

CCP-TP-169

Revision 2

CCP

Operating the Mobile Segmented Gamma Scanner

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APPROVED FOR USE

RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	10/12/2007	Initial issue.
1	06/19/2008	Revised to be consistent with Revision 1 of the Melton Valley Segmented Gamma Scanner Calibration Report.
2	11/18/2009	Revised in response to the U.S. Environmental Protection Agency (EPA) ORNL-CH-NDA-09-002CR and references to control charts removed and editorial changes made.

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1.0 PURPOSE

This procedure contains the operating instructions to perform a nondestructive assay (NDA) of a waste drum using the Segmented Gamma Scanner (SGS).

1.1 Scope

This procedure specifies instructions to operate the SGS. Instructions cover startup of the SGS, Quality Control (QC) assays, assay of drums containing suspect transuranic (TRU) waste, and shutdown of the SGS. A coaxial germanium detector is used to quantify the activity of individual radioisotopes present in the drum. The Multi-Group Analysis software and a Low Energy Germanium (LEGe) detector are used for isotopic analysis. The range of the SGS is Lower Limit of Detection (LLD) to 220.4 g Total Pu for both Sum of Segments (Transmission corrected) and Summed Spectrum (Efficiency or Density-based) modes. Density range for *Summed Spectrum analysis* mode is from 0.015 g/cm³ to ≤ 1.72 g/cm³. *Sum of Segments analysis* mode is limited by transmission (≥ 0.0005). Both modes are limited by spectral quality, dead time, and other factors as identified by an Expert Analyst (EA). This procedure may also be used to provide isotopic data to combine with neutron measurements from the Drum Waste Assay System (DWAS) Imaging Passive/Active Neutron (IPAN) instrument for final assay results.

2.0 REQUIREMENTS

2.1 References

Baseline Documents

- NDA2000 Users Manual, Canberra Industries, Inc.
- NDA2000 Technical Reference Manual, Canberra Industries, Inc.

Referenced Documents

- CCP-PO-002, *Transuranic Waste Certification Plan*
- CCP-QP-002, *CCP Training and Qualification Plan*
- CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*
- CCP-QP-008, *CCP Records Management*
- CCP-QP-011, *CCP Notebooks and Logbooks*

- CCP-QP-022, *CCP Software Quality Assurance Plan*
- CCP-TP-168, *CCP Drum Waste Assay System Imaging Passive/Active Neutron/Segmented Gamma Scanner Data Generation Level Validation*
- CCP-TP-172, *CCP Calibrating the Mobile Segmented Gamma Scanner*
- MV-SGS-0101-CAL-001 *Segmented Scanner-01 (SGS-01-01) Calibration and Confirmation Report*

2.2 Training Requirements

- 2.2.1 All personnel performing this procedure will be trained and qualified in accordance with CCP-QP-002, *CCP Training and Qualification Plan*, prior to performing this procedure.

2.3 Equipment List

2.3.1 Coaxial germanium detector with collimator

2.3.2 LEGe detector with collimator and cadmium filter

2.3.3 SGS system including the following components:

- Sample rotator
- Transmission source and detector elevation mechanism
- Transmission source shutter assembly

2.3.4 Canberra Digital Signal Processor

2.3.5 Analysis computer and ancillary equipment, such as monitors, printers, etc.

2.4 Software

2.4.1 NDA2000 Waste Assay

2.4.2 GENIE 2000, Gamma Acquisition and Analysis

2.5 Precautions and Limitations

2.5.1 Precautions and Limitations as detailed in the Activity Hazard Analysis (AHA), are as follows:

- [A] The germanium detectors are operated at a high voltage. DO **NOT** disconnect the cables when high voltage is applied.
- [B] The germanium detectors require liquid nitrogen (LN) cooling for proper operation. The extremely cold temperature of LN can cause severe burns to the skin.
- [C] One radiation transmission source is installed in the transmission source assembly. A significant dose rate can occur in the transmission source beam when the transmission shutter is open.

