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PROCEDURES RADIATION MEASUREMENTS TASK - FERNALD RI/FS AUGUST, 1987

08/30/87

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PROCEDURES

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INTERNATIONAL TECHNOLOGY CORPORATION

PROCEDURES

RADIATION MEASUREMENTS TASK

Fernald RI/FS

August, 1987

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RESPONSIVE TO THE NEEDS OF ENVIRONMENTAL MANAGEMENT

RADIATION MEASUREMENTS AT FERNALD FMPC

REMEDIAL/FEASIBILITY STUDY FOR PRODUCTION AREA

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RADIATION MEASUREMENT TASK
QUALITY CONTROL PROGRAM ELEMENTS
Fernald RI/FS

Instruments:	PIC	SPA-3	FIDLER
Before Survey Begins	* Calibrated by Manufacturer	20 nodes Zone 2 0 - 500 μR/hr	Voltage Plateau Plotted
		30 Nodes Zone 1 0 - 500 μR/hr	5 test areas w/lab
Instrument Daily Out Check	Battery Check	Battery	Battery
	Check Source and Bkgd at same point	Check 0.1 μCi Cs source with count rate on QC	Am Check Source with count rate on QC
		Check source with Am for discriminator	
		Bkgd at trailer	
Weekly Program Check	7 locations including Waste Storage Area	Correlate with PIC at 7 locations	5 Bkgd locations same place each week
Linearity	0 - 500 μR/hr		5 test areas with lab analysis

<u>Reproducibility</u>

- Survey grid nodes with PIC & SPA-3 in waste pit area to ensure westom data is similar.

- After 100 fidler measurements are recorded, use Random # generator to select 10% of the sub grid and resurvey.

TITLE: Methodology to Conduct Radiation Measurements for the RI/FS, Fernald, FMPC	NO: RSL-2000	PAGE: 1
	REVISION: 0	DATE: 8-17-87

1.0 PURPOSE

This procedure provides the type and frequency of radiation measurements that will be collected during the Remedial Investigation conducted at the Fernald Feed Material Production Center.

2.0 SCOPE

This procedure applies to the use of the radiation survey instruments used to conduct indirect radiation measurements in an effort to characterize the radioactive material in the soil surrounding the Fernald FMPC.

3.0 RESPONSIBILITY

3.1 It is the responsibility of the Health Physics Services Manager, or his designee, to ensure that this procedure is followed during the field program phase.

3.2 It is the responsibility of the Health Physics Services Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure, the PIC, and the SPA-3.

3.3 It is the responsibility of the person performing this procedure to follow it and report any abnormal occurrences or results to the Health Physics Services Manager, or his designee, immediately.

4.0 REFERENCES

4.1 Exposure Rate Measurements Using A Pressurized Ion Chamber RSL-2001, REV 0

4.2 Correlation of Sodium Iodide Detector to the Pressurized Ion Chamber, RSL-2002, REV 0

4.3 Walk Over Surveys Using A Large Volume Scintillation Detector, RSL-2003 REV 0

4.4 Near Surface Gamma Radiation Survey Using the Field Instrument for Detection of Low Energy Radiation (FIDLER) RSL-2004

4.5 In-Situ Gamma-Ray Measurements Using the Delta Gamma Technique, RSL-2005

5.0 REQUIREMENTS

5.1 All procedures must be previously approved by the project management team.

5.2 The grid survey must be completed before survey in the area begins.

6.0 PROCEDURE

6.1 Zone 2

6.1.1 Collect samples in Zone 2 using the Pressurized Ion Chamber (PIC) for at least 20 locations distributed throughout Zone 2.

6.1.1.1 Zone 2 is located outside of the production area and has been surveyed using grids approximately 1000 feet apart. The flyash piles and the sewage treatment area is included in Zone 1.

6.1.1.2 Each location shall be predetermined by the task leader, evenly distributed throughout the exclusion area.

6.1.1.3 The PIC should be located at a grid node.

6.1.1.4 The measurement should be conducted in accordance with procedure RSL-2001.

6.1.1.5 Collect additional data with the Large Volume Scintillation Detector in order to correlate this Detector with the PIC, in accordance with procedure RSL-2002.

6.1.2 Collect Data using the Large Volume Scintillation Detector at each Grid Node in Zone 2.

6.1.2.1 Each Grid Node is Approximately 1000 feet apart.

6.1.2.2 Record the Data on the Form, Appendix 10-1, found in Procedure RSL-2003.

6.1.2.3 This Survey Should Continue Outside of Area 2 if Elevated Concentration of Radioactive Materials are Detected. Additional Grids Should be Identified and Surveyed such that there is at least 300 feet beyond Areas of Elevated Concentration.

