

CCP-TP-144

Revision 0

CCP Hanford SuperHENC Calibration Procedure

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1.0 PURPOSE

This procedure describes steps for calibrating the Central Characterization Project (CCP) Super High Efficiency Neutron Counter (SuperHENC) Assay System. CCP and authorized personnel are responsible for determining the radioactive content of waste containers intended for shipment to the Waste Isolation Pilot Plant (WIPP). The CCP SuperHENC is equipped with a High-Purity Germanium (HPGe) Detector for the detection of gamma-emitting radionuclides and utilizes passive neutron analysis methodologies to measure the spontaneous fission neutron signal of nuclides contained in containers of contact-handled (CH) transuranic (TRU) waste.

This procedure applies to calibrations from Lower Limit of Detection (LLD) to 502 grams (g) of total plutonium (Pu) (30.1 Pu-240eff g). Most wastes will contain weapons-grade (WG) plutonium, but other plutonium isotopics distribution are possible. CCP SuperHENC assays will include isotopic analysis to differentiate between these waste types.

1.1 Scope

This procedure provides specific instructions for calibrating the CCP SuperHENC and describes the calibration of both the neutron and gamma components of the CCP SuperHENC.

2.0 REQUIREMENTS

2.1 References

Baseline Documents

- American Society for Testing of Materials (ASTM) Publication No. C 1030, *Standard Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectroscopy*, Annual Book of ASTM Standards, Vol. 2.01
- Brown and Firestone, *Table of Radioactive Isotopes*, 7th Edition, Wiley, 1986
- CCP-PO-002, *CCP Transuranic Waste Certification Plan*

Referenced Documents

- 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-TP-137, *CCP Operation of the Hanford SuperHENC Assay System*

2.2 Training Requirements

- 2.2.1 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 Quality Control (QC) matrix container.
- 2.3.2 Other test container containing certified sources and appropriate matrices, as needed.
- 2.3.3 Standard Waste Box forklift attachment.
- 2.3.4 Advanced Multiplicity Shift Register (AMSR)-150 or equivalent.
- 2.3.5 Digital Spectrometer junior (DSPECjr) or equivalent.

- 2.3.6 Interface chassis.
- 2.3.7 Preamplifier Power Supply or equivalent.
- 2.3.8 Compumotor Motion Controller.
- 2.3.9 Computers for neutron and gamma systems.
- 2.3.10 Software
 - SUPRHENC.EXE
 - MAESTRO
- 2.3.11 Sources/Standards

NOTE

Standards must be traceable to a nationally accredited measurement program or, if secondary standards are used, the secondary standard must have a documented correlation to a primary standard.

- Californium (Cf)-252 Add-A-Source
- Europium (Eu)-152 or a combined Americium (Am)-241/Eu-152 gamma source
- Pu-239 Daily Performance Check

2.4 Precautions and Limitations

- 2.4.1 The Nondestructive Assay (NDA) Operator shall be aware of the following hazards:

NOTE

The SuperHENC will start without audible warning.

- [A] High Voltage (HV) power.
- [B] Liquid Nitrogen (LN).
- [C] Radioactive waste containers.

[D] Moving parts (e.g., shield door, loading table, and turntable).

[E] Radioactive sources are in use.

2.5 Prerequisite Actions

2.5.1 System Startup

[A] Verify system startup activities have been performed in accordance with CCP-TP-137, *CCP Operation of the Hanford SuperHENC Assay System*.

2.6 Definitions

2.6.1 **Operational Day** – A 24-hour period during which the equipment is operated.

3.0 RESPONSIBILITIES

NOTE

The NDA Operator and the NDA Lead Operator (LO) may be the same individual.

