON position and confirm that audible clicks are produced and increase in frequency as the detector nears the check source. The clicks will be silent in the OFF position; however, the audible alarm condition will still be active.

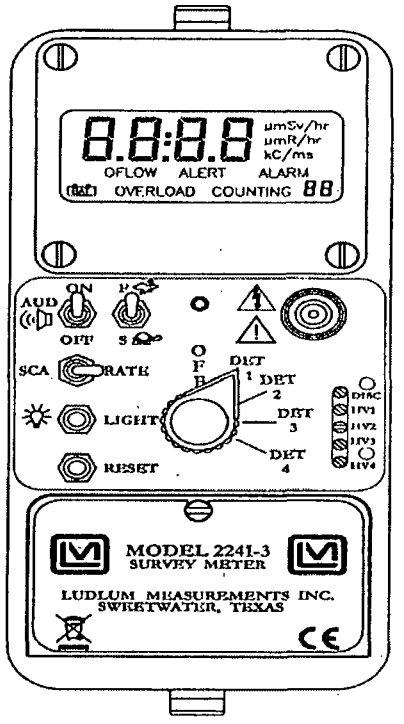


Photo 2

8. Move the detector near the check source to check that preset alert and higher alarm conditions are indicated on the display and the alarm is activated. (Note: This may have already occurred during Step 6 or 7.) Depress the RESET switch to acknowledge (and silence) the alarm. Move the detector away from the check source and depress RESET again to reset the alarm and alert indicators. If an alarm condition is not present (but above the preset alert level), depressing the RESET switch will reset the alert condition and zero the ratemeter.

9. Place the SCA/RATE switch in the SCA position. Depress the count switch button at the front end of the carrying handle to start the count cycle. The word "COUNTING" should be displayed on the LCD screen; it will disappear at the end of the predetermined count period. If a scaler alarm occurs, press RESET to acknowledge (and silence) the alarm; however, the count switch button must be depressed to clear the alarm indicator on the display and reset the count cycle.

10. Depress and release the LIGHT switch to verify that the backlight works. The light will automatically go off after a few seconds.

11. Select the desired F/S (see Additional Operation Information), AUD ON/OFF, and RATE/SCA settings, and proceed to use the instrument (no warm-up time is required).

Calibration Procedures:

Annual calibration by Ludlum Measurements Inc., is recommended. Recalibration should also be performed after any maintenance or adjustments have occurred. Recalibration normally is not necessary after battery and cable replacements or exterior cleanings. No field calibration of the instrument is required.

Additional Operation Information:

- The instrument is suitable for indoor and outdoor use over a temperature range of -20° C to 50° C, and at a relative humidity of less then 95% (non-condensing).

- The "S" position (slow) is normally used when displaying low numbers, requiring a stable display. The "F" position (fast) is generally used when high count levels are encountered.

Applications:

The primary use for the Model 2241-3 and Model 44-62 detector is general purpose surveying and gross counting for gamma radiation. In addition, the small diameter of the 44-62 detector enables it to be used for downhole applications.

Limitations:

- In order to use a certain detector, for example the Model 44-62, the detector must be configured with the 2241-3 to work properly.

- The instrument operates on two D-cell batteries, which will discharge during use. Carrying extra batteries with the unit at all times is recommended.

- The current configuration of the 2241-3 with the Model 44-62 detector will detect only gamma radiation; neither alpha nor beta radiation will be detected.

Battery Use:

To install the two D-cell batteries, turn the rotary detector selector switch to the OFF position. Open the battery lid by turning the thumb screw a quarter turn counter-clockwise. Install the batteries into the compartment, taking notice of the (+) and (-) markings inside the battery door.

Note: Never store the instrument over 30 days without removing the batteries. Although this instrument will operate at very high ambient temperatures, battery seal failure can occur at temperatures above 100°F.

Main Inventory of Items and Accessories:

- Model 2241-3 instrument
- Cable for connecting detector
- Model 44-62 Gamma Scintillator detector

Replacement of Auxiliary Equipment and Supplies:

No routine replacement of auxiliary equipment or supplies (other than batteries) is required.