6.1.3 For Each Measurement Collected in 6.1.2 such that the Measured Radiation Levels exceed 200 uR/HR, the Delta Gamma Technique Shall be Used.

6.1.3.1 This Data Shall be Collected at the Grid Node Location.

6.1.3.2 The Measurement Shall be Conducted in Accordance with Procedure RSL-2005.

6.2 <u>Zone 1</u>

6.2.1 Collect samples in the production area using the PIC for at Least 30 Locations distributed throughout Zone 1.

6.2.1.1 Zone 1 includes the production area, the area surrounding the waste storage area, the 2 flyash piles and the sewage treatment area. These areas have been surveyed using grids approximately 100 feet apart.

6.2.1.2 Each location shall be predetermined by the Task Leader.

6.2.1.3 The locations will be selected according to the activity present, ranging from normal background to approximately 500 uR/HR.

6.2.1.4 The measurements shall be conducted in accordance with procedure RSL-2001.

6.2.1.5 Collect additional data at the same locations using the large volume scintillation detector in order to correlate this detector with the PIC, in accordance with procedure RSL-2002.

6.2.2 Collect data, using the large volume scintillation detector, for each 100' grid Zone 1.

6.2.2.1 Collect Data at each grid node in Zone 1.

6.2.2.2 This data shall be collected in accordance with procedure RSL-2003.

6.2.2.3 Any areas which have been "flagged" should be resurveyed to determine the extent of the contamination.

6.2.3 The Delta Gamma technique (RSL-2005) should be used for location when the large volume scintillation detectors (6.2.2.1) indicate a gamma exposure rate in excess of 200 uR/hr.

6.2.3.1 This data should be collected at the grid node location.

6.2.3.2 The measurement shall be collected in accordance with procedure RSL-2005.

7.0 PRECISION AND ACCURACY

None

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsible for Inspection

8.1.1 The Health Physics Services Manager, or his designee, shall inspect the work of technicians performing this procedure for completeness and adequate quality.

8.1.2 The technicians performing this procedure shall inspect data forms for accuracy and completeness and shall inspect instruments for proper operation.

9.0 CALCULATIONS

None

10.0 APPENDICES

TABLE 1

Summary of Survey Locations

INSTRUMENT	ZONE 1 100' GRID	ZONE 2 1000' GRID
PIC	GRID NODE 20 spls ranging from Bkgd to 500 uR/hr RSL-2001 RSL-2002	GRID NODE 30 spls ranging from Bkgd to 500 uR/hr RSL-2001 RSL-2002
SPA-3	AT ALL GRID NODES	Complete Survey RSL-2003 Grid Node
FIDLER	NOT USED	Complete Survey RSL-2004
Delta Gamma	Any Grid Node > 200 uR/hr	Any Grid Node > 200 uR/hr

TITLE: Exposure Rate Measurements Using a Pressurized Ion Chamber	NO: RSL-2001	PAGE: 1
	REVISION: 0	DATE: 7-21-87

1.0 **PURPOSE**

This procedure provides instruction to ensure uniform measurement techniques when using a secondary standard instrument, the pressurized ion chamber, for determining external gamma-ray exposure rate at a height of one meter above the soil for facility surfaces.

2.0 **SCOPE**

This procedure applies to the use of the Reuter-Stokes pressurized ion chamber (PIC) for field measurements of gamma-ray exposure.

3.0 **RESPONSIBILITY**

3.1 It is the responsibility of the Health Physics Services Manager, or his designee, to ensure that this procedure is followed during the field program phase.

3.2 It is the responsibility of the Health Physics Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure and the Reuter-Stokes PIC.

3.3 It is the responsibility of the person performing this procedure to follow it and report any abnormal occurrences or results to the Health Physics Services Manager, or his designee, immediately.

4.0 **REFERENCES**

4.1 Reuter-Stokes PIC Operational Manual.

4.2 NCRP Report No. 50, Environmental Radiation Measurements.

5.0 REQUIREMENTS

5.1 Equipment and Materials

5.1.1 Reuter-Stokes PIC

5.1.2 Stop watch

5.1.3 Gamma-Ray Exposure Rate Survey form (Appendix 10.1)

6.0 PROCEDURE

6.1 Instrument Setup

6.1.1 Attach sensor head to tripod.

6.1.2 Adjust height of the centerline of the chamber to one meter from the surface to be measured.

6.1.3 Ensure that the electrometer and mode switches are both in the OFF position.

6.1.4 Connect cable to read-out housing.

6.1.5 Turn DISPLAY/RECORDER switch to ON.

6.1.6 Turn ELECTROMETER switch to Zero.

6.1.7 Turn MODE switch to BATT position.

6.1.8 Simultaneously depress the PUSH-TO-READ switch (located below digital display device) and the switch designated 300 V.

