

CCP-TP-108

Revision 6

Calibrating the CCP High Efficiency Neutron Counter Using NDA2000

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APPROVED FOR USE

RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	01/12/2004	Initial issue
1	04/02/2004	Revised to clarify and enhance the instructions for calibrating the HENC Using NDA 2000.
2	05/06/2004	Revised to address CBFO comments. Revised in response to LLNL certification audit.
3	02/26/2005	Incorporate changes to address HENC operations at the INL.
4	04/15/2005	Revised to incorporate changes to address CBFO comments and new INL fire safety requirements.
5	06/15/2006	Revised to address corrective actions identified in response to Carlsbad Field Office (CBFO) CAR-06-022.
6	04/11/2007	Revised to incorporate the use of the automated door closers with the fire suppression system and update AAS description.

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1.0 PURPOSE

The purpose of this procedure is to prescribe the method for calibrating the Central Characterization Project (CCP) Mobile High Efficiency Neutron Counter (HENC) system. The HENC includes Add-A-Source (AAS) matrix correction and gamma spectrometry.

This procedure applies to calibrations suitable for assaying waste in transuranic (TRU) waste drums with an expected range of 0 to 200 grams (g) of Plutonium (Pu).

Most wastes will contain weapons-grade (WG) Pu, but heat-source waste and other Pu isotopics are possible. HENC assays will include isotopic analysis to differentiate between these waste types.

The existing calibrations will be verified and confirmed in accordance with this procedure and documented in a Supplemental Calibration, Confirmation, and Verification Report.

1.1 Scope

This procedure provides specific instructions for calibrating the CCP HENC to assay the radioactive content of waste containers and describes the calibration of both the neutron and gamma components of the CCP HENC.

2.0 REQUIREMENTS

2.1 References

Baseline Documents

- Canberra Industries, Inc. Publication No. 9231594F, *NDA 2000 Users Manual* (corresponding to current software version)
- Canberra Industries, Inc. Publication No. 9231595C, *NDA 2000 Technical Reference Manual* (corresponding to current software version)
- Canberra Industries, Inc. Publication ACK No. 72039, *Neutron Multiplicity Counter Characterization Report, High Efficiency Neutron Counter (HENC)*, Waste Isolation Pilot Plant
- Document No. 96179, Rev. A, *Model HE-WDAS High Efficiency Waste Drum Assay System w/Add-A-Source Option, Hardware Reference Manual*

- CCP-PO-001, *CCP Transuranic Waste Characterization Quality Assurance Project Plan*
- CCP-PO-005, *CCP Conduct of Operations*
- CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*
- CCP-QP-011, *CCP Notebooks and Logbooks*
- CCP-QP-022, *CCP Software Quality Assurance Plan*

Referenced Documents

- DOE/WIPP-02-3122, *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*
- CCP-HSP-010, *CCP Nondestructive Assay System Health and Safety Plan*
- CCP-PO-002, *CCP Transuranic Waste Certification Plan*
- CCP-QP-002, *CCP Training and Qualification Plan*
- CCP-QP-008, *CCP Records Management*
- CCP-TP-107, *Operating the CCP High Efficiency Neutron Counter Using NDA 2000*
- MP-RS&C-6.16, *Radioactive (Non-Nuclear) Source Control*

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 Hardware

- [A] HENC with High-Purity Germanium (HPGe) Detector and the AAS option
- [B] Canberra Neutron Multiplicity Counter, Model JSR-14 or equivalent
- [C] Canberra Digital Signal Processors, Model DSA-1000 or equivalent
- [D] Light Stack Indicator (Red, Blue, Yellow, and Green)

2.3.2 Software

- [A] NDA2000, Waste Assay
- [B] Genie 2000, Gamma Acquisition and Analysis
- [C] Multi Group Analysis (MGA), Isotopics

2.3.3 Calibration Sources

- [A] Performance Check Drum and Check Source(s)
- [B] Matrix Drums
- [C] Plutonium Standards
- [D] Americium (Am)-241/Europium (Eu)-152 Gamma Line Sources

2.4 Precautions and Limitations

- 2.4.1 The rollup door is an integral part of the fire suppression system. Automatic door closers have been added as part of the fire suppression system so the HENC can be operated with the rollup doors in the OPEN position.