Parts List:

Part Type	Part Name	Part Description	Quantity
Battery	Instrument batteries	Standard D-cell batteries	2
Cable	Standard Ludlum "C" cable	5' cable w/ "C" connections on both ends	1
Detector	Model 44-62 Gamma Scintillator	6 3/4" long, 3/4" diameter tan probe	1
Instruction Manual	Instruction manual for Model 2241-3 Survey Meter	67-page 11" x 8 1/2" manual	1
Instruction Manual	Instruction manual for Model 44-62 Gamma Scintillator	7-page 8 1/2" x 5 1/2" manual	1

Routine Maintenance:

Frequency	Action	Manual Reference	Performed By
Before Each Use	Perform an operational check	Page 2-2	OSC/START
Annually	Factory recalibration and certification	Page 6-1	Ludlum Measurements Inc.
After Each Use	Perform decontamination[1]	Page 6-1	OSC/START

Notes:

[1] The Model 2241-3 may be externally cleaned with a damp cloth (using only water as the wetting agent). Do not immerse in any liquid. Observe the following precautions when cleaning:

1. Turn the instrument OFF and remove the batteries.
2. Allow the instrument to sit for 1 minute before performing any external cleaning or accessing internal components for maintenance.

Shipping Requirements:

Proper decontamination should be performed prior to shipping the instrument and accessories. To return the instrument for repair or calibration, provide sufficient packing material and labeling for safe handling. Include detector(s) and related cable(s) for calibration. Include brief information as to the reason for return, as well as the following return shipping information:

- Return shipping address
- Customer name and contact
- Telephone number

Contact Information (Technical Support):

Ludlum Measurements, Inc.
501 Oak St, P.O. Box 810
Sweetwater, TX 79556
Telephone: 325-235-5494
Fax: 325-235-4672
Website: http://www.ludlums.com
E-mail: ludlum@ludlums.com

References:

Ludlum Measurements, Inc. Instruction Manual for Ludlum Model 44-62 Gamma Scintillator. July 1999. 7 pages.

Ludlum Measurements, Inc. Instruction Manual for Ludlum Model 2241-3 Survey Meter. July 2007. 67 pages.

Ludlum Scaler/Ratemeter—Model 2241-3

Ludlum Measurements, Inc., Model 2241-3
Region 7 EPA Equipment #1596, #1597, & #1598
Homeland Security #N/A
RCMS #10973
November 2009 (Region 7)

NOTE: Guides are to be used by trained personnel only and ARE NOT TO REPLACE THE MANUFACTURER'S OPERATIONS OR TECHNICAL MANUALS. These guides were developed by field personnel for utilization by EPA and its contractors, and are helpful in quick startup and operations. Various limitations have been identified through the experience of the development group. Different makes, models, and updates to this equipment may change the limitations. Calibration, maintenance, and use should be recorded in a logbook. If you have any changes or revisions, please email kroone.janice@epa.gov.

Uses:

The Model 2241-3 is a portable, microprocessor-based, digital scaler/ratemeter designed for use with scintillation, Geiger-Mueller (G-M), and proportional-type detectors for measurement of ionizing radiation. The instrument is typically used for general-purpose surveying and gross counting of alpha, beta, and gamma radiation. Four probes (detectors) are supplied with the Model 2241-3:

1. Model 44-9 Geiger-Mueller (G-M) "pancake probe" is approximately 11" long, detects **alpha and beta** radiation (some gamma radiation also) and is used with the instrument's rotary selector switch pointed toward the one (first) position (red dot)—see photos on this page. The pancake probe is mostly used for contamination control by carefully surveying personnel and equipment for loose radioactive material.

2. Model 44-2 "sodium iodide" (NaI) low level **gamma** scintillator detector is an approximately 6 ½" X 2" round tan probe which is used with the instrument's rotary selector switch pointed toward the two position (yellow dot). The sodium iodide is a high efficiency gamma detector that is useful for finding lost sources. Often a grid pattern survey is utilized for this type of detector since the audible has a high frequency of counts even at normal background levels. The sodium iodide detector is a low range instrument.

3. Model 133-8 **gamma** G-M detector is about 4" X 7/8" with a metallic finish and is used with the instrument's rotary selector switch turned toward the third position (blue dot). This high range instrument is used in the R/hr exposure range.

