Use of DRAFT Interim Gamma Spectroscopy Guidance for Waste Characterization

On 10/26/99, at a meeting that included essentially all of the providers of gamma spectroscopy services for characterization of wastes, a plan was described for eventually standardizing gamma spectroscopy techniques and documentation across LMER. One step of that plan was for gamma spectroscopy providers to employ the following DRAFT Interim Gamma Spectroscopy Guidance beginning 11/1/99. Consistent with the plan, over the next two weeks representatives of LWS/WCO will meet with representatives of each of the provider groups (one-on-one) to review the DRAFT interim guidance and reach accord as to how each of the provider groups can/will comply with the guidance. The methods defined will be the basis of the WSPSs that need to be prepared for support of the WIDs that transmit gamma spectroscopy-based characterizations performed starting 11/1/99. In addition, the meeting discussions will be used to make necessary modifications to the Interim Guidance document, resulting in a FINAL Interim Guidance document by 11/15/99. Under the current plan, this final interim guidance document will be used until a general standard is developed and implemented, which is expected to be by the end of the first quarter of CY 2000.

Please note that the DRAFT interim guidance is to be used for work initiated 11/1/99. The applicable guidance for work performed prior to 11/1/99 and still in the certification program review process remains the guidance distributed by e-mail on 10/28/99.

Please let us know if you want further clarification on this matter.

This document will be placed on the WCP Home Page for convenience.

ORNL Waste Certification Program

'DRAFT' Interim Gamma Spectroscopy Guidance Standardization Requirements
Dated: 10/26/9

The following guidelines are being established to standardize applications and traceability of gamma spectroscopy used for the characterization of radioactive waste packages prepared by LMER waste generators at ORNL. It will be necessary to develop a gamma spectroscopy profile (GSP) which will be an attachment to the Waste Stream Profile Sheet submitted for approval. The WSPS submittal will be a broad based profile that will cover the specific application of gamma spectroscopy as it applies to radioactive waste characterization. In addition all submittals of waste item descriptions (WIDs) which have been characterized by direct gamma spectroscopy will include a printout of the gamma spectroscopy output. Each of the criteria identified below will be specifically addressed in the WSPS GSP and those items identified as being provided with the gamma spectroscopy output will be provided with each WID submittal:

1. Detector Dead Time:

Maintain less than 10%. The gamma spec output shall be provided with the WID data package that specifically identifies the associated detector dead time for the acquired spectrum. Gamma spec data will be reviewed for detector dead time. If the detector dead time is greater than 10%, the generator will provide a explanation for any activity compensations as a result of the increased detector dead time or

provide justification that the reported activity values do not need to be compensated for due to detector dead time.

2. Energy Calibration Checks/Control Charting:

Perform energy calibration checks and control charting at least daily and prior to use if the detector has been idle. A control chart shall be established for each detector that will verify detector and electronic component performance. The GSP will provide a reference to the associated procedure and the statistical reference documentation used in the development of the control charting procedure. Include with the GSP examples of the energy calibration checks, control chart, and associated gamma spec output. Identify where records of the daily/prior to use energy calibration checks and control charts will be maintained.

3. Activity Calculation:

The following formula is the basis for activity calculations:

A (Bq) = CPS/(G x E x Y x SA)

Where:
CPS = raw counts in the primary peak
G = Geometry
E = Intrinsic Efficiency
Y = Yield Per Decay
SA = Sample Attenuation

Each of the above variables needs to be addressed and explained in the GSP WSPS submittal.

a. **CPS:** The counts per second (cps) are the raw counts in the primary peak used in radionuclide activity computations acquired during the spectrum prior to any geometry, efficiency, yield per decay, or sample attenuation compensation. Describe how the gamma spec output will identify the primary peak used in radionuclide activity computations.
b. **Geometry (G):** Provide a technical description as to how geometry compensations are accomplished. Provide a description of the quantifiable geometry efficiency determinations and how the gamma spec output will be annotated to reference and identify the quantifiable geometry. Reference associate procedures utilized in geometry efficiency determinations, include example geometry efficiency determinations/compensations for a specific geometry and describe where the associated geometry efficiency files will be maintained.
c. **Intrinsic Efficiency (E):** Provide a technical description of the detector primary efficiency calibration determination. The reference to intrinsic efficiency is only associated with the specific detector efficiency associated with energy spectrum emission. Reference associate procedures utilized for energy efficiency calibration determinations, include example efficiency curves for a specific geometry and describe where the associated calibration files will be maintained.
d. **Yield Per Decay (Y):** Provide a technical description as to the specific reference from which the gamma spec nuclide library was developed to arrive at the yield per decay for each radionuclide.
e. **Sample Attenuation (SA):** Provide a technical description as to how the waste matrix/packaging attenuation compensations are made in determining the waste item/package activity calculations. Provide an example calculations which demonstrates how sample attenuation compensations will be incorporated into activity calculation determinations.

4. Background:

A background gamma spectrum shall be acquired for each measurement configuration or location change, at a minimum, on at least a daily basis or when background levels are suspected to have changed. The background spectrum shall be subtracted from the actual waste package/item gamma spectrum. Provide a description of how this will be accomplished. The background gamma spectrum used in the background subtraction shall be identified on the waste package/item gamma spectrum. The background gamma

spectrum shall be maintained on file by the gamma spec provider and shall be readily accessible for audit purposes.

5. Radionuclide Identification:

The following reviews and reporting requirements shall be accomplished by the gamma spec provider and/or gamma spec software, as appropriate, prior to the submission of WID packages characterized by gamma spectroscopy;

- Gamma spec data must include an 'unidentified peaks' report associated with the spectral analysis. All unidentified gamma peaks reported by the gamma spectroscopy software shall be reviewed. Each unidentified peak will be evaluated and annotated by the gamma spec provider. An explanation as to the unidentified peak's association with the radioactivity contained in the waste package shall be provided (e.g. secondary peak, primary peak of unidentified library peak, background activity, single escape peak, annihilation peak, etc.)
- If the gamma spec software provides an output which identifies the radionuclide based upon a nuclide library and/or calculates the radionuclide content of the waste package, this output will identify the primary peak used in radionuclide activity computations, primary and secondary radionuclide reported peaks will be reviewed to ensure the appropriate branching ratios exist to substantiate radionuclide identity determinations, etc. For instances in which a short lived daughter in a decay chain has been identified that is in secular equilibrium with the parent and the long lived parent has not been identified, the gamma spec shall directly attribute the activity to the short lived daughter. Due to the secular equilibrium condition, the gamma spec should be annotated assigning the activity to the long lived parent in the decay chain.
- If the gamma spec software is providing radionuclide activity data, the software shall report 2 sigma counting errors in the same radioactivity units as the reported radionuclide activity.

6. Pure Beta and/or Pure Alpha Activity:

Each submitted waste stream shall have analytical analyses performed to verify that pure beta and/or pure alpha emitters are not present which the gamma spectroscopy system may not detect. This analytical analyses shall be performed in accordance with the protocol established in WM-SWO-507, Radiological Characterization Plan For Solid Low Level Waste. Essentially this can be accomplished by obtaining representative smears of the contamination either directly from the waste item or from the area/process which originally contaminated the waste item. A gamma spec, gross beta, and gross alpha analysis shall be performed. Utilizing the protocol established in WM-SWO-507 or other preapproved method, will determine the necessity to perform pure beta and/or pure alpha analyses. Process Knowledge (PK) can be used provided waste stream analytical data is submitted to support the PK.