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## PHYSICS DIVISION PROCEDURE

### RADIOLOGICAL CHARACTERIZATION OF WASTE

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## PHYSICS DIVISION PROCEDURE

### RADIOLOGICAL CHARACTERIZATION OF WASTE

#### 1. Scope

This document specifies the requirements which must be met when applying the method of gamma-ray spectroscopy for determining the identity and quantity of radionuclides present in waste, containing or suspected to contain radioactivity, generated in ORNL Physics Division facilities. Techniques which may be used to meet these requirements are given in Physics Division Guideline "APPLICATION OF HIGH-RESOLUTION GAMMA-RAY SPECTROSCOPY TO THE RADIOLOGICAL CHARACTERIZATION OF WASTE."

#### 2. References

- a. ORNL Compliance with SLLW Acceptance Criteria, ORNL-WC-006.
- b. Radiological Characterization Plan for SLLW, WM-SWO-507 (to be replaced by ORNL-WC-507).

#### 3. Requirements

##### 3.1 Calibration

The detection efficiency shall be calibrated using an NBS- or NIST-traceable standard source for each source-detector geometry used for measuring the radionuclide content of waste, with the following exception: For source-detector distances,  $d$ , larger than 24 inches, use the efficiency for  $d=24$  inches and then multiply the reported activities by  $(d/24)^2$ .

The energy and resolution (FWHM) shall be calibrated using calibration sources having at least three gamma-ray transitions with well known energies covering the energy range from approximately 100 keV to 1500 keV. The counting time and source-detector distance shall be adjusted to provide at least 1,000 counts in each peak used in the calibration.

##### 3.2 Quality Control

Quality Control checks of the energy, resolution, and efficiency of the detector system shall be made to ensure that the performance of the detector system has not degraded beyond specified limits. A Quality Control check shall be performed at least monthly, or before the detector system is used for radiological characterization if it has been idle for more than 30 days.

##### 3.3 Background Substation

A background spectrum shall be acquired at the location where the detector system is to be used for radiological characterization. A new background measurement shall be made whenever the measurement configuration or location

changes, or when background levels are suspected to have changed. The background spectrum appropriate for the detector location and configuration shall be used to correct the waste item spectrum for background radiation.

### 3.4 Detector Dead-time

The detector system dead-time (DT) should be kept below 15% whenever possible by appropriate selection of the source-detector distance. If the detector system is to be operated at  $DT > 15\%$ , the efficiency, energy, and resolution calibration of the detector system shall be checked at the higher dead-time and the system recalibrated if the values are outside Quality Control limits.

### 3.5 Waste Activity Homogeneity

The homogeneity of the activity present in the waste item shall be checked by measuring the count rate with various parts of the waste item oriented toward the detector, or by scanning the item with a survey meter. If significant ( $>20\%$ ) inhomogeneity is found, multiple orientations of the waste item shall be used to acquire the waste item gamma-ray spectrum, or appropriate corrections applied to the reported activities.

### 3.6 Geometrical and Self-Attenuation Corrections

Where appropriate, correction factors for the density and geometry of the material being analyzed shall be determined and applied to the reported activities.

### 3.7 Radionuclides with No Gamma-Ray Emission

The estimated quantities of non-gamma-ray-emitting radionuclides present, based on the activities of gamma-ray emitting radionuclides present and the radionuclides expected to be produced in the waste stream, shall be entered on the analysis report.

### 3.8 Analysis Report Review

The waste item gamma-ray spectrum analysis report shall be reviewed to ensure that radionuclide assignments are consistent with those expected in this waste stream, any unidentified peaks are accounted for, geometrical and self-attenuation corrections are documented, and any non-gamma-ray emitting radionuclides expected to be present are reported. All changes shall be documented on the hard copy of the report and the report shall be signed and dated by the reviewer.

## 4. Records Management

Electronic copies of waste item spectra, background, and calibration data shall be maintained for a minimum of one year from the time that the waste is removed from Physics Division jurisdiction. All computer-generated files shall be backed up on a regular basis, at a minimum within 30 days of origination.

A hard copy of each waste item gamma-ray spectrum analysis report shall be included in the waste disposal documentation package. A backup copy of the report, either as a duplicate hard copy or as an electronic file, shall be maintained for a minimum of one year from the time that the waste is removed from Physics Division jurisdiction.

5. Training Requirements

Personnel who operate the detector system and review the gamma-ray spectrum analysis reports shall complete training provided by the Physics Division before approval will be granted to these personnel to use gamma-ray spectroscopy for radiological characterization of waste.