6.1.9 If the digital display shows less than 85 (as a percent of charge) replace 300 V battery.

6.1.10 Check the charge on the -14V, +14V, and 12V lead-acid batteries by depressing switch immediately below the voltmeters for each battery. If the needle is on or near the shaded area of the meter, recharge these batteries before proceeding.

6.1.11 Place the MODE switch in the DC position.

6.1.12 Place the ELECTROMETER switch in the ZERO position and wait 60 seconds.

6.1.13 Place the ELECTROMETER switch in the read position.

6.1.14 Turn the recorder ON.

6.2 Actual Gamma-Ray Exposure Measurement

6.2.1 After proper instrument setup by following steps 6.1.1 through 6.1.14, reset the mechanical counter and start the stop watch simultaneously.

6.2.2 After at least 60 minutes, and when the counter integrates the next micro R (uR), record elapsed time and integrated exposure.

6.2.3 Record the exposure rate (see Appendix 1).

7.0 PRECISION AND ACCURACY

7.1 The accuracy of the instrument is specified by the manufacturer, Reutor Stokes to be ± 5% at 10 uR/hr.

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsibility for Inspection

8.1.1 The Health Physics Services Manager, or his designee, shall inspect the work of the technicians performing this procedure for completeness and adequate quality.

8.1.2 The technicians performing this procedure shall inspect data forms for accuracy and completeness and shall inspect instrument for proper operation.

8.2 Equipment Monitoring

8.2.1 The instrument being used shall be checked to ensure calibration data has not expired.

9.0 CALCULATIONS

$$uR/hr = \frac{60\ min./hr}{Count\ time\ minutes} \times \text{exposure recorded by PIC}$$

10.0 APPENDICES

TITLE: Exposure Rate Measurements Using a Pressurized Ion Chamber	NO: RSL-2001	PAGE: 5
	REVISION: 0	DATE: 7-21-87

Gamma-Ray Exposure Rate Survey

Site:_____ Location:_____

Date:_____ Survey No.:_____ Surveyor:_____

Scaler Model:_____ Serial No.:_____ Count Time:_____

Probe Model:_____ Serial No.:_____ Background:_____CPM

Comments:_____ Calibration Factor:_____ μR/hr/cpm

Location	μR/hr at 1 meter	Location	μR/hr at 1 meter	Location	μR/hr at 1 meter	Location	μR/hr at 1 meter

TITLE: Correlation of Sodium Iodide Detector to the Pressurized Ion Chamber	NO: RSL-2002	PAGE: 1
	REVISION: 0	DATE: 8-17-87

1.0 **PURPOSE**

This procedure provides the method for correlating scintillation detector measurements with more accurate pressurized ion chamber (PIC) measurements.

2.0 **SCOPE**

This procedure describes the methodology for correlating counts obtained using an Eberline SPA-3 coupled to a ratemeter/scaler to the exposure rate measurements taken with the PIC.

3.0 **RESPONSIBILITY**

3.1 It is the responsibility of the Health Physics Services Manager, or his designee, to ensure that this procedure is followed during the field program phase.

3.2 It is the responsibility of the Health Physics Services Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure, the PIC, and the SPA-3.

3.3 It is the responsibility of the person performing this procedure to follow it and report any abnormal occurrences or results to the Health Physics Services Manager, or his designee, immediately.

4.0 **REFERENCES**

4.1 Reuter-Stokes PIC Operational Manual

4.2 Eberline SPA-3, Gamma Scintillation Probe, or equivalent, Instruction Manual

4.3 Eberline ESP-1, Instruction Manual

5.0 **REQUIREMENTS**

5.1 Equipment and Materials

5.1.1 Eberline SPA-3

5.1.2 Eberline ESP-1

5.1.3 Reuter-Stokes PIC

5.1.4 Site map

6.0 **PROCEDURE**

6.1 Site-Specific Measurements with SPA-3 and PIC

6.1.1 Ensure that the SPA-3 and the PIC are operating properly.

6.1.2 Select various site locations ranging in activity from normal background to approximately 500 micro R/hr (uR/hr).

NOTE: The measurement locations should be chosen so that the exposure rate does not vary with slight differences in positioning of the two detectors. There should not be a varied photon spectrum.

6.1.3 Take measurements alternately at each location with both instruments at approximately one meter from ground surface.

6.1.4 Allow the PIC to stabilize for 5 minutes before recording the data.

6.1.5 Allow the scintillation detector to stabilize for at least 1 minute before recording the data.

6.1.6 Record results on the Site-Specific Exposure Rate Correlation form (see Appendix 10.1).

6.1.7 This procedure should be repeated for at least 7 locations weekly to document the placement and time variations. These same 7 locations should be surveyed each time.