2.5.2 The NDA Operator SHALL verify that NO personnel are beyond the SGS barrier in the assay room prior to operating the SGS.

2.6 Definitions

2.6.1 **Daily** - Once each day the SGS is used.

2.6.2 **Operational Week**- Any week (7 consecutive days) the SGS is used.

3.0 RESPONSIBILITIES

3.1 NDA Operator

3.1.1 Operates the SGS System.

3.1.2 Ensure all software is on the Software Inventory List (SIL) and approved in accordance with CCP-QP-022, *CCP Software Quality Assurance Plan*, before use.

3.2 NDA Lead Operator (LO)

3.2.1 Provides supervision of all NDA system activities

3.3 NDA Expert Analyst (EA)

3.3.1 Establishes QC boundary values based on evaluation of actual QC assay data.

3.3.2 Analyzes all associated SGS data.

3.4 Vendor Project Manager (VPM)

3.4.1 Oversees SGS operations.

4.0 PROCEDURE

4.1 SGS System Startup

4.1.1 Check that the LEGe and coaxial germanium detectors have a sufficient amount of LN by observing the green cold indicator on each detector is lit.

4.1.2 Ensure that power is ON to the computer, monitor, and signal processor.

4.1.3 Ensure that power is ON to the SGS electrical cabinet.

[A] If applicable, turn and hold the OVERRIDE/RESET key (~2 seconds) on the SGS electrical cabinet and release.

4.1.4 Select the NDA2000 Operations icon on the desktop to start the program.

4.1.5 Verify the software is on the SIL for the site before use.

4.1.6 Verify the reference pulser peak is in the correct channel (e.g., 7275, or as specified by the NDA Lead Operator [LO]), **AND** monitor periodically throughout the shift.

4.2 Emergency Shutdown Steps

4.2.1 **IF** a problem occurs while the SGS is in operation, **THEN** press an Emergency STOP button, **AND** notify the NDA LO.

4.2.2 **IF** an electrical problem occurs, **THEN** turn OFF the power switch located on the door of the SGS electrical cabinet, STOP WORK, **AND** notify the NDA LO and the VPM.

4.2.3 **IF** a problem is encountered in step 4.2.1 or 4.2.2, **THEN** document the problem and resolution in the NDA Operational Logbook in accordance with CCP-QP-011, *CCP Notebooks and Logbooks*, **AND** initiate a Nonconformance Report (NCR), if applicable, in accordance with CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*.

4.3 Quality Control (QC) Background Check

NOTE

The QC Background Check is performed daily at the beginning of each counting session. The QC Background Check is used to identify changes in the background level. The operator must ensure the transmission source is exposed during the QC Background Check so that the peak position and the peak resolution are acceptable.

The QC Background Check results will be reviewed and evaluated daily to determine continued acceptability of the SGS and to monitor performance trends. This check may be performed after the QC Calibration Check.

- 4.3.1 Select the Green Light icon on the toolbar and then select QC Background Check from the drop-down menu.
- 4.3.2 On the Assay - Routine screen, check the following:
 - [A] Transmission Count Time: 200 sec
 - [B] Assay Count Time: 300 sec
- 4.3.3 Select Start Assay at the bottom of the screen.
- 4.3.4 On the Item Information screen, select Done to start the QC Background Check.
- 4.3.5 **IF** the Assay Warning Log Window is displayed, **THEN** document the event and resolution in the NDA Operational Logbook in accordance with CCP-QP-011, **AND** initiate an NCR, if applicable, in accordance with CCP-QP-005.

NOTE

The Assay screen will present information about the status of the assay and how much time is remaining. A STOP option is available to allow the NDA Operator to stop the assay.

Assay operations are automatic. Data are acquired for 200 seconds with the transmission source exposed. Then data are acquired for 300 seconds without the transmission source exposed. The data are analyzed, compared to acceptance criteria, and stored without NDA Operator intervention.