3.1 NDA Operator

3.1.1 Transfers all records generated by this procedure to the Facility Records Custodian.

3.2 NDA Lead Operator (LO)

3.2.1 Oversees SuperHENC operations.

3.2.2 Ensures work is performed in a safe manner in accordance with CCP procedures.

3.3 NDA Expert Analyst (EA)

3.3.1 Evaluates acceptability of collected waste data.

3.3.2 Prepares the Calibration Confirmation and Validation report as required.

3.3.3 Provides guidance in evaluating equipment concerns.

3.3.4 Prepares the Calibration Verification Report as required.

3.4 Facility Records Custodian

3.4.1 Receives, processes, and transmits all records generated by this procedure in accordance with CCP-QP-008, *CCP Records Management*.

4.0 PROCEDURE

4.1 Startup

NDA Operator

4.1.1 Perform background measurements in accordance with CCP-TP-137.

4.2 Gamma System Calibration

NOTE

Gamma system calibration is performed without a container being loaded on the gamma turntable. Either an Eu-152 or a combined Am-241/Eu-152 source may be used.

NOTE

The designated location for the source will be determined by the NDA Expert Analyst (EA). Since this is an energy check/calibration and not an efficiency check, an exact location is not required.

4.2.1 Ensure that the source is placed at the designated location in front of HPGe Detector.

4.2.2 Observe as the Nuclear Chemical Operator (NCO) starts MAESTRO, if **NOT** already started.

4.2.3 Observe as the NCO performs the following computer operations:

[A] OPEN SERVICES->JOB CONTROL menu from MAESTRO.

[B] Select Eu-152 CHECK, **AND** click OPEN.

NOTE

MAESTRO will now acquire gamma spectrum for the preset time (300 sec), and will print a Region of Interest (ROI) Report.

4.2.4 Observe as the NCO performs the following from the MAESTRO menu:

[A] Click FILE->SAVE AS.

- [B] Enter file name (e.g., YYYYMMDD_GCHK_NN) where YY represents the year, MM represents the month, DD represents the day, and NN represents the sequential number for the current day (e.g., 01, 02, 03).
- [C] Save data as an Integer CHN file type.
- [D] Click FILE->ROI REPORT on MAESTRO menu.
- [E] Click OK to print ROI Report.

4.2.5 Print name, sign, and date the ROI Report.

4.2.6 Remove source.

4.3 Neutron System Calibration

NOTE

Neutron system calibration is based on the original calibration of the system documented by the Hanford Site. Calibration confirmation and verification will be performed to validate the original calibration. This section serves as a placeholder for any future calibration efforts.

4.4 SuperHENC System Calibration Confirmation

NOTE

Calibration confirmation shall be performed using at least one source and matrix configuration. Independent standards that have **NOT** been used for calibration must be used.

Calibration confirmation shall be performed after each calibration or re-calibration.

The NDA EA will provide the detailed information concerning the number and strength of the sources, the matrix container configurations, and the number of replicates.

NDA EA

- 4.4.1 Provide information on the appropriate source configuration.
- 4.4.2 Verify the source standard(s) are traceable to suppliers maintaining a nationally accredited measurement program, **AND** independent of the sources used for calibration.

- 4.4.3 Provide information on source position within the non-interfering matrix container.

NDA Operator

- 4.4.4 Perform background and source instrument performance checks in accordance with CCP-TP-137.
- 4.4.5 Perform replicates for each source configuration in accordance with CCP-TP-137, as directed by the NDA EA.

NDA EA

NOTE

In order to confirm that the calibration of the SuperHENC was correctly established, the accuracy and precision of the system are determined after each calibration or re-calibration by performing replicate measurements of a non-interfering matrix. Calibration confirmation replicate measurements shall be performed on containers of the same nominal size as those in which actual waste is assayed and according to approved waste assay procedures. The number of replicate measurements to be performed shall be documented and technically justified. Accuracy is reported as percent recovery (%R). The applicable range for accuracy shall not exceed 100% plus or minus 30 percent on a non-interfering matrix. Precision is reported as percent relative standard deviation (%RSD). The %RSD shall **NOT** exceed the values listed in Table A-3.2 of CCP-PO-002, *CCP Transuranic Waste Certification Plan*, for the corresponding number of replicate measurements in a non-interfering matrix.