6.2 Correlation by Use of a Least Square Regression

6.2.1 After performing measurements as per steps 6.1.2, 6.1.3, and 6.1.4, correlate the readings from the PIC and the SPA-3 using the following regression equation:

$$E = a(Em)+b$$

Where:

E is the PIC reading in uR/hr,
a is the slope of the line,
Em is the SPA-3 reading in counts per time interval,
b is the Y-axis intercept.

7.0 PRECISION AND ACCURACY

None

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsible for Inspection

8.1.1 The Health Physics Services Manager, or his designee, shall inspect the work of technicians performing this procedure for completeness and adequate quality.

8.1.2 The technicians performing this procedure shall inspect data forms for accuracy and completeness and shall inspect instrument for proper operation.

8.2 Equipment Monitoring

8.2.1 The instrument being used shall be checked to ensure calibration date has not expired.

9.0 CALCULATIONS

None

10.0 APPENDICES

TITLE: Walk-Over Surveys Using a Large Volume Scintillation Detector	NO: RSL-2003	PAGE: 1
	REVISION: 0	DATE: 7-21-87

1.0 **PURPOSE**

This procedure provides instruction for uniform measurement techniques when using a large volume scintillation detector for a walk-over survey.

2.0 **SCOPE**

This procedure applies to walk-over surveys conducted with any portable large volume scintillation detector.

3.0 **RESPONSIBILITY**

3.1 It is the responsibility of the Health Physics Services Manager, or his designee, to ensure that this procedure is followed during the field program phase.

3.2 It is the responsibility of the Health Physics Services Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure and large volume scintillation detectors.

3.3 It is the responsibility of the person performing this procedure to follow it and report any abnormal occurrences or results to the Health Physics Services Manager, or his designee, immediately.

4.0 **REFERENCES**

4.1 Operation manuals for large volume scintillation detectors

5.0 **REQUIREMENTS**

5.1 Equipment

5.1.1 Large volume portable scintillation detector with headphones

5.2 Materials

5.2.1 Site map

5.2.2 Weighted flags

6.0 PROCEDURE

6.1 Walkover Survey

6.1.1 After ensuring that the instrument is properly calibrated and in proper working order, proceed to the assigned grid area and reset the scaler on the ratemeter/scaler.

6.1.2 Use a tape measure to subdivide the 100 foot grid into 4 equal sections, 25 feet each.

6.1.3 Record the countrate detected at each 100' grid point. This sample should be collected at approximately 3 feet from the ground.

6.1.4 At one corner of the grid, start the scale and timer and walk at a steady rate (approximately two feet per second) over the entire grid. Begin along one side and cover the entire grid in a rectilinear fashion until all areas have been surveyed.

6.1.5 The scintillation probe should be suspended by a rope or strap and swung from side-to-side in a serpentine fashion. The 25' by 25' grid should be surveyed in approximately 2 minutes.

6.1.6 During the walk-over, the survey meter count rate will be monitored with earphones. Any location with an elevated count rate in localized areas will be marked by dropping a weighted flag and the survey will continue at the same pace.

6.1.7 After the walk-over of the grid is completed, the scaler and timer are stopped and the grid ID number, the total count, and the elapsed time are recorded on the Surface Measurements Field Logbook form (see Appendix 1).

6.1.8 Return to each location which has been "flagged" within the grid and perform a systematic survey beginning at the flag and working outward to determine the areal extent of the elevated reading.

6.1.9 Record the highest count rate, the approximate location and areal extent.

6.1.10 Insert a marker at the location of highest reading. The marker should indicate the grid ID number, surveyor initials, and date.

6.1.11 Prepare a list each day showing all grid locations which have been flagged and the reading at each location. The soil sampling coordinator will use this information to determine the number and locations of surface soil samples to be collected.

7.0 PRECISION AND ACCURACY

None

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsibility for Inspection

8.1.1 The Health Physics Services Manager, or his designee, shall inspect the work of technicians performing this procedure for completeness and adequate quality.

8.1.2 The technicians performing this procedure shall inspect data forms for accuracy and completeness and shall inspect instrument for proper operation.