The Assay Warning Log window is displayed if any errors or warnings have occurred during the assay.

Results of the assay may contain one of two types of Flags (e.g., Above boundary "Ab" or Below boundary "Be").

4.3.6 To obtain the Quality Assurance (QA) Last Results Report (see Attachment 1, QA Last Results Report, for an example) for review, perform the following:

- [A] Select the Magnifying Glass icon on the tool bar to go to the NDA2000 Data Review screen.
- [B] Select QA on the tool bar, **AND** then select Plot/Reports on the menu.
- [C] Select Segment Bkgnd, **AND** select Last Report at the bottom of the screen.

4.3.7 **IF** the values on the QA Last Results Report have exceeded a boundary, indicated by either a "Be" or "Ab" flag, **THEN STOP WORK, AND** notify the NDA LO and VPM.

NOTE

An external event not associated with performance of the system (e.g., high activity container placed in proximity to the system) may cause a background failure. The mitigation would be to remove the container from the vicinity of the system. This would not require an NCR.

- [A] Investigate the cause of the out of boundary condition, **AND** determine if an NCR is required.

- [B] **IF** an NCR is required,
THEN initiate an NCR in accordance with CCP-QP-005,
AND DO NOT resume operations until the approved NCR
disposition instructions are complete.
- [C] **IF** an NCR is **NOT** required,
THEN mitigate the problem as directed by the NDA LO, note
the resolution in the NDA Operational Logbook in
accordance with CCP-QP-011, **AND** repeat the QC
Background Check.

NOTE

The non-statistical QC boundaries are the background count rate, the transmission source peak centroid, full width half maximum (FWHM) and count rate.

Movement of radioactive material to locations near the SGS may affect the background count rate. Identifying and removing potential sources that elevated the background should return the background count rate to an acceptable level.

The peak centroid may drift due to a large temperature change. The amplifier gain may require adjustment to restore the peaks to the proper position.

Any significant transmission source count rate change should be investigated and corrected, as required.

The NDA LO, in consultation with the NDA EA, may determine that a non-statistical boundary, which has been exceeded (e.g., FWHM or centroid), is acceptable to allow operations to continue.

4.3.8 **IF** the values **DO NOT** exceed any boundaries and there are **NO** flags,
THEN check that all entries on the QA Last Results Reports (Segmented Bkgnd **AND** Transmission) do **NOT** contain any error flags, **AND** print the QA Last Results Reports.

4.3.9 Print name, sign, and date the reports.

4.3.10 Place in the Batch Data Report (BDR) holding file.

4.4 Quality Control (QC) Calibration Check

NOTE

The QC Calibration Check is performed daily at the beginning of the counting session. The QC Calibration drum is used for this assay.

The Assay screen will present information about the status of the assay and how much time is remaining. A "STOP" option is available to allow the NDA Operator to stop the assay. Notify the NDA LO if the assay is stopped.

The QC Calibration Check will be reviewed and evaluated daily to determine continued acceptability of the SGS and to monitor performance trends.

- 4.4.1 Load the QC Calibration drum on the SGS.
- 4.4.2 Select the Green Light icon on the toolbar and then select QC Calibration Check.
- 4.4.3 On the Assay - Routine screen, check the following:
 - [A] Container Type set to 17C w/o liner
 - [B] Assay Count Time: 100 sec.
 - [C] Transmission Count Time: 100 sec.
- 4.4.4 Select Start Assay at the bottom of the screen.
- 4.4.5 On the Item Information screen, enter the following data:
 - [A] Enter QC Cal. Check in the Item ID field.
 - [B] Set Matrix Type to Combustible, as required.
 - [C] Set Gross Weight to 2.3 kg.
- 4.4.6 Select Done to start the QC Calibration Check.
- 4.4.7 **IF** the Assay Warning Log Window is displayed, **THEN** document the event and resolution in the NDA Operational Logbook in accordance with CCP-QP-011, **AND** initiate an NCR, if applicable, in accordance with CCP-QP-005.

