SECTION 5.3

GAMMA SCINTILLATION DETECTOR CHECK-OUT AND CROSS CALIBRATION

1.0 Purpose

To describe the procedures for cross calibration and operational check-out of gamma scintillation detectors.

2.0 Responsibilities

- The site coordinator is responsible for assuring that this procedure is implemented.
- Survey team personnel are responsible for following this procedure.

3.0 Procedure

3.1 Equipment

✔ Ratemeter: Model PRM-6, Eberline Instrument Corporation; Model 12, Ludlum Instrument Corporation; or equivalent.

✔ Sodium iodide detector: Model 489-55, Victoreen Instrument Co.; Model SPA-3 or Model PG-2, Eberline Instrument Corporation; or equivalent.

✔ Pressurized Ionization Chamber (PIC): Model RSS-112, Reuter Stokes Co.

✔ Cable: MHV-MHV; or other connectors, as applicable.

✔ Record forms.

✔ Check source.

3.2 Instrument/Detector Assembly and Operational Check-Out

3.2.1 Turn ratemeter on, check batteries, and replace if necessary.

PRM-6 and Model 12: Turn the instrument selector switch to BATT. Note condition of batteries on the analog scale. If the reading falls below the acceptable range shown on the meter face, replace the batteries.

2221: Turn the instrument on. Depress battery button. A digital display reading less than 5.6 volts indicates battery power is marginal and batteries should be replaced.

3.2.2 Adjust the high voltage to approximately 900 V.

3.2.3 Turn ratemeter off. Attach scintillation detector and turn ratemeter back on.

3.2.4 Determine the background count average with the ratemeter set to slow response:

PRM-6: rotate the response knob, counter clockwise to the stop.
Model 12: set the response switch to "S".

Record the average count rate on the first data line of the Instrument Operational Check-out Form (Figure B-1 or equivalent).

3.2.5 Determine the acceptable background response limits by setting the ratemeter to fast response:

PRM-6: rotate the response knob clockwise to the stop.
Model 12: set the response switch to "F".

Record the actual lowest and highest values observed on the Instrument Operational Check-out Form (Figure B-1 or equivalent).

3.2.6 Turn the instrument selector switch scale to the 1K scale. Select a gamma check source (e.g., Co-60, Cs-137), place on the front of the detector, and observe the meter to ensure the detector is responding (if low activity check sources are used, it may be necessary to change to a lower scale on the instrument).

3.2.7 Determine the check source count rate and record the count rate on the first data line of the record form. Also, determine the ± 10% variation of the check source count rate as the source response limits and record the values at the bottom of the Instrument Operational Check-out form (Form B-1 or equivalent).

NOTE: The form and check source are to accompany the instrument to the field survey site.

3.2.8 Perform cross-calibration.

3.2.8.1 Assemble PIC, turn on, check batteries (see Section 5.8), and allow to stabilize approximately 5 minutes.

3.2.8.2 Place the PIC at a location of measurable activity. If no such areas are present perform the calibration at 6 to 10 locations on the site. Adjust the tripod to position the center of the PIC chamber at 1 meter above the surface.

3.2.8.3 Determine the exposure rate (see Section 7.5). Record on Cross Calibration Form (Figure B-3 or equivalent).

3.2.8.4 Remove the PIC and measure the scintillation detector count rate at 1 meter above the surface. Record this value on the Cross Calibration Form (Figure B-3 or equivalent).

3.2.8.5 Repeat steps 3.2.8.2 to 3.2.8.4 for locations of different radiation intensities. If possible, obtain calibration points throughout the entire range of radiation levels noted on the site. In this case a minimum of 5 different measurements in each of the ranges—<20 μR/h, 20 to 100 μR/h, and 100 to 500 μR/h is recommended.

3.2.8.6 Prepare a calibration curve of detector count rate versus exposure rate. There is a computer program which will generate a table of these values. The electronic file path is Y:\ESSAP\ESSAP Tech\ESSAPTEC\CALIBRATION INFO\FIELD CALCS\piccal.xls.

NOTE: Calibration curves determined using cable lengths of 3 meters or less are not necessarily applicable to instrument/detector combinations using cables greater than 3 meters long.

3.2.9 Consistent Instrument Display

For sites where several instrument/detector units will be used in the same area, units may be adjusted to display similar responses.

3.2.9.1 Obtain a gamma radiation source with an activity great enough to be distinguished at a distance of 1 meter.

3.2.9.2 Place each of the detectors at a prescribed distance from the source and check readings. The distance should be a minimum of one meter, chosen to give a instrument/detector response >10,000 cpm.

3.2.9.3 If all units do not respond within 10% of each other, adjust the high voltages to obtain the same meter response. The voltage should be between 750 and 950 volts; if outside this range,l do not attempt to use the detector for this purpose.

3.2.9.4 If voltage adjustments were necessary, perform steps 3.2.4 through 3.2.7 again.

3.2.9.5 Record operational voltage on the Instrument Operational Check-out Form (Figure B-1 or equivalent). If the voltage has been set to a value other than 900 V, indicate in the Comments section that the Operating Voltage was adjusted to allow for consistent response between instruments at this site.

3.3 Site Operational Check-Out

When initially checking out equipment on site, set the ratemeter to slow response and determine the average background count rate. Compare the background to the response limits. Position the check source on the detector. Compare the count rate to the check source response limits.

3.3.1 Should the site background and/or check source response fall outside of the acceptable response limits determined at calibration, then site-specific backgrounds and/or check source response limits used for instrumentation operational check-out will be required. The site-specific operational background range will be determined in accordance with Step 3.2.5. The site-specific check source response limits will be determined in accordance with steps 3.2.6 and 3.2.7.

3.3.2 At the start of each workday, at midday, and end of day, set the ratemeter to slow response and determine the background count rate average. Record the time of day and the background count rate on the Instrument Operational Check-out Form (Figure B-1 or equivalent). Compare the background to the response limits. If acceptable, continue with checkout. If outside limits, investigation and documentation of subsequent actions is required.

3.3.3 At the start of each work day, at midday (if site logistics permit), and end of each workday position the check source on the detector. Record the count rate on the Instrument Operational Check-out Form. Compare the response to the acceptable response range. If outside the response limits, investigation and documentation of subsequent actions is required.