Appendix F

Radiological Survey Procedures

F.1 Radiological Survey Procedures

This section describes the actions and method used by the Monticello Legacy Management (LM) Representative when conducting radiological surveys for the purpose of identifying radiologically contaminated material and determining the Radium-226 (Ra-226) concentration of that material. This section applies to all radiological surveys on Monticello supplemental standards properties and the temporary storage facility.

F.1.1 Responsibilities

Monticello LM Representative—Will be responsible for:

- Performing radiological surveys in accordance with this procedure,
- Maintaining his/her instruments in calibration and in good working condition,
- Collecting accurate, adequate, and appropriate data, and properly recording such data,
- Notifying the Site Manager in the event that conditions outside the normal scope of this procedure are found (these conditions may include finding radiologically contaminated material in excess of 130 picocuries per gram (pCi/g) and/or suspected hazardous material, or encountering safety hazards in the course of performing duties).

Site Manager—Will be responsible for overseeing the data collected to ensure it meets programmatic goals discussed in the *Long-Term Surveillance and Maintenance Plan for the Monticello NPL Sites.*

F.1.2 Instrument Response Checks

The results of a daily instrument response check for each instrument must be within 20 percent of the After-Calibration Source Response before the instrument may be used. Follow the procedure below to determine whether the instrument is still in calibration.

F.1.2.1 After-Calibration Source Response

Ensure each calibrated instrument has a completed After-Calibration Source Response Check Data Sheet (Figure F–1). If necessary, set up the After-Calibration Source Response Check Data Sheet as follows:

- Select the correct source for the type of instrument. Guidelines for source selection are provided in DOE approved health and safety procedures, maintained by the contractor, for portable radiation survey instrument response checks (e.g., HS–310-01).
- Record the following information at the top of the After-Calibration Source Response Check Data Sheet (form GJ1974e shown in Figure F−1).

  —Location (site) (e.g., Monticello),

  —Date,

After-Calibration Source Response Check Data Sheet

Location _____

Month _____Day _____ Year _____

Survey Instrument Data

Manufacturer _____

Model No. _____

Government Property No. _____

Calibration Due Date_____

Detector/Probe Data *(if applicable)*

Manufacturer _____

Model No. _____

Government Property No. _____

Calibration Due Date _____

Check Source Data

Isotope _____

Source I.D. No. _____

Instrument Scale	Source Detector Distance	Shielding/Geometry	Instrument Response	-20%	+20%	Scale Units

Comments:

_____

_____

_____

_____

_____

_____

_____

_____	_____	_____
Performed by (print)	*Performed by (signature)*	*Date*
_____	_____	_____
Reviewed by (print)	*Reviewed by (signature)*	*Date*

File Index No. _____

Figure F−1. After-Calibration Source Response Check Data Sheet

—Instrument manufacturer, model number, and government property number,

—Probe manufacturer, model number, and government property number,

—Instrument and probe calibration due date, and

—Radioactive check source identification number and isotope.

- Select the appropriate scale and choose a source-to-detector distance and geometry and any shielding necessary to obtain an instrument response at or near the middle of the scale.
- Record this information and the instrument response on the After-Calibration Source Response Check Data Sheet.
- Expose the instrument to a source of radiation.
- ***If*** the instrument functions only as a rate meter, ***then*** allow the meter to stabilize for approximately 30 seconds.
- ***If*** the instrument is equipped with integrating or scaler functions, ***then*** allow the meter to count the source for 1 minute.

Record the indicated value in the instrument response column of the After-Calibration Source Response Check Data Sheet.

Calculate the values 20 percent above and below the instrument response, and record these values in the appropriate locations on the After-Calibration Source Response Check Data Sheet.

- Repeat all the steps in this subsection for each type of radiation detection instrument and for each scale. For instruments that automatically adjust the scale (i.e., microprocessor based instruments), repeat all of the steps in this subsection at two activities in the range of expected radioactivity to be measured.