2.4.2 The HENC will start without an audible warning. The NDA Operator shall control access to the equipment. The following hazards are addressed in Safety Training for personnel that operate the HENC system:

- Liquid nitrogen (LN)
- Sealed radioactive sources
- Drums containing radioactive and hazardous materials
- Moving parts (e.g., shield doors, conveyors)

2.4.3 The Gamma Detector includes a LN Dewar that must be filled periodically. Caution will be exercised to prevent injury from the extremely cold temperature in accordance with CCP-HSP-010, *CCP Nondestructive Assay System Health and Safety Plan*, and Host site-specific health and safety plans.

2.4.4 Only qualified personnel will handle radioactive sources in accordance with MP-RS&C-6.16, *Radioactive (Non-Nuclear) Source Control*.

2.4.5 The HENC contains heavy moving parts and the NDA Operator will ensure that there are no personnel in the Equipment Bay during normal system operations.

2.5 Definitions

2.5.1 **AAS** – A Californium (Cf)-252 source ($\sim 10^5$ n/s) introduced during an assay to correct the detected neutron signal for sample moderation. The AAS is stored in an enclosure and shielded on top of the HENC. It is automatically controlled so it is never exposed while a HENC door is open.

3.0 RESPONSIBILITIES

3.1 Nondestructive Assay (NDA) Operator

- 3.1.1 Operates the HENC assay system.
- 3.1.2 Performs all procedural steps unless otherwise specified.
- 3.1.3 Starts the documentation for the HENC calibration records.

NOTE

The NDA Operator and the NDA Lead Operator (LO) may be the same individual. The NDA LO may perform the NDA Operator tasks and functions at any time.

3.2 NDA Lead Operator (LO)

- 3.2.1 Provides the technical supervision for the operation and calibration of the system.
- 3.2.2 Provides guidance in the event of abnormal conditions.
- 3.2.3 Provides direct guidance to the NDA Operator during calibration activities.

3.3 NDA Expert Analyst (EA)

- 3.3.1 Reviews and approves the HENC calibration data.
- 3.3.2 Prepares the Calibration, Confirmation, and Verification Report; the Supplemental Calibration, Confirmation and Verification Report; or the Verification Report, as required.
- 3.3.3 Provides direct guidance to the NDA LO during calibration activities.

3.4 Vendor Project Manager (VPM)

- 3.4.1 Oversees HENC operations.

3.5 Facility Records Custodian

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

3.6 Forklift Operator

3.6.1 Supports HENC operations, as required.

4.0 PROCEDURE

| NDA Operator

4.1 Pre-Calibration Checks

4.1.1 Check that all personnel have left the Equipment Bay.

4.1.2 Perform an initial Environmental Background Measurement in accordance with CCP-TP-107, *Operating the CCP High Efficiency Neutron Counter Using NDA 2000*.

4.1.3 Verify the rollup door is OPEN.

[A] **IF** the rollup door is CLOSED,
THEN immediately notify the NDA LO and the Vendor
Project Manager (VPM).

4.1.4 Ensure mechanism control switch is in the COMPUTER position.

4.2 Neutron Calibration

CAUTION

The rollup door is an integral part of the fire suppression system. Automatic door closers have been added as part of the fire suppression system so the HENC can be operated with the rollup doors in the OPEN position.

NOTE

Primary calibration standards SHALL be obtained from suppliers maintaining a nationally accredited program. When primary standards are not available, the standards used shall be correlated with primary standards obtained from a nationally accredited measurement program. Calibration is performed once prior to assaying TRU waste items and repeated at such time that the response and performance of the system has been determined to **NOT** meet acceptance criteria prescribed in applicable procedures and plans.

Performance of calibration measurements and calibration functions shall be documented in the NDA Operational Logbook. Calibration confirmation results will be summarized and documented in either a Calibration, Confirmation, and Verification Report or Supplemental Calibration, Confirmation, and Verification Report, as required.

4.2.1 Mass Calibration

NOTE

The NDA Operator will perform calibrations under the direct guidance of the NDA EA. The drum load and unload features may be disabled and the assay performed manually at the discretion of NDA EA. The NDA EA SHALL be notified upon termination of any assay or other abnormal condition.

NDA EA

- [A] Create **OR** edit the Pu Declarations prior to initiating the calibration measurements, as applicable.