4. Model 44-38 is an energy compensated "side window" **beta-gamma** G-M round probe that is approximately 6" X 1" and metallic in finish. It is used in the fourth position (white dot) on the instrument's rotary selector switch. This detector includes a rotary shield, which when opened, allows the detection of beta radiation for energies above about 200 kiloelectron volts (keV). The shield must be closed for proper gamma radiation detection. The side

window probe is a broad range instrument that is most commonly used for general surveys. The side window can be closed or open to account for just gamma or the combination of gamma and beta radiation, respectively.

Quick Start-up and Operation:

Connecting a detector to the Ludlum Model 2241-3 Meter:
CAUTION: The rotary selector switch on the Model 2241-3 should be in the **OFF** position before connecting or disconnecting the cable or detectors. Otherwise, a mild electric shock may occur if contact is made with the center pin of the free connector.

Connect the detectors to the Model 2241-3 using the "C" series cable provided with the instrument. For each connection, firmly push the connectors together while twisting clockwise (1/4 turn) until the connection is secured. Because each instrument must be calibrated to a specific detector (or detectors), the detectors are not interchangeable from one unit to another.

Operational Check:

To ensure that the survey meter is functioning properly, perform an operational check as follows before using the instrument:

1. Place two D-cell batteries in the instrument.

2. Connect one of the four detectors to the instrument using the cable provided. Be sure to turn the unit off before changing detectors.

3. Move the detector selector switch on the 2241-3 to the appropriate detector position (as discussed above), depending on which probe you have attached to the instrument. Note the check source and calibration sticker on the side of the instrument. It provides response check values for each detector against the check source except for the high range detector Model 133-8.

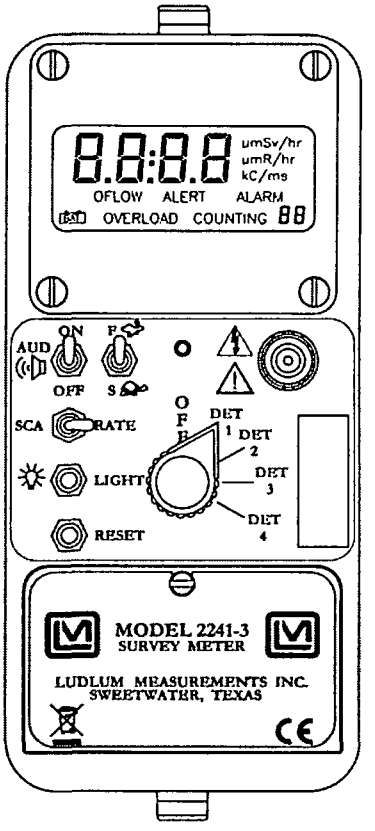
4. Place the SCA/RATE (scaler/ratemeter) toggle switch in the RATE position. The display will go through a brief initialization process.

5. The display will auto range to the current radiation level. Check for an appropriate background readings as indicated below:

    a. Model 44-2 detector – typically 1,400 to 2,600 counts per minute (cpm) or 8 to 15 microRoentgens per hour (μR/hr).

    b. Model 44-9 detector – typically 25 to 50 cpm or 8 to 15 μR/hr.

    c. Model 44-38 detector – typically 8 to 15 μR/hr.



6. **Conduct a response check by opening the check source door and placing the end of the detector in contact with the check source.** The value indicated on the meter should correspond to +/- 20% of the value listed on the calibration sticker on the side of the instrument for the specific detector. If the response check or background reading is not within the appropriate aforementioned range, the meter should be placed out of service. Holding the detector in a consistent manner with each reading will help produce more consistent readings.

   NOTE: The sodium iodide detector is placed perpendicular against the check source at its end; the pancake probe requires removal of the red cap and then placing the detector window against the check source; and the side window detector requires an open window reading with the slots facing toward the check source while performing the response check.

7. Switch the AUD ON/OFF switch to the ON position and confirm that audible clicks are produced and increase in frequency as the detector nears the check source. The clicks will be silent in the OFF position; however, the audible alarm condition will still be active (i.e., can still be heard).

8. If a scaler reading is desired, place the SCA/RATE switch in the SCA position. Note that this switch must be lifted upwards to move it. When switching to SCA, a single "0" should be displayed on the Liquid Crystal Display (LCD). Depress the count switch button at the front end of the carrying handle to start the count cycle. The word "COUNTING" should be displayed on the LCD; it will disappear at the end of the predetermined count period. The predetermined count time can be changed; however, this requires adjusting the SCALER TIME for the individual detector that is accessed by unlatching the meter housing.