8.2 Equipment Monitoring

8.2.1 The instrument being used shall be checked to ensure calibration date has not expired.

9.0 CALCULATIONS

None

10.0 APPENDICES

TITLE: Walkover Survey Using a Large Volume Scintillation Detector	NO: RSL-2003	PAGE: 5
	REVISION: 0	DATE: 7-21-87

Surface Measurements Field Logbook Form

Sheet No._____of_____

Site:_____ Surveyors:_____

Area:_____ Recorded By:_____

Date:_____ Count Time:_____ Background:_____CPM

_____CPM

(-X)W←←←←Coordinates→→→→E(+X)

(-Y)S ←←←←Coordinates→→→→N(+Y)

Comments:_____ Scaler Model_____ Serial No._____

_____ Probe Model_____ Serial No._____

_____ Scaler Model_____ Serial No._____

_____ Probe Model_____ Serial No._____

_____ PIC Serial No._____

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TITLE: Near Surface Gamma Radiation Survey Using the FIDLER	NO: RSL-2004	PAGE: 1
	REVISION: 0	DATE: 8-18-87

1.0 PURPOSE

This procedure provides the method by which a Field Instrument for the Detection of Low Energy Radiation (FIDLER) is used to monitor ground surface deposits of uranium.

2.0 SCOPE

This procedure describes the methodology for monitoring ground surface deposits of uranium using a Field Instrument for the Detection of Low Energy Radiation (FIDLER).

3.0 RESPONSIBILITY

3.1 It is the responsibility of the Health Physics Services Manager, or his designee, to ensure that this procedure is followed during the field program phase.

3.2 It is the responsibility of the Health Physics Services Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure and the FIDLER.

3.3 It is the responsibility of the person performing this procedure to follow it and report any abnormal occurrences or results to the Health Physics Services Manager, or his designee, immediately.

4.0 REFERENCES

4.1 Ludlum Model 2220, Instruction Manual.

4.2 UMTRA Procedure 10.17.3 - In-Situ Ra-226 Measurement Using the Shielded Delta Procedure.

4.3 Initial performance data sheet from TMA/Eberline Instrument Calibration Group.

4.4 Tinney, J. F. and Kock, J. J., An X-Ray Screening Meter for Plutonium Contamination, UCRL-5000-67-3, 1967.

5.0 REQUIREMENTS

5.1 Equipment

5.1.1 Field Instrument for the Detection of Low Energy Radiation (FIDLER) with headphones.

5.1.2 Ludlum Model 2220 Ratemeter - Scaler

5.2 Materials

5.2.1 Am-241, check source

5.2.2 Site map including grid system coordinates

5.2.3 Cables

6.0 PROCEDURE

6.1 Initial Instrument Setup (High Voltage Plateau)

6.1.1 Inspect the FIDLER, ratemeter-scaler, and interconnecting cable for obvious damage.

6.1.2 Before connecting the FIDLER and ratemeter-scaler, adjust the high voltage to 900 volts or less.

6.1.3 Turn the ratemeter-scaler selector switch to off.

6.1.4 Connect FIDLER to ratemeter-scaler and take to an area which, from previous measurements, is known to exhibit slightly elevated background radiation.

6.1.5 Turn the ratemeter-scaler selector switch to the HV setting and adjust the high voltage to 900 volts.

6.1.6 Place the FIDLER in a position so that a series of 0.5 minute counts can be made at 50 volt increments. Record 3 readings for each voltage setting (see Appendix 10.1 - top section) from 900 through 1400 volts.

6.1.7 Reset high voltage to 900 volts.

6.1.8 Place Am-241 source approximately one inch from the beryllium entrance window near the center of the probe.

6.1.9 Repeat the series of 0.5 minute readings at 50 volt increments from 900 to 1400 volts and record (see Appendix 10.1 - bottom section).

6.1.11 Set the ratemeter-scaler high voltage according to the midpoint of the plateau as determined from the graph prepared as per step 6.1.10.

6.2 <u>Daily Source Check</u>

6.2.1 Following completion of step 6.1.11, establish a fixed source-to-detector distance is a matter of record and reproducible from one day to the next.

6.2.2 Check calibration date of ratemeter - scaler. If calibration is past due use another ratemeter - scaler.

6.2.3 Make 5 one minute counts with the Am-241 source in its check position and record each count in the instrument log book.

6.2.4 Determine the average count rate and plot this value on the control chart.

6.2.5 If the average count rate falls within the $\pm$ 3 of the mean, the FIDLER may be used for field measurements. If the average count rate is not within the boundary, corrective action must be taken. Instructions for corrective actions are given in Section 6.3.

6.3 <u>Corrective Action for FIDLER when Average Count rate is greater than + 3</u>

6.3.1 Check to see if ratemeter-scaler high voltage is set at the plateau midpoint. If not, adjust HV to plateau midpoint and repeat steps 6.2.3 - 6.2.5.

6.3.2 Turn off ratemeter-scaler and disconnect cable to FIDLER. Clean the cable and chassis connectors with ethyl alcohol and let dry.

6.3.3 Reconnect cable, turn on ratemeter-scaler, and check voltage setting.

6.3.4 Check source to detector distance and make corrections if necessary.

6.3.5 Repeat steps 6.2.3 - 6.2.5.

6.3.6 If the average count is still greater than ± 3 , then turn off the ratemeter-scaler and use a substitute ratemeter-scaler.

