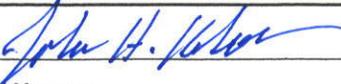
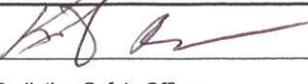


Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.10

OPERATION OF GAMMA SCINTILLATION DETECTORS

1.0 OBJECTIVE

To provide instruction for the operation of gamma scintillation detectors for the measurement of gamma radiation levels for environmental characterization, remediation support, and contamination monitoring surveys.

2.0 SCOPE

This standard operating procedure (SOP) applies to the operation of gamma scintillation detectors using external probes with sodium iodide (NaI) crystals or plastic scintillators. These instruments may be used to determine ambient gamma radiation levels and/or worker exposure in facility areas and from packages or vehicles.

3.0 POLICY

Instruments will be used in accordance with manufacturer's recommendations, SOPs, and site-specific requirements by trained personnel. The use of an instrument outside of its intended capabilities requires approval by the CHDT Radiation Safety Officer (RSO) or designee.

4.0 RESPONSIBILITIES

Responsibilities of the CHDT RSO, management, and staff are defined in the CHDT Radiation Protection Plan (SOP DR 15.RPP.01).

5.0 SURVEY DATA COLLECTION

5.1 Instrument Description

Gamma scintillation detectors are a group of instruments that utilize an external gamma scintillation crystal with a ratemeter or scaler detector. NaI crystals that are present within the detectors may range in size from 1-inch by 1-inch (1x1) to 3-inches by 3-inches (3x3). Thinner NaI crystals or plastic scintillators may also be used to preferentially detect lower-energy gamma radiation and x-rays. The CHDT RSO or designee should be consulted for the appropriate crystal size for the specific application.

The meters typically used with gamma detectors provide measurements in units of counts per minute (cpm), although some meters may be calibrated to provide measurements in units of exposure (such as microRoentgens per hour [$\mu\text{R/hr}$]). Gamma detectors may be used with a global positional system (GPS) device to allow for data logging and subsequent mapping of surface gamma radiation levels.

5.2 Instrument Setup and Initial Quality Control

Upon receipt of the instrument through purchase or rental, the following steps should be taken to initially setup the instrument and verify that it is in good working order.

- Verify that the instrument calibration is current; confirm that serial number on instrument matches that on the calibration certificate; confirm high voltage (HV) setting on instrument with calibration
- Perform ten (10) initial background quality control (QC) measurements
 - Use location away from radioactive sources
 - Depress the scaler count button to collect a one-minute count. Record the measurement, and repeat for 10 measurements.
 - Calculate the average plus and minus 20%. Subsequent background QC measurements must fall within this range.
- Perform ten (10) initial source QC measurements
 - Use cesium-137 source in a repeatable geometry (i.e., orientation of the source relative to the meter). Other gamma radiation sources may also be applicable depending on the specific instrument used.
 - Use same location as background measurements
 - Depress the scaler count button to collect a one-minute count. Record the measurement, and repeat for 10 measurements.
 - Calculate the average plus and minus 20%. Subsequent source QC measurements must fall within this range.
 - If the meter used with the instrument does not perform scaler measurements (i.e., only has ratemeter function), consult SOPs 15.OPS.07, *Operation of Exposure Rate/Dose Rate Meter*, and 15.OPS.09, *Operation of GM Pancake Probe*, for instruction on conducting QC measurements on a ratemeter instrument.

5.2.1 Daily Instrument Quality Control

Each day that the instrument is used, the following QC checks and measurements must be performed and recorded.

- Check the battery by depressing the “BAT” button
- Check the HV against the calibrated HV
- Perform background QC measurement
 - Use same location as with initial QC measurements
 - Measurement must be within plus or minus 20% of the initial average
- Perform source QC measurement
 - Use same location and source geometry as with initial QC measurements

- Measurement must be within plus or minus 20% of the initial average

If either measurement does not fall within the required tolerances, turn the unit off, turn it back on, and repeat the measurement(s). If the unit fails a second consecutive time, remove the unit from service and notify the CHDT RSO or designee.

5.2.2 Collection of Survey Measurements

While scaler measurements can be collected with a gamma scintillator, it is primarily a scanning tool. Survey measurements with a gamma scintillator may be collected in exterior locations as part of a gamma walkover survey (GWS) or as part of a contamination survey. Scanning measurements collected during a GWS rely on the technician's monitoring of the audio output of the meter to identify elevated areas. Data logging by a GPS system is used to log individual measurements and locations, and can be used to determine scanning speeds. When scanning, the technician should keep the detector approximately 6 inches from the ground surface, moving the detector in a "Z"-pattern while walking forward. If the survey goal is to identify contamination, any locations with increases in count rates should be re-surveyed at a slower pace in order to pinpoint the source location.

5.2.3 Evaluation of Results

Logged scanning measurements can be evaluated for outliers by generating contour maps and or performing statistics on the data. Calculation of the Z-score (i.e., number of standard deviations from the mean) of each measurement in the data set can identify statistical anomalies. In addition, a time series plot of the logged data versus collection time may also identify anomalies and or fluctuations in naturally-occurring background.

The scanning data may also be evaluated against the observed ambient background in the area. In addition, it may be possible to correlate the instrument response to concentrations of radionuclides in soil using the Microshield modeling software and procedures developed in NUREG-1507, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions* (NRC 1998). The CHDT RSO should be consulted on project- or task-specific data evaluation requirements.

6.0 STANDARDS AND CRITERIA

Specific evaluation criteria may be established for the type of survey being performed. The CHDT RSO or designee should be consulted to determine the appropriate limits for any new activity.

7.0 REFERENCES

Detector-specific instrument operation manuals

NRC 1998. *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions*, NUREG-1507, June.