NDA Operator

- [B] Instruct the Forklift Operator to load the calibration reference drum onto the conveyor.
- [C] **IF** the NDA2000 Automatic Loading/Unloading feature is **NOT** operational,
THEN GO TO Section 4.7 for Manual Drum Loading/Unloading into HENC Assay Chamber.

NOTE

Standards measurement follows the same steps as item assay. For more information on assaying items, see CCP-TP-107.

- [D] Start the NDA2000 Operations program, if necessary.
- [E] Begin the passive mass calibration assay.
- [F] On the ASSAY – ROUTINE screen, enter, select, or ensure as applicable or as designated by the NDA EA the following:
 - [F.1] Container Type
 - [F.2] Geometry
 - [F.3] Neutron Cycle Time and Count Time
 - [F.4] Gamma Count Time
 - [F.5] Disable Load/Unload box is **NOT** checked
- [G] Click the START ASSAY button at the bottom of the screen.
- [H] From the “Item Information” entry screen, enter or select the following, as applicable, or as designated by the NDA EA:
 - [H.1] Item ID
 - [H.2] Description
 - [H.3] Location
 - [H.4] Sample Type
 - [H.5] Matrix Type
 - [H.6] Percent Full
 - [H.7] Gross Weight
 - [H.8] Density

[H.9] Declaration.

[H.10] Any other descriptive information.

- (a) **IF** the Declaration settings need to be modified, **THEN** click the EDIT DECLARATION button, **AND** modify the Declaration settings as necessary.

[I] Select DONE.

NOTE

A "result" report is **NOT** generated as a formal record. It is a formatted presentation of data for evaluation by the NDA EA to determine the progress and/or success of the calibration. The data will be provided in the Calibration, Confirmation, and Verification Report, or its supplement.

[J] Print a result report at the end of the assay which will be forwarded to the NDA EA for review.

[K] **IF** the NDA2000 Automatic Loading/Unloading feature is **NOT** operational, **THEN** GO TO Section 4.7 for Manual Drum Loading/Unloading into HENC Assay Chamber.

[L] Instruct the Forklift Operator to unload the calibration reference drum from the conveyor.

[M] Repeat steps 4.2.1[B] through 4.2.1[L] until all calibration drums have been counted.

[N] Start the NDA2000 Calibration program, **AND** perform the following:

[N.1] Set SELECT A CALIBRATION to MASS.

[N.2] Select PERFORM CALIBRATION from the CALIBRATION OPERATIONS menu.

[O] Set the following as appropriate or as designated by the NDA EA:

- Detector Category
- Geometry
- Sample Type

NOTE

The NDA2000 Mass Calibration Wizard will guide the NDA Operator through the calibration process. An existing calibration can be edited from the NDA2000 Mass Calibration Wizard by locating it in the MASS CALIBRATION drop-down menu and clicking the EDIT EXISTING MASS CALIBRATION button.

[P] Start the NDA2000 Mass Calibration Wizard by clicking the NEW MASS CALIBRATION button.

[P.1] Enter the calibration description on the CALIBRATION DESCRIPTION screen, **AND** select NEXT>.

NOTE

The NDA2000 Mass Calibration Wizard will next present the Pu-240 Effective Mass results for all the calibration measurements for the selected sample type. Using the horizontal bar will allow the NDA Operator to see all of the data for each measurement.

The NDA EA will identify which data points **DO NOT** fit the curve. Discordant data points will be addressed in either the Calibration, Confirmation, and Verification Report or the Supplemental Calibration, Confirmation, and Verification Report prepared by the NDA EA.

[Q] Review the results.

[R] Change each acceptable result from DO NOT USE to USE FROM COUNT FILE to indicate that the data will be used in the calibration.

[S] Select NEXT> to bring up the CALIBRATION PLOT screen.

[T] Verify that the data points on the plot are acceptable.

[T.1] **IF** a data point is **NOT** acceptable,
THEN use the BACK button
AND mark the discordant data point as DO NOT USE.

[U] Select NEXT> to return to the CALIBRATION PLOT screen **AND** repeat step 4.2.1[T] until the data points are acceptable.