6.3.7 If problems still exist, repeat instruction 6.1 in its entirety.

NOTE: Repeated failures will require attention by the manufacturer.

6.4 Determine FIDLER Response to Terrestrial Background Radiation

6.4.1 At each background station (location selected as part of the site characterization), establish an area where measurements can be made with the FIDLER probe in contact with the surface soil.

6.4.2 Mark the location established in step 6.4.1 so that additional or repeat measurements can be made at later dates.

6.4.3 In a field logbook, describe the area chosen for background measurements and list specific features (ex. - soil is sandy, rocky, wet, damp, etc.). Also record climatic conditions at the time measurements are made.

6.4.4 Make five one minute counts and record in the field logbook.

6.4.5 When all background measurements have been completed, compare the average count rate at each station with the concentration of uranium and thorium in soil samples collected at that point.

6.4.6 Prepare a table representing data from step 6.4.5.

6.5 Establish Field Calibration Factors for the FIDLER

6.5.1 Choose several test areas where surface radioactivity ranges from near normal background to at lease 10 times the background radiation level.

6.5.2 Perform 5 one minute measurements at each location with the FIDLER in contact with the ground surface and record the count rate in a field logbook.

6.5.3 collect a sample of surface soil (0-6 inch) and submit it to the field laboratory for a gamma-ray spectroscopic analysis for uranium content.

6.5.4 Following completion of the analysis of soil samples, compare the data from step 6.5.2 to the soil concentration of uranium and prepare a table of values (see Appendix 10.4 for an example).

6.5.5 Based on information from step 6.5.4, establish a field calibration factor which represents an estimate of uranium concentration and record this factor in the instrument logbook (see Table 1 for an example of determining field calibration factor).

6.6 <u>Use of the FIDLER to Scan Ground Surfaces</u>

6.6.1 Determine that the FIDLER/ratemeter-scaler system has been checked and is ready for field measurements.

6.6.2 Consider any special instruction that might be given from the field sampling coordinator.

6.6.3 Subdivide grid block squares so that the total area of an individual subdivided block can be scanned in one-half or one minute intervals. Use a calibrated measuring tape for grid measurements.

NOTE: Areas of 12.5 feet by 12.5 feet can be scanned in one-half minute.

6.6.4 Drainage paths will have been staked at 100 foot intervals. Scanning these areas with the FIDLER can only be done if the area is free of standing or flowing water. If the area is dry, place a grid stake at 25 foot intervals between the 100 foot stakes.

6.6.5 Attach a surface measurements field logbook form (Appendix 10.2) to a clipboard and mark the grid block coordinates in the boxes along the left and top margins.

6.6.6 The grid should be scanned in a serpentine manner. Begin along one side and cover the grid in a rectilinear fashion until the entire grid is surveyed.

6.6.7 Scan measurements will be recorded as integral counts over the area to be scanned. That is, pulses from the FIDLER will be summed for one-half minute or for one minute. Turn the amin selector switch of the ratemeter-scaler to either 0.5 or 1 minute (whichever applies to the size of subdivided block from step 6.6.4).

6.6.8 Push the ratemeter-scaler reset button as the scan begins.

6.6.9 Do not slow scanning speed when increased audible signals are heard, but do record the presence of apparent "hot spots" when the integrated count for the scan is recorded.

6.6.10 Upon completion of the scan for an individual grid block, record the integrated count in its respective position on the surface measurements field logbook form (Appendix 10.2). Place a check mark above the recorded count to signify that anomalous or "hot spot" areas may exist on the basis of audible signals for that grid block.

6.6.11 After completion of 100 measurements (a full surface measurements field logbook form), use a random number generator and repeat measurements at 10 percent of the grid points.

NOTE: Using the 10 block by 10 block matrix on the form, the top row represents positions 1-10, the second row 11-20, and so on. The random number generator is to be based on a total of 100 location numbers.

6.6.11.1 Record the repeat measurements in the lower half of the square for a given grid point coordinate on the surface measurements field logbook form.

6.6.12 Organize individual subdivided grid blocks, which appeared to have anomalous radiation levels during the scanning process, into an efficient measurement sequence.

6.6.12.1 Use a single surface measurements field logbook form to record measurements for an individual subdivided grid block. On this form, label the coordinates of the northwest corner of the grid block in the upper left and left top block reserved for grid coordinates (see Appendix 10.3 for an example).

6.6.12.2 Measurements are to be made using the ratemeter-scaler in its microprocessor controlled counting mode. Turn the ratemeter-scaler to the "C" position. This will adjust the ratemeter-scaler to integrate a total of 1000 counts and, after a delay of 3 seconds, display the result in counts per minute.