NOTE

The Assay Warning Log window will be displayed if any errors or warnings have occurred. The data are analyzed, compared to acceptance criteria, and stored without NDA Operator intervention.

Results of the assay may contain one of two types of Flags (e.g., Investigate “In” or Action “Ac”). These limits are statistically derived with the “In” Flag being greater than ± 2 -sigma and less than or equal to ± 3 -sigma, and the “Ac” Flag being greater than ± 3 -sigma.

4.4.8 To obtain the QA Last Results Report for review, perform the following:

- [A] Select the Magnifying Glass icon on the tool bar to go to the NDA2000 Data Review screen.
- [B] Select QA on the tool bar, **AND** select Plot/Reports on the menu.
- [C] Select QC Calib Check, **AND** select Last Report at the bottom of the screen.

4.4.9 **IF** the value on the QA Last Results Report indicates a ± 2 -sigma “In” flag,
THEN perform the following:

- [A] Notify the NDA LO, **AND** note the problem and resolution in the NDA Operational Logbook in accordance with CCP-QP-011.
- [B] **IF** possible, identify the cause of the failure,
THEN correct the problem.
- [C] Repeat the QC Calibration Check no more than two times.

NOTE

Calibration Verification shall be performed after any one of the following conditions has occurred:

- Major system repairs and/or modifications
- Replacement of the measurement system's components (e.g., detector, neutron generator, or supporting electronic components that have the capacity to affect data)
- Significant change to the system's software
- Relocation of the system
- Failure of QC Calibration Checks (in "Ac" Flag or 3 consecutive "In"Flags, respectively)

4.4.10 **IF** three successive ± 2 -sigma "In" QC failures **OR** one ± 3 -sigma "Ac" QC failure occurs,
THEN perform the following:

- [A] STOP WORK, **AND** notify the NDA LO and VPM.
- [B] Initiate an NCR in accordance with CCP-QP-005, **AND DO NOT** resume operations until the NCR disposition instructions have been completed.
- [C] Perform Calibration Verification in accordance with CCP-TP-172, *CCP Calibrating the Mobile Segmented Gamma Scanner*, and submit Calibration Verification Report to the Facility Records Custodian.

4.4.11 Print the QA Last Results Report(s).

4.4.12 Print name, sign, and date the QA Last Results Report(s).

4.4.13 Place the QA Last Results Report(s) in the BDR holding file.

4.4.14 Unload the QC Calibration Check drum from the SGS.

4.5 Weekly Interfering Matrix Drum Assay

NOTE

At least once per operational week, the NDA LO, in conjunction with the NDA EA, will ensure that an interfering matrix will be used to assess the long-term stability of the SGS matrix correction. Surrogate waste drums will reflect the type of waste, (i.e., homogeneous solids or heterogeneous debris waste) currently being assayed. To verify calibration, radioactivity standards must be selected such that, over a six month period, the operating range of the assay system is tested in each applicable waste matrix. The NDA EA will supply the tare weight information for the measured matrix drum to the NDA LO.

The NDA LO provides the Weekly Interfering Matrix data for inclusion in the BDR in accordance with CCP-TP-168, *CCP Drum Waste Assay System Imaging Passive/Active Neutron/Segmented Gamma Scanner Data Generation Level Validation*.

- 4.5.1 Obtain a 55-gallon interfering matrix drum and source(s) as directed by the NDA LO.
- 4.5.2 Load the interfering matrix drum on the SGS.
- 4.5.3 Select the Green Light icon on the toolbar, **AND** then select Item Count I from the dropdown menu.
- 4.5.4 On the Assay - Routine screen, check the following:
 - [A] Container Type set to 17C w/o liner.
 - [B] Assay Count Time: 120 sec
 - [C] Transmission Count Time: 30 sec
- 4.5.5 Select Start Assay at the bottom of the screen.
- 4.5.6 On the Item Information screen perform the following:
 - [A] Enter the matrix drum identification in the Item ID field.
 - [B] In the field labeled Description 1, enter Interfering Matrix.
 - [C] In the field labeled Location, enter the facility location (e.g., DWAS/IPAN/SGS).