- [V] Enter the following information:
 - [V.1] Fit Model set to POLYNOMIAL.
 - [V.2] Number of Coefficients selected to produce the best fit to the data.
- [W] Verify the mass limits span the Pu-240 Effective Mass range of the standards used in the calibration and make any other needed adjustments.
- [X] Select FINISH to accept and store the calibration.

NOTE

Plotted data will be included as either a part of the Calibration, Confirmation, and Verification Report or Supplemental Calibration, Confirmation, and Verification Report, as required.

- [Y] Forward the calibration plot to the NDA EA for review.
- [Z] Select EXIT to leave the MASS CALIBRATION screen.

NDA EA

- [AA] Approve the calibration as follows:
 - [AA.1] To approve the calibration for use **AND** to bring up the list of all Mass Calibrations, perform the following:
 - (a) Select APPROVAL from the calibration operations menu or click on the APPROVE toolbar icon.
- [BB] To Approve the selected calibration, check “✓” the box corresponding to that calibration in the APPROVAL screen.
- [CC] To Unapprove the selected calibration, clear its check “✓” box.
- [DD] Select OK when finished.
- [EE] **IF** the calibration is to be the default calibration, **THEN** select the SET DEFAULT function from the CALIBRATION OPERATIONS drop-down menu.
- [FF] Verify the settings in the SET DEFAULT screen are correct **AND** select NEXT>.

- [GG] Select a new default MASS CALIBRATION from the second SET DEFAULT screen.
- [HH] Select SAVE to set the default MASS CALIBRATION **AND** return to the previous dialog.
- [II] Select CLOSE to return to the NDA2000 CALIBRATIONS screen.
- [JJ] For the automated waste analysis (AWA) enter the neutron mass calibration coefficients into the appropriate software setup screens.

CAUTION

The rollup door is an integral part of the fire suppression system. Automatic door closers have been added as part of the fire suppression system so the HENC can be operated with the rollup doors in the OPEN position.

NOTE

The AAS calibration was performed at the factory and need not be repeated. The AAS calibration will be re-normalized each time the Cf-252 AAS is replaced.

4.2.2 Re-Normalization After Replacement of the AAS

NOTE

The Cf-252 source used for the AAS matrix correction must be replaced when the neutrons/second output is no longer adequate as designed by the NDA EA, and each new source must have a new certificate.

The NDA Operator will perform the AAS re-normalizations under the direct guidance of the NDA EA.

NDA Operator

- [A] Perform the following to re-establish the Reference Rate after the installation of a new Cf-252 source:
 - [A.1] Instruct the Forklift Operator to load the empty drum as appropriate onto the conveyor.

- [A.2] **IF** the NDA2000 Automatic Loading/Unloading feature is **NOT** operational,
THEN GO TO Section 4.7 for Manual Drum Loading/Unloading into HENC Assay Chamber.
- [A.3] Select ADD-A-SOURCE PERTURBATION assay from the NDA2000 Operations Program.
- [B] On the ASSAY - ROUTINE screen, enter or select as applicable or as directed by the NDA EA the following:
 - [B.1] Set Container Type to 55-GALLON DRUM.
 - [B.2] Set the count time as instructed by the NDA EA.
 - [B.3] Ensure the Disable Load/Unload box is **NOT** checked.
 - [B.4] Click the START ASSAY button.
 - [B.5] On the ITEM INFORMATION screen, enter a unique measurement name (e.g., RefNewAAS), **AND** select or enter as applicable or as directed by the NDA EA, any additional information on the measurement, such as Gross Weight of the container, Source ID, Declaration, or other as prompted by the screen.
- [C] Select DONE to start the measurement.

NOTE

Various printouts, plots, and/or reports are generated throughout this procedure for use by the NDA EA. These are subsequently provided to Records as part of the Calibration, Confirmation and Verification Report or its supplement.

- [D] **WHEN** the analysis is complete,
THEN review the printout, **AND** forward to the NDA EA.
- [E] The NDA EA approves the re-normalization as follows:
 - [E.1] Start the NDA2000 Calibration program, **AND** set SELECT A CALIBRATION to ADD-A-SOURCE.
 - [E.2] Select PERFORM CALIBRATION from the CALIBRATION OPERATIONS menu.