6.6.12.3 Record a total of nine "C" scale measurements in each grid block; at the corners, at midpoints along each side of the grid block, and in the center of the block (see Appendix 10.3 for an example).

6.6.13 When all measurements have been completed, sign and return surface measurements field logbook forms to the field sampling coordinator, and return the FIDLER/ratemeter-scaler system to its storage area for end of the day checkout and preparation for the next day.

7.0 PRECISION AND ACCURACY

None

8.0 QUALITY ASSURANCE PROVISIONS

8.1 Responsibility for Inspection

8.1.1 The Health Physics Services Manager, or his designee, shall inspect the work of personnel performing this procedure for completeness and adequate quality.

8.1.2 Personnel performing this procedure shall inspect data forms for accuracy and completeness and shall inspect instrumentation for proper operation.

8.2 Equipment Monitoring

8.2.1 The instrumentation being used shall be checked to ensure calibration dates have not expired.

9.0 CALCULATIONS

None

10.0 APPENDICES

TITLE: Near Surface Gamma Radiation Survey Using the FIDLER	NO: RSL-2004	PAGE: 9
	REVISION: 0	DATE: 8-18-87

Response of Fidler Detectors

Date: _____

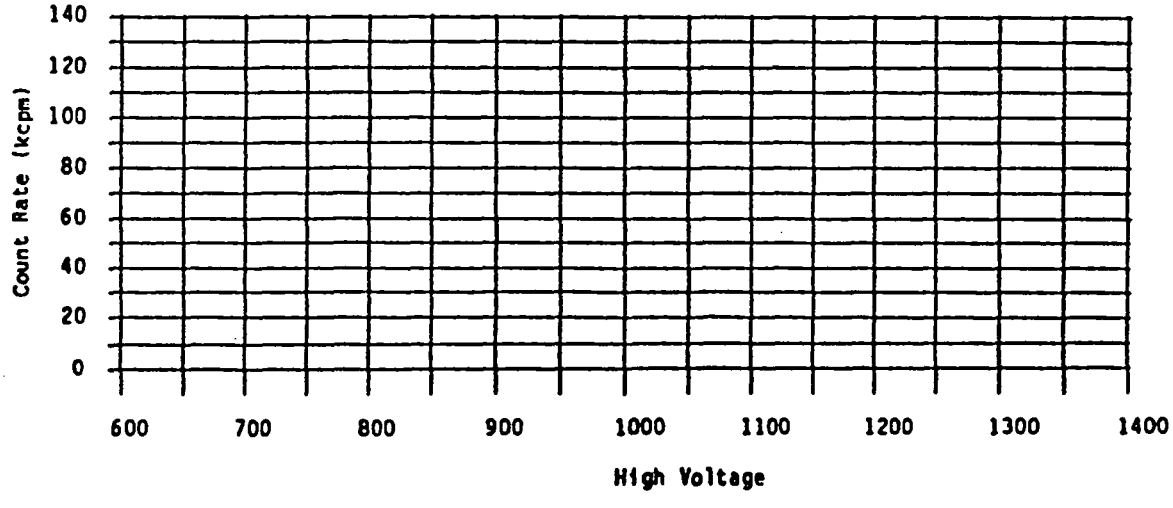
Location: _____

Scaler Model: _____ Serial No.: _____ Count Time: _____

Probe Model: _____ Serial No.: _____ Recorded by: _____

Count Rate As A Function Of High Voltage

High Voltage	Bkg CPM_1	Bkg CPM_2	Bkg CPM_3	Bkg Avg. CPM		Am-241 CPM_1	Am-241 CPM_2	Am-241 CPM_3	Am-241 Avg. CPM
600									
650									
700									
750									
800									
850									
900									
950									
1000									
1050									
1100									
1150									
1200									
1250									
1300									
1350									
1400									



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Surface Measurements Field Logbook Form

Sheet No.____of____

Site:_____ Surveyors:_____

Area:_____ Recorded By:_____

Date:_____ Count Time:_____ Background:_____CPM

_____CPM

(-X)W←←←←Coordinates→→→→E(+X)

(-Y)S ←←←←Coordinates→→→→N(+Y)

Comments:_____ Scaler Model_____ Serial No._____

_____ Probe Model_____ Serial No._____

_____ Scaler Model_____ Serial No._____

_____ Probe Model_____ Serial No._____

_____ PIC Serial No._____

TITLE: In-Situ Gamma-Ray Measurements Using the Delta-Gamma Technique	NO: RSL-2005	PAGE: 1
	REVISION: 0	DATE7-18-87

1.0 PURPOSE

This procedure provides the method for the in-situ measurement of gamma-rays emitted from surface soil, and to provide a technique for screening potentially contaminated soils in the presence of adjacent sources of air scattered gamma radiation.