[D] Enter the following information as directed by the NDA LO:

[D.1] Matrix Type, as required

[D.2] Percent Volume Utilized (100)

[D.3] Gross Weight (net weight)

4.5.7 Select Done to start the Drum Assay.

NOTE

The Assay Warning Log window will be displayed if any errors or warnings have occurred. The assay results will be analyzed and stored.

4.5.8 Perform the following at the completion of the assay:

[A] Review the assay report.

[B] Unload interfering matrix drum as required.

[C] Record any warnings or errors in the NDA Operational Logbook, in accordance with CCP-QP-011.

4.5.9 Forward all records for inclusion in the BDR to be processed in accordance with CCP-TP-168.

4.6 Production Assays

NOTE

The Assay screen will present information about the status of the assay and how much time is remaining. A "STOP" option is available to allow the NDA Operator to stop the assay. Notify the NDA LO if the assay is stopped.

Section 4.6 will be repeated for each drum to be assayed. If a drum is not on the Acceptable Knowledge (AK) Tracking Spreadsheet, it will **NOT** be assayed unless directed by the NDA LO (e.g., Performance Demonstration Program drums).

4.6.1 Load the waste drum on the SGS.

4.6.2 Verify that the container is on the Acceptable Knowledge (AK) Tracking Spreadsheet, **AND** that the waste stream number is correct.

- 4.6.3 Select the Green Light icon on the toolbar, **AND** then select Item Count I from the dropdown menu.
- 4.6.4 On the Assay - Routine screen, check the following:
- [A] Container Type set to 17C w/o liner.
 - [B] Assay Count Time: 120 sec
 - [C] Transmission Count Time: 30 sec
- 4.6.5 Select Start Assay at the bottom of the screen.
- 4.6.6 On the Item Information screen perform the following:
- [A] Enter the drum number in the Item ID field.
 - [B] In the field labeled Description 1, enter the BDR identification as OR-DWAS-XXXX, where XXXX is a sequential number, from the NDA Operational Logbook, representing the number of batches processed.
 - [C] In the field labeled Location, enter the facility location (e.g., DWAS/IPAN/SGS).
 - [D] In the field labeled Comment, enter additional information, as required.
 - [E] Enter the following information as directed by the NDA LO:
 - [E.1] Matrix Type, as required
 - [E.2] Percent Volume Utilized (from Central Characterization Project [CCP] Radiography Data Sheet or Visual Examination Data Sheet)
 - [E.3] Gross Weight (net waste weight from CCP Radiography Data Sheet or Visual Examination Data Sheet)
- 4.6.7 Select Done to start the Drum Assay.

NOTE

The Assay Warning Log window will be displayed if any errors or warnings have occurred. The assay results will be analyzed and stored.

4.6.8 Perform the following at the completion of the assay:

- [A] Review the assay report.
- [B] Unload waste drum as required.
- [C] Record any warnings or errors in the NDA Operational Logbook in accordance with CCP-QP-011.

4.6.9 Forward all records for inclusion in the BDR to be processed in accordance with CCP-TP-168.

5.0 RECORDS

5.1 Records generated during the performance of this procedure are maintained as QA records in accordance with CCP-QP-008, *CCP Records Management*.

5.1.1 QA/Lifetime

[A] QA Last Results Report (flows into CCP-TP-168)

- QC Background Check
 - Segmented Bkgnd
 - Transmission
- QC Calibration Check

5.1.2 QA/Nonpermanent

[A] Six-month Interfering Matrix Report