- [E.3] Select the 55-Gallon Drum Container, **AND** EDIT EXISTING AAS CALIBRATION.
- (a) **IF** a warning message appears, that indicates “editing the default calibration will unapprove the calibration and clear the default setting” and “Do you wish to proceed?”, **THEN** select YES.
- [E.4] On the second ADD-A-SOURCE CALIBRATION screen, select CALCULATE AAS CALIBRATION POINTS.
- [E.5] Click the ADD-A-SOURCE REFERENCE ellipsis button.
- (a) Select the measurement that was just performed.
- (b) Select REPLACE POINT.
- [E.6] Repeat step 4.2.2[E.3] for each data point (matrix type) as applicable.
- [E.7] Click OK when finished and then click EXIT.
- [E.8] Approve the re-normalized AAS calibration, **AND** set it as the default.

[F] Exit the NDA2000 Calibration program.

NDA Operator

- [G] **IF** the NDA2000 Automatic Loading/Unloading feature is **NOT** operational, **THEN** GO TO Section 4.7 for Manual Drum Loading/Unloading into HENC Assay Chamber.
- [H] Instruct the Forklift Operator to unload the empty drum from the conveyor.

4.3 Gamma Calibration

NOTE

Primary calibration standards shall be obtained from suppliers maintaining a nationally accredited program. When primary standards are not available, the standards used SHALL be correlated with primary standards obtained from a nationally accredited measurement program. Calibration is performed once prior to assaying TRU waste items and repeated at such time that the response and performance of the system has been determined to **NOT** meet acceptance criteria prescribed in applicable plans and procedures.

Performance of calibration measurements and calibration functions shall be documented in the NDA Operational Logbook. Gamma calibration confirmation results will be summarized and documented in a Calibration, Confirmation, and Verification Report.

NOTE

The gamma-ray spectrometer accomplishes two functions: isotopic analysis and quantitative analysis. An energy calibration and an efficiency calibration of the gamma spectrometer are required for quantitative analysis. An efficiency calibration is not required for isotopic analysis.

During operation, an audible warning will **NOT** sound before motion of the HENC starts. Access to the equipment bay shall be controlled by the NDA Operator during calibration operations. Personnel are **NOT** routinely allowed in the equipment bay during calibration operations.

The NDA Operator will perform the calibration under the direct guidance of the NDA EA.

4.3.1 Gamma Energy Pre-Calibration

- [A] Before calibration begins, the NDA EA will create calibration source certificates as necessary.

NOTE

Copies of the Certificates of Calibration for the six line sources used for calibration will be included in the Supplemental Calibration, Confirmation, and Verification Report.

There is no requirement to perform neutron calibrations before performing gamma calibrations. Gamma and neutron calibrations can be performed independently of each other at any time.

4.3.2 Energy Calibration

NOTE

Only qualified personnel will handle radioactive sources.

- [A] Place Am-241/Eu-152 Gamma Line sources in proximity to the gamma detector.
- [B] Exit all NDA2000 programs **AND** open the Genie 2000, Gamma Acquisition and Analysis program.
- [C] Open an appropriate data source.
- [D] Select CALIBRATE.
- [E] Select SETUP, **AND** verify the following settings:
 - [E.1] Energy Units set to keV.
 - [E.2] Tolerance Units set to ENERGY.
 - [E.3] Analysis Sequence Description set to ENERGY CALIBRATION REPORT.
 - [E.4] Calibration Settings:
 - (a) Tolerance-Energy Cal set to 1.5 keV.
 - (b) Tolerance-Eff. Match set to 1.00 keV.
 - [E.5] Tail Curves set to LOW.
 - [E.6] Continuum set to STEP.

- [E.7] Channels set to 4.
- [E.8] Select OK to accept the settings.
- [F] Adjust instrument so that spectral range of approximately 2000 keV is displayed in 16k channels.
- [G] Collect a spectrum to obtain adequate counting statistics.
- [H] Perform an energy calibration from the Genie 2000 Acquisition & Analysis screen.
- [I] Select SHOW.
- [J] Verify the energy calibration parameters:
- [J.1] Gain Setting set to 0.125 ± 0.001 keV/ch.
- [J.2] Zero Setting set to 0.00 ± 0.1 ch.
- [K] **IF** the settings are **NOT** within the ranges specified in step 4.3.2[J] above,
THEN repeat steps 4.3.2[F] through 4.3.2[J] to refine the settings.
- [L] **WHEN** the settings are correct in step 4.3.2[J],
THEN select PRINT to print the energy and shape plots,
AND forward to the NDA EA for review and inclusion in the Supplemental Calibration, Confirmation, and Verification Report.
- [M] Click OK twice to save the calibration settings, **AND** exit the calibration process.
- [N] **IF** a second digital signal processor has been installed for MGA determinations,
THEN ensure that it is set to the following settings and ranges:
- [N.1] Gain setting set to approximately 0.075 ± 0.001 keV/ch.
- [N.2] Zero setting set to approximately 0.00 ± 0.1 ch.