F.1.2.2 Gamma Scintillometer Daily Response Check

- Check the instrument tag to ensure the instrument is calibrated. Scintillometers are calibrated, by contract service providers, every 12 months or after major repair.
- Perform a battery check by selecting Check Mode. The battery voltage must be at least 25 percent; if not, turn the E-600 off and replace the batteries.
- **Note:** If the battery icon appears while using the scintillometer in any operational mode, stop and replace the batteries and start over.
- Set the response setting to “MED” (medium). This is a 4-second response time.
- Insert the detector of the crutch scintillometer into the hole in the operational check fixture.
- Turn the mode select switch to Ratemeter and toggle the Gross/Net button to Gross.
- Compare the reading to the response check range specified on the After-Calibration Source Response Check Data Sheet (Figure F–1). Record the data in the applicable column of the Daily Instrument Response Check Data Sheet form (GJ1974Ae shown in Figure F–2).

Gamma Scintillometer Daily Instrument Response Check Data Sheet

Source ID No. _____ Isotope _____ Scale Units _____ Page ___ of ___
Detector Model _____ Property No. _____ Probe Model _____ Property No._____
Month _____ Year _____ Month _____ Year _____

Initial below and on the Instrument Response Check Sticker if daily response check is satisfactory						
	Response (Scale or Decade)					
Day						Initials
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

Initial below and on the Instrument Response Check Sticker if daily response check is satisfactory						
	Response (Scale or Decade)					
Day						Initials
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

_____ _____
Reviewed by (print and sign) Reviewed by (print and sign)

_____ _____
Date Date Record File No._____

Figure F−2. Daily Instrument Response Check Data Sheet

- If a reading is out of range, check the instrument settings to make sure all settings were correct. If they were not correct, change the settings, and repeat the operational check. If instrument settings were correct, tag the instrument as defective, and return the instrument for repair.

F.1.2.3 Delta Scintillometer Daily Response Check

- Check the instrument tag to ensure the instrument is calibrated. Deltas are calibrated, by contract service providers, every 12 months or after major repair.
- Turn power switch to ON.
- Replace the batteries if an arrow and colons appear in the display.
- Place the delta on the top surface of the operational check fixture.
- Using the rotary switch, select the desired counting interval (normally 120 seconds).
- Remove the tungsten filter from the slot on the undersurface of the instrument.
- Depress the START button to initiate the UP or total count.
- Verify that the displayed count is increasing; if the displayed count is decreasing, depress the RESET button then the START button.
- When the total-count interval is complete, record the total count on the Daily Instrument Response Check Data Sheet (Figure F−2).
- Compare the total-count operational check reading to the operational check range specified on the After-Calibration Source Response Check Data Sheet (Figure F−1). If the total count is within the range specified, record the data in the appropriate column of the Daily Instrument Response Check Data Sheet. The instrument may now be used for Ra-226 measurements.
- If the total count is not within the specified range, ensure that all instrument settings are correct. If any instrument settings are found to be incorrect, correct them and repeat the response check.
- If the instrument settings are correct, tag the instrument with a “Defective” tag. Record the operator’s name, instrument serial number, and date on the tag. Submit the instrument for repair.

F.1.3 Background Determination

- Set the gamma scintillometer function switch set to “FAST” position (1-second response time), the mode select switch set to Ratemeter, and the Gross/Net button toggled to Gross. Rescale the analog meter by pressing the Range Up or Range Down buttons. The digital display will provide accurate information up to twice the range of the meter scale.
- Measure background locations by switching to the Scaler Mode and press the Star Key to initiate a 10-second count. The average value is displayed at the end of 10 seconds.
- Take three to five scintillometer readings in areas away from the suspected contamination. Typical background for the Monticello area is 90 to 120 counts per second (cps).
- Record these readings on a 20- or 50-scale map (for city streets and utilities and for Highway 191 and 491 rights-of-way) or a 200-scale map (for MS−00176−VL and

MP−00211−VL). A hand-drawn map may also be drawn and labeled in the LTS&M record book for the site. Figure F−3 shows an example of the recorded readings.

- Average these readings to determine the background value.