- 4.4.6 Evaluate the results using the Calibration Confirmation criteria specified in CCP-PO-002.

NOTE

If the criteria are met, then the calibration is confirmed.

- 4.4.7 Document the results in a Calibration Confirmation and Validation Report **OR** a subsequent report.
- 4.4.8 **IF** the criteria are **NOT** met, **THEN** evaluate the cause, initiate a Nonconformance Report (NCR) in accordance with CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*, correct, **AND** retest as needed.

4.5 SuperHENC System Calibration Verification

NOTE

Calibration verification shall be performed using at least one source and matrix configuration. Calibration source standards or secondary source standards that have been correlated with the calibration source standards may be used. The Daily Performance Check will be used for verification measurements unless otherwise directed by the NDA EA.

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

- Major system repairs and/or modifications
- Replacement of system measurement components (e.g., detector, neutron generator or supporting electronic components) that have the capacity to affect data
- Significant changes to the system's software
- Relocation of the system

The NDA EA will provide the detailed information concerning the number and strength of the sources, the matrix container configuration, and the number of replicates.

4.5.1 Obtain the appropriate source and matrix (e.g., calibration, verification source and matrix container) configuration as directed by the NDA EA.

4.5.2 Ensure that the source(s) are positioned within the matrix container, as applicable.

NDA Operator

4.5.3 Perform background and source instrument performance checks in accordance with CCP-TP-137.

4.5.4 Perform replicates for each source configuration in accordance with CCP-TP-137, as directed by the NDA EA.

NDA EA

- 4.5.5 Using the same criteria established for non-interfering matrix measurements, evaluate the verification measurement results to determine the statistical agreement with the source activity or daily performance check, as applicable.
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NOTE

If the criteria are met, then the calibration is verified.

- 4.5.6 Document the results in the Calibration Verification Report.
- 4.5.7 **IF** the criteria are **NOT** met, **THEN** evaluate the cause, initiate an NCR in accordance with CCP-QP-005, (if applicable), correct **AND** retest as needed.
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NOTE

SHUT DOWN and START UP of the equipment is performed in accordance with CCP-TP-137.

- 4.6 Preparation of Calibration Confirmation and Validation Report
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NOTE

The Calibration Confirmation and Validation Report may be a revision or supplement to an earlier document. The supplement or revision may result from data changes or additions as appropriate.

NDA EA

- 4.6.1 Prepare a Calibration Confirmation and Validation Report to include the following elements:
- [A] Introduction.
 - [B] Detailed calibration description(s).
 - [C] Acceptance criteria for calibration confirmation and validation.
 - [D] Description of calibration confirmation and validation.
 - [E] Results of calibration confirmation and validation measurements.

- [F] Measurement controls for Quality Assurance (QA).
- [G] Typical instrument LLD.
- [H] Assembly of reference containers for calibration.
- [I] Types of matrices.
- [J] Mass ranges.
- [K] Initial measurement control limits for Daily Performance Check container and weekly interfering matrix container(s).

4.6.2 Prepare a Total Measurement Uncertainty (TMU) Document for instrument precision, biases, and TMU analysis, if necessary.

4.6.3 Complete the Calibration Confirmation and Validation Report.

4.7 Records Transmittal

NDA Operator

4.7.1 Transfer all records generated by this procedure to the Facility Records Custodian.

Facility Records Custodian

4.7.2 Receive, process, and transmit all records generated by this procedure in accordance with CCP-QP-008.

5.0 RECORDS

5.1 Records generated during the performance of this procedure are maintained as QA records in accordance with CCP-QP-008. The records are the following:

5.1.1 QA/Nonpermanent

- [A] Calibration Confirmation and Validation Report
- [B] Calibration Verification Report (if applicable)
- [C] TMU Document, as required