4.3.3 Efficiency Calibration

NOTE

The Gamma Spectrometer must be calibrated for efficiency with a filter in place if that filter is to be used during waste assay. The Gamma efficiency calibration with filter installed must be confirmed and/or verified separately from the Gamma efficiency calibration without a filter. Calibration steps are the same whether or not a filter is in place.

- [A] Remove all sources not used in the calibration from the vicinity of the Gamma Counter.
 - [B] Verify matrix drums have been prepared and are available for the Efficiency Calibration.
-

NOTE

Up to 45 measurement data points can be used for the Efficiency Calibration. A uniform distribution of source material is approximated by using line sources (sources with uniformly deposited radioactivity along the length of the rod) placed vertically in the drum at specific radial distances such that when the drum is rotated the radiation response seen by the detector is uniform. The system is capable of performing a full efficiency calibration and displaying a plot of the results.

- [C] To assemble a reference drum, place a set of six Am-241/Eu-152 Gamma line sources into tubes 2, 3, 4, 5, 6, and 9 in a Q² style standard matrix 55-gallon drum.
- [D] Instruct the Forklift Operator to load the reference drum onto the conveyor.
- [E] **IF** the NDA2000 Automatic Loading/Unloading feature is **NOT** operational, **THEN GO TO** Section 4.7 for Manual Drum Loading/Unloading into HENC Assay Chamber.
- [F] From the NDA2000 Operations program, begin the gamma efficiency calibration assay.

- [G] On the ASSAY – ROUTINE screen, enter or select as applicable or as designated by the NDA EA the following:
- Container Type
 - Geometry
 - Gamma Count Time
 - Ensure the Disable Load/Unload box is **NOT** checked
- [H] Click the START ASSAY button at the bottom of the screen.
- [I] From the ITEM INFORMATION entry screen, enter or select the following as applicable or as designated by the NDA EA:
- Item ID
 - Geometry
 - Location
 - Sample Type
 - Matrix Type
 - Percent Full
 - Gross Weight
 - Density
 - Certificate
 - Any other descriptive information pertinent to the measurement
- [J] Click the DONE button at the bottom of the screen.
- [K] **IF** the NDA2000 Automatic Loading/Unloading feature is **NOT** operational, **THEN GO TO** Section 4.7 for Manual Drum Loading/Unloading into HENC Assay Chamber.
- [L] Instruct the Forklift Operator to unload the reference drum from the conveyor.
- [M] Repeat steps 4.3.3[C] through 4.3.3[J] until all matrix-standard configurations have been counted.
- [N] Start the NDA2000 Calibration program.
- [O] Choose EFFICIENCY from the SELECT A CALIBRATION pull-down menu.
- [P] Begin the efficiency calibration by selecting PERFORM CALIBRATION.
- [Q] Select appropriate container and geometry.

- [R] Select NEW EFFICIENCY CALIBRATION.
- [S] Enter a calibration description and select NEXT.
- [T] Select the counts to be included in this calibration on the COUNTS screen.
- [U] Adjust the calibration as needed and select FINISH on the EFFICIENCY PLOT screen.
- [V] Exit the EFFICIENCY CALIBRATION screen.
- [W] Approve the Efficiency calibration.
- [X] Set the default Efficiency calibration.

4.3.4 Remove **AND** store sources, as applicable.

4.4 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 drum configurations, and the number of replicates.

NDA EA

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

NDA Operator

- 4.4.2 Obtain the appropriate source configuration(s) from the NDA EA.
- 4.4.3 Assure the source(s) within the non-interfering matrix drum are positioned, as required.
- 4.4.4 Perform background and source instrument performance checks in accordance with CCP-TP-107.

- 4.4.5 Perform replicates for each source configuration per CCP-TP-107, as directed by the NDA EA.