9. If the ratemeter alarm activates, depress the RESET button to acknowledge (and silence) the alarm and/or alert indicators.

10. Depress and release the LIGHT switch to verify that the backlight works. The light will automatically go off after a few seconds.

11. Select the desired F/S (see Additional Operation Information), AUD ON/OFF, and RATE/SCA settings, and proceed to use the instrument (no warm-up time is required).

Calibration Procedures:

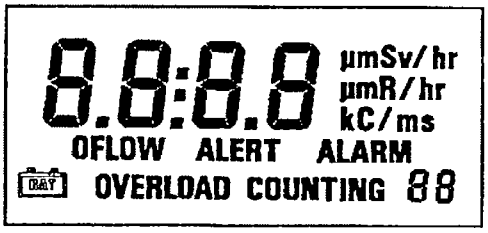
Annual calibration by Ludlum Measurements Inc., is recommended. Recalibration should also be performed after any maintenance or adjustments have occurred. Recalibration normally is not necessary after battery and cable replacements or exterior cleanings. No field calibration of the instrument is required.

Additional Operation Information:

- The instrument is suitable for indoor and outdoor use over a temperature range of -20 to 50 degrees Celsius (^{o} C), and at a relative humidity of less then 95% (non-condensing).

- The "F"/"S" (Fast/Slow) toggle switch selects either a fast or slow counting response time of the displayed reading. Generally a slow response time is used when a stationary and precise measurement is required. A fast response time is used for most other measurements.

- The scaler measures in counts per preselected units of time—usually one minute. Using the ratemeter setting and the check source, the pancake probe reads in counts per minute (cpm) or in 1,000 counts per minute (Kcpm), whereas the other detectors read in microRoentgens per hour (μR/hr) or milliRoentgens per hour (mR/hr). The appropriate multiplier automatically changes as needed. The ratemeter mode is for general survey purposes, whereas the scaler mode has more specific purposes, beyond the scope of this document.



- When the instrument is first turned on, all items on its liquid crystal display (LCD) light up. A few seconds is required, while the screen initializes, before the first reading can be taken.

- If an alert threshold is achieved (only on the ratemeter mode), the word "Alert" appears on the LCD. If detectible radiation increases to the alarm threshold, the word "Alarm" appears on the LCD and an alarm sounds regardless of whether the audio is turned on or not. These alarms are factory set, but can be changed—see the manufacturer's product manual. Push the reset button to acknowledge and silence the alert/alarm.

- Two other alarm settings can occur: (1) "OFLOW" occurs when the radiation count exceeds 100,000 counts per second (CPS) or if the dead time is greater than 75%; (2) "Overload" occurs when radiation intensity is above the instrument's maximum operating capacity.

Applications:

The primary use for the Model 2241-3 and its detectors is for general purpose surveying and gross counting of alpha, beta, and gamma radiation contamination. Proper readings occur with relative humidity less than about 95 percent—i.e., the instrument should not be used in the rain or snow.

Limitations:

- In order to use a certain detector, the detector must be configured with the 2241-3 to work properly. Do not swap detectors from one unit to another.

- The instrument operates on two D-cell batteries. Carrying extra batteries with the unit at all times is recommended.

- Instrument readings are not equivalent to dose—other factors (e.g., duration of exposure, type of radiation) are involved in determining dose.

Battery Use:

To install the two D-cell batteries, turn the rotary detector selector switch to the OFF position. Open the battery lid by turning the thumb screw a quarter turn counter-clockwise. Install the batteries into the compartment, taking note of the (+) and (-) markings inside the battery door. Battery condition is shown via an icon in the LCD.

Note: Never store the instrument over 30 days without removing the batteries. Although this instrument

will operate at very high ambient temperatures, battery seal failure can occur at temperatures above 100 degrees Fahrenheit (°F).