F.1.4 Gamma Scan

- Set the gamma scintillometer function switch set to "FAST" position (1-second response time), the mode select switch set to Ratemeter, and the Gross/Net button toggled to Gross. Rescale the analog meter by pressing the Range Up or Range Down buttons. The digital display will provide accurate information up to twice the range of the meter scale.
- Measure anomalies by switching to the Scaler Mode and press the Star Key to initiate a 10-second count. The average value is displayed at the end of 10 seconds.
- Walk slowly over the area of the survey swinging the detector in a 4- to 6-foot wide traverse approximately 3 inches off the ground.
- Note any areas that exceed 1.3 times the background value. Typical background values for the Monticello area are 90 to 120 cps; areas that are 1.3 times background will normally be 120 to 160 cps. (A reading of 160 to 200 cps typically equates to 5 pCi/g Ra-226; however, this correlation is highly variable.) All areas that exceed 1.3 times the average background will be investigated with the delta scintillometer to determine the Ra-226 concentration.
- As the traverse is performed, note the boundaries of the elevated areas and mark them with spray paint, if needed.
- Ensure the entire area of interest is scanned.
- Record these readings on the appropriate-scale map in the LTS&M record book (include date and map page) for the site. Figure F−3 shows an example of the recorded readings.

F.1.5 Delta Measurements

- Following the gamma scan, investigate all areas that exceed 1.3 times the average background with the delta scintillometer to determine the Ra-226 concentration of the soil.
- Make a delta measurement at the highest gamma location within each discrete area.
- If needed, make additional measurements to establish the area boundary.
  Note: The U.S. Environmental Protection Agency standard for Monticello is 6.0 pCi/g. However, for conservatism, an action level of 5.0 pCi/g will be used for delta measurements.
- Turn power switch to ON and set the time switch to the desired interval (normally 120 seconds). Remove the filter.