NDA EA

NOTE

In order to confirm that the calibration of the NDA system 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 plus or minus 30% 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 the 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.
- 4.4.7 **IF** the criteria are met, the calibration is confirmed, **THEN** document the results in a Supplemental Calibration, Confirmation, and Verification Report **OR** a subsequent report.
- 4.4.8 **IF** the criteria are **NOT** met, **THEN** evaluate the cause, correct **AND** retest as needed.

4.5 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 Drum Check drum, DPC 1999, will be used for verification measurements unless otherwise directed by the NDA EA. Certain activity-based verification measurements, such as detector efficiency, may require the use of gamma line sources.

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

- Major system repairs and/or modifications
- Replacement of major system components, including detectors and supporting electronic components that have the capability to affect the measurement results
- 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 drum configuration, and the number of replicates.

NDA Operator

- 4.5.1 Obtain the appropriate source and matrix (e.g., daily performance check, verification source and matrix drum) configuration as directed by the NDA EA.
- 4.5.2 Assure the source(s) within the matrix are positioned, as required.
- 4.5.3 Perform background and source instrument performance checks per CCP-TP-107, as necessary.
- 4.5.4 Perform replicates for each source configuration per CCP-TP-107, as directed by the NDA EA.

NDA EA

- 4.5.5 Evaluate the verification measurement results to determine the statistical agreement (Z-Test equal to or less than 1.96) with the source activity **OR** daily performance check acceptance criteria identified in the systems operating procedure, **OR** evaluate the results using the Calibration Confirmation criteria specified in CCP-PO-002, as applicable.
- 4.5.6 **IF** the criteria are met, the calibration is verified, **THEN** document the results in the Verification Report.
- 4.5.7 **IF** the criteria are **NOT** met, **THEN** evaluate the cause, correct **AND** retest as needed.

NOTE

The equipment is started up and shut down in accordance with CCP-TP-107.

- 4.6 Preparation of the Supplemental Calibration, Confirmation, and Verification Report

NDA EA

- 4.6.1 Prepare a Supplemental Calibration, Confirmation, and Verification Report to include the following elements:
- [A] Introduction
 - [B] Detailed calibration description(s)
 - [C] Acceptance criteria for verification and confirmation of the calibration
 - [D] Description of verification and confirmation of the calibration
 - [E] Results of calibration confirmation and verification measurements
 - [F] Measurement controls for Quality Assurance (QA)
 - [G] Typical instrument LLDs
 - [H] Assembly of reference drums for calibration
 - [I] Types of matrices

- [J] Mass ranges
- [K] Initial measurement control limits for daily performance drum and weekly interfering matrix drum(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 Supplemental Calibration, Confirmation, and Verification Report.

4.7 Manual Loading/Unloading into HENC Assay Chamber

NDA Operator

4.7.1 Manually Load A Drum

- [A] At the electrical cabinet, place the Mechanism Control switch in the MANUAL position.
- [B] Turn the Front Door Control switch to the OPEN position **AND** hold until the HENC door is fully OPEN, **AND** the drawbridge has completely lowered.
- [C] Turn the Conveyor Control switch to the LOAD position **AND** hold until the drum is loaded onto the HENC turntable.
- [D] Turn the Front Door Control switch to the CLOSE position **AND** hold until the drawbridge has raised **AND** the HENC door is fully closed.

4.7.2 Manually Unload A Drum

- [A] At the electrical cabinet, place the Mechanism Control switch in the MANUAL position.
- [B] Turn the Front Door Control switch to the OPEN position **AND** hold until the HENC door is fully OPEN **AND** the drawbridge has completely lowered.
- [C] Turn the Conveyor Control switch to the UNLOAD position **AND** hold until the drum is unloaded and stops at the limit sensor.
- [D] Turn the Front Door Control switch to the CLOSE position **AND** hold until the drawbridge has raised **AND** the HENC door is fully closed as necessary.

4.8 Records Transmittal

| 4.8.1 Forward all records generated by this procedure to the Facility
Records Custodian.

Facility Records Custodian

| 4.8.2 Receive, process, and transmit records 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 Verification Report, as applicable
- [B] Supplemental Calibration, Confirmation, and Verification Report, as applicable
- [C] TMU Document, as applicable
- [D] Verification Report, as applicable