Main Inventory of Items and Accessories:

- Model 2241-3 instrument
- C-series cable for connecting detectors to the Model 2241-3 instrument
- Model 44-2 gamma scintillator detector
- Model 44-9 pancake detector for alpha and beta radiation
- Model 44-38 energy-compensated beta-gamma Geiger Mueller detector
- Model 133-8 gamma detector
- Check source (attached to side of instrument)
- D-cell batteries (minimum of two; carry four for best results)

Replacement of Auxiliary Equipment and Supplies:

No routine replacement of auxiliary equipment or supplies (other than batteries) is required.

Parts List:

Part Type	Part Name	Part Description
Cable	Instrument Cable	36" black C-series cable
Cap	Caplug	2 7/8" red plastic cap for pancake probe
Case	Instrument Case	Hardigg iM2300 Storm case
Check Source	Cesium-137 1.0 μCi Check Source	1" yellow disk
Detector	Model 133-8 Gamma Detector	4" x 7/8" diameter silver-colored metal tube w/ C-series connection
Detector	Model 44-2 Gamma Scintillator	6 1/2" x 2" diameter tan-colored metal tube w/ C-series connector
Detector	Model 44-38 Energy Compensated Beta-Gamma (G-M) Detector	6" x 1" diameter silver-colored metal tube w/ C-series connection
Detector	Model 44-9 Alpha-Beta-Gamma Detector	11" pancake probe
Instruction Manual	Ludlum Model 133-8 Gamma Detector Instruction Manual	8 page 9" x 5" manual; Feb 2008
Instruction Manual	Ludlum Model 2241-3 Survey Meter Instruction Manual	50 page 8 1/2" x 11" manual; July 2007
Instruction Manual	Ludlum Model 44-2 Gamma Scintillator Instruction Manual	12 page 9" x 5" manual; Oct 2007
Instruction Manual	Ludlum Model 44-38 Beta-Gamma Detector Instruction Manual	10 page 9" x 5" manual; Oct 2007
Instruction Manual	Ludlum Model 44-9 Alpha-Beta-Gamma Detector Instruction Manual	10 page 9" x 5" manual; May 2007
Power Supply	Battery	Two D-cell batteries
Strap	Shoulder Strap	Black fabric shoulder strap

Note: μCi - microCuries

Routine Maintenance:

Frequency	Action	Manual Reference	Performed By
Before Each Use	Operational check	Page 2-2	OSC/START
After Each Use	Decontamination[1]	Page 6-1	OSC/START
Monthly	Functional Test/Battery Check[2]	None	START
Annually	Factory recalibration and certification	Page 6-1	Ludlum Measurements Inc.

Notes:

[1] The Model 2241-3 may be externally cleaned with a damp cloth (using only water as the wetting agent). Do not immerse in any liquid. Observe the following precautions when cleaning:

a. Turn the instrument OFF and remove the batteries.

b. After use allow the instrument to sit for 1 minute before performing any external cleaning or accessing internal components for maintenance.

[2] Additionally, check that all parts are present.

OSC On-scene coordinator
START Superfund Technical and Response Team

Shipping Requirements:

Proper decontamination should be performed prior to shipping the instrument and accessories. To return the instrument for repair or calibration, provide sufficient packing material and labeling for safe handling. Include detector(s) and related cable(s) for calibration. Include brief information as to the reason for return, as well as the return shipping information. Be sure to keep the Certificate of Calibration with the unit at all times. This is kept under the foam within the top portion of the case.

Contact Information (Technical Support):

Ludlum Measurements, Inc.
501 Oak St, P.O. Box 810
Sweetwater, TX 79556
Telephone: 325-235-5494
Fax: 325-235-4672
Website: http://www.ludlums.com
E-mail: ludlum@ludlums.com

References:

Ludlum Measurements, Inc. Instruction Manual for Ludlum Model 44-2 Gamma Scintillator. October 2007. 12 pages.

Ludlum Measurements, Inc. Instruction Manual for Ludlum Model 44-9 Alpha, Beta, Gamma Detector. May 2007. 10 pages.

Ludlum Measurements, Inc. Instruction Manual for Ludlum Model 44-38 Beta-Gamma Detector. October 2007. 10 pages.

Ludlum Measurements, Inc. Instruction Manual for Ludlum Model 133-8 Gamma Detector. February 2008 (Serial Number 158103 and Succeeding Serial Numbers). 8 pages.

Ludlum Measurements, Inc. Instruction Manual for Ludlum Model 2241-3 Survey Meter. July 2007. 50 pages.