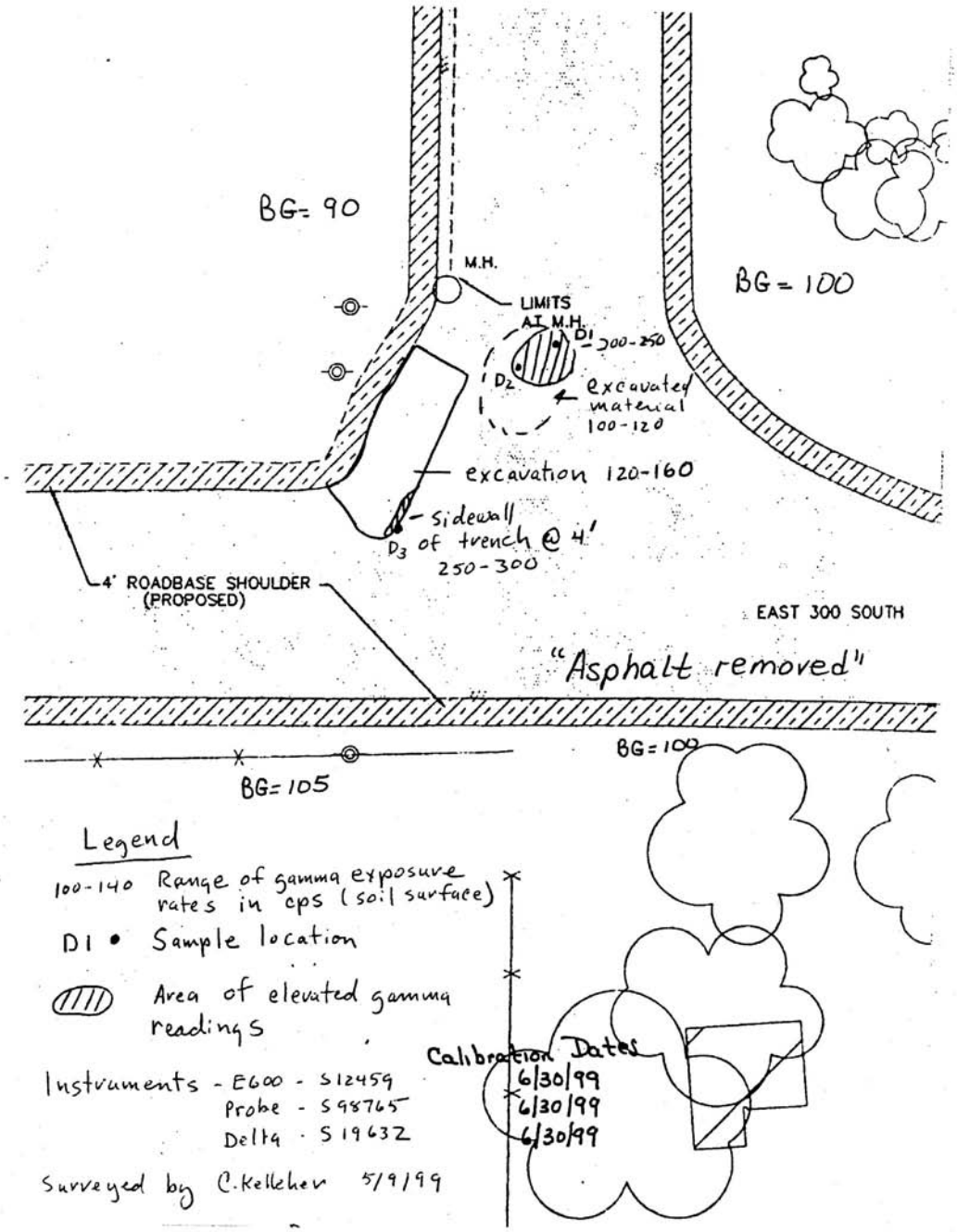

Figure F−3. Example of Recorded Readings—Before and During Excavations

- Place the instrument on the surface to be measured. If possible, the instrument should not be moved during the sequence of unfiltered and filtered measurements.
- Turn power switch to ON. Press the START button to initiate the total count. Verify that the count is increasing; if it is not, depress the RESET button and then the START button.
- At the end of the counting interval, record the total count on the Delta Scintillometer Field Data form (see Figure F−4).
- Place the filter in the receptacle beneath the detector without moving the detector.
- Depress the START button and verify that the count is decreasing.
- At the end of the counting interval, record the difference (delta count) on the Delta Scintillometer Field Data form.
- Calculate the uncertainty using the following equation:

$$\%\,\text{Uncertainty} = 100 \times \frac{\sqrt{2\text{TC} - \text{Delta}}}{\text{Delta}}$$

Where TC is the total count, and Delta is the delta count.

- Calculate the Ra-226 of the measurement using the following equation:

$$\text{Ra-226} = \text{slope} \times (\text{delta count} / \text{count time}) - \text{intercept}$$

The slope and intercept values are found on the card attached to the instrument.

- Mark with orange spray paint all material 5.0 pCi/g or greater. These materials are considered radiologically contaminated.

DELTA SCINTILLOMETER FIELD DATA

LOCATION: Monticello City Streets	**MODEL TYPE:** EL-0018-B
ADDRESS: 500 N 200 E	**INSTRUMENT GJPO:** 10035
DATE: 5/12/99	**CALIBRATION EXPIRES:** 8/29/99
OPERATOR: C Kelleher	**SLOPE & INTERCEPT:** 0.39955 2.59

***ALL COUNT TIMES ARE 120 SECONDS UNLESS NOTED OTHERWISE**

Sample Location	*Total Count	*Delta Count	% Uncer (<15%)	Depth	Ra-226 pCi/g	Comments (Optional)
# 1	6528	1573	7	0"	2.3	by edge of excavation
# 2	5679	1241	8	0"	1.2	pile of material

CRK 5/12/99

$Ra\text{-}226\ slope * \left(\frac{Delta\ Count}{120\ seconds}\right) - intercept$	$\%\ Uncer = \frac{\sqrt{(2 * Total\ Count)} - Delta}{Delta} * 100$

Verified: E Supervisor Date: 5/14/99

H:\A-FORMS\DELTA.FLD (11/96)

Figure F−4. Delta Scintillometer Field Data Form

End of current text