2.0 SCOPE

This procedure is based on procedures developed for the Uranium Mill Tailings Remedial Actions (UMTRA) Program for measuring in-situ Ra-226 concentrations in soil where adjacent sources of radiation influence probe measurements. This procedure will be used to screen for anomalous gamma radiation levels in areas where adjacent sources of radiation influence the use of an unshielded probe.

3.0 RESPONSIBILITY

3.1 It is the responsibility of the Health Physics Services Manager, or his designee, to ensure that this procedure is followed during the field program phase.

3.2 It is the responsibility of the Health Physics Services Manager, or his designee, to delegate the performance of this procedure to personnel that are experienced with this procedure and the Delta-Gamma Technique.

3.3 It is the responsibility of the person performing this procedure to follow it and report any abnormal occurrences or results to the Health Physics Services Manager, or his designee, immediately.

4.0 REFERENCES

4.1 UMTRA Procedure 10.17.3 - In-Situ Ra-226 Measurement Using the Shielded Delta Procedure

5.0 REQUIREMENTS

5.1 Equipment and Materials

5.1.1 Shielded Delta Housing

5.1.2 Portable ratemeter/scalers

5.1.3 Eberline SPA-3 NaI Detector

5.1.4 Am-241 check source

5.1.5 Site map

5.1.6 Shielded Delta-Gamma In-Situ Measurement Background Assessment form (Appendix 10.1)

5.1.7 Shielded Delta-Gamma In-Situ Measurements Field Radiation Measurements form (Appendix 10.2)

6.0 PROCEDURE

6.1 Background Assessment

6.1.1. Check high voltage (as stated on detector probe).

6.1.2 Check threshold setting (100).

6.1.3 Check window setting (gross model).

6.1.4 Check battery conditions (BAT indicator off) on the ratemeter/scaler.

6.2 Source Check

6.2.1 Position Am-241 check source in a reproducible, fixed geometry to detector.

6.2.2 Make 3 one minute counts with the detector probe unshielded and record (see Appendix 10.1).

6.2.3 Make 3 one minute counts with the detector probe shielded and record (see Appendix 10.1).

6.2.4 Calculate and record the average for the three unshielded measurements, the three shielded measurements, and delta of the unshielded and the shielded measurements (see Appendix 10.1).

6.2.5 Perform 3 unshielded and 3 shielded background counts at 10 site locations and record (see Appendix 10.1).

6.2.6 Perform calculations for delta, average, standard deviation, and average + 3 standard deviations as indicated on Appendix 10.1.

NOTE: Measurements subsequently taken during the field work that have a delta count greater than the average background plus three standard deviations of the background will be marked, and the area will be further characterized by taking additional delta-gamma measurements and sampling the surface soil.

6.3 <u>In-Situ Gamma-Ray Measurements</u>

6.3.1 Daily before each sampling exercise, perform steps 6.1.1, 6.1.2, 6.1.3, and 6.1.4.

6.3.2 With probe unshielded, make and record (see Appendix 10.2) 3 measurements with the ratemeter/scaler set to integrate 1000 counts ("C" scale).

6.3.3 With probe shielded, make and record (see Appendix 10.2) 3 measurements with the ratemeter/scaler set to integrate 1000 counts ("C" scale).

6.3.4 Compare the sample delta to the average background delta plus three standard deviations of the background delta. If the sample delta is greater, the location will be staked and the areal extent of material further characterized by making additional delta-gamma measurements, and by obtaining surface soil samples.

7.0 PRECISION AND ACCURACY

None

8.0 QUALITY ASSURANCE PROVISIONS

None

9.0 CALCULATIONS

None

10.0 APPENDICES

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Shielded Delta-Gamma In-Situ Measurement

Background Assessment

Project Name:_____ Recorded By:_____

Date:_____ Time:_____

Delta Housing No.:_____ Daily Check Results:_____

Probe No.:_____ HV_____(1000V) Threshold_____(100)

Ratemeter/Scaler No.:_____ BAT_____(OK) Window_____(OUT)

Check Source No.:_____ Check Location:_____

Unchielded C_1*_____ C_2_____ C_3_____ Avg. Unshielded_____

Shielded C_1*_____ C_2_____ C_3_____ Avg. Shielded _____

Delta 1_____ 2_____ 3_____ Avg. Delta _____

Bkg. Meas.	Location	Unshielded C_1*	Unshielded C_2	Unshielded C_3	Shielded C_1*	Shielded C_2	Shielded C_3	Delta
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Average _____

Std. Dev._____

Ave. ± 3 Std. Dev._____

*Each count represents the counts per minute based on integration of 1000 cts. on the "C" scale of a ratemeter/scaler.

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