

CCP-TP-063

Revision 12

CCP

Operating the High Efficiency Neutron Counter Using NDA2000

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PRINTED NAME

APPROVED FOR USE

RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	10/11/2003	Initial Issue
1	12/04/2003	Updated Section 4.0 and revised Attachments 1-3 to reflect the data produced by the HENC.
2	03/22/2004	Updated All Sections and deleted Attachment 3 to incorporate changes resulting from the LANL MSA / LRA and Dry-runs December 2003 - February 2004.
3	04/21/2004	Incorporated the CBFO Adequacy Review comment, from CCP-TP-103, to correct the document number for the Calibration and Validation Report in Section 2.1. Updated Section 4.7, Tables 1 and 2.
4	05/14/2004	Incorporated CBFO Audit comment resolution into Section 1.0 and step 4.7 to correct the range of plutonium in the procedure.
5	10/01/2004	Redistribute EA, ITR, and TS functions. Revised QC section. Addressed CBFO comments.
6	10/10/2005	Revised operating range description in Section 1.0. Revised step 4.6.8 to reflect when an NCR will be generated. Revised Weekly Interfering Matrix Table 2.
7	03/31/2006	Extended calibration range of the instrument. Revised procedure to reflect both HENC #1 and HENC #2 operations.
8	11/30/2006	Revised to require counting-to-precision for all MT-83 wastes in response to CAR-LANL-007-06.
9	11/27/2007	Revised to incorporate updates in the Plutonium-239 Activity and Plutonium-239 Fissile Gram Equivalent limits per changes to DOE/WIPP-02-3122, <i>Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant</i> and CCP-PO-002, <i>CCP Transuranic Waste Certification Plan</i> . In addition, revised to remove restriction on High Efficiency Neutron Counter (HENC) #2 use. Certification letter for Los Alamos National Laboratory (LANL) Central Characterization Project (CCP) issued on July 11, 2007 approving HENC #2 for certification measurements. Revised calibration range discussion in Section 1.0.

RECORD OF REVISION (Continued)

Revision Number	Date Approved	Description of Revision
10	11/27/2007	Clarified calibration range discussion per the U.S. Environmental Protection Agency's (EPA) acceptance of the changes in the calibration as a Tier 1 change.
11	10/15/2008	Revised to address the drum tipping concern, to incorporate freeze file changes, and to incorporate operational clarifications.
12	11/17/2010	Revised to include Lead-Lined Calibration, improve efficiency of operations, add clarifying text, and make editorial corrections.

TABLE OF CONTENTS

1.0 PURPOSE..... 5
1.1 Scope..... 5

2.0 REQUIREMENTS..... 6
2.1 References 6
2.2 Training Requirements..... 7
2.3 Equipment List 7
2.4 Precautions and Limitations..... 8
2.5 Definitions 9

3.0 RESPONSIBILITIES..... 10
3.1 HENC Operator 10
3.2 HENC Expert Analyst (EA) 10
3.3 HENC Lead Operator (LO) 10
3.4 Vendor Project Manager (VPM)..... 10
3.5 Facility Records Custodian 10

4.0 PROCEDURE..... 11
4.1 Pre-Startup Actions..... 11
4.2 Emergency Shutdown Operations 14
4.3 Environmental Background Check..... 15
4.4 Daily Quality Control (QC) Check 18
4.5 Weekly Interfering Matrix Drum Measurements..... 23
4.6 Waste Drum Assays 23
4.7 Preparation of the Weekly Interfering Matrix Drum 27

5.0 RECORDS..... 28

LIST OF ATTACHMENTS

Attachment 1 – Last Results Report (Example)..... 29
Attachment 2 – Radioassay Data Sheet (Example) 31
Attachment 3 – Control Chart (Example) 32

1.0 PURPOSE

This procedure describes steps for operating the High Efficiency Neutron Counters (HENCs). Mobile Characterization Services (MCS) personnel are responsible for determining the radioactive content of waste containers intended for shipment to the Waste Isolation Pilot Plant (WIPP). For this purpose, a HENC, with Canberra NDA2000 software, is equipped with a High-Purity Germanium (HPGe) Detector for the detection and analysis of gamma-emitting radionuclides, and utilizes passive neutron analysis methods to measure the spontaneous fission neutron signal of nuclides contained in 55-gallon drums of contact-handled (CH) transuranic (TRU) waste. This procedure provides instructions for the operation of the HENC Nondestructive Assay (NDA) System with Add-A-Source (AAS) and gamma-ray spectrometry.

This procedure applies to the measurement of homogeneous solids and debris waste in TRU waste drums that are measured by the HENC #1 and HENC #2 Systems at Los Alamos National Laboratory (LANL). Both HENCs have a neutron calibration range from Lower Limit of Detection (LLD) to 16.28 grams (g) ²⁴⁰Pu-effective for multiplying waste forms (i.e., predominantly ²³⁹Pu materials). For non-multiplying waste forms (i.e., predominantly ²³⁸Pu materials), the neutron calibration range extends from LLD to 35.0 g of ²⁴⁰Pu-effective. The plutonium mass calibration range for the gamma component of the HENC is from the LLD to 217g of Weapons-Grade Pu as limited by dead time. From a gamma measurement standpoint, the HENCs are limited to measuring drums with a bulk density range between 0.018 g/cubic centimeter (cc) and 2.1 g/cc. Lead-lined drums are only certified for assay at HENC #2. For lead-lined drums, the bulk density range is between 0.03 g/cc and 2.15 g/cc. The gamma system operating range is set at 325 grams of total plutonium for weapons grade material. The gamma system operating range is set at 27 grams total plutonium for heat source material.

Data from this procedure is used to assay the radioactive content in 55-gallon drums containing TRU waste, sorting drums based on the 100 nanocuries per gram (nCi/g) TRU limit, and confirming radioisotopes identified by acceptable knowledge (AK).

1.1 Scope

This procedure provides specific instructions for operating the HENC Systems and using Canberra NDA2000 software to assay waste containers for their radionuclide content, including: startup, use of the system's neutron and gamma components, drum loading, assay of TRU and TRU-mixed drums, and shutdown of the equipment.

2.0 REQUIREMENTS

2.1 References

Baseline Documents

- American Society for Testing (ASTM) Publication No. C 1207, *Standard Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting*
- Canberra Industries, Inc., Publication, *High Efficiency Neutron Counter Technical Reference Manual*
- Canberra Industries, Inc., Publication No. 9231594F, *NDA 2000 User Manual* (corresponding to current software version)
- Canberra Industries, Inc., Publication No. 9231595C, *NDA 2000 Technical Reference Manual* (corresponding to current software version)
- Document No. 96179, Rev. A, *Model HE-WDAS High Efficiency Waste Drum Assay System w/Add-A-Source Option, Hardware Reference Manual*
- Document No. 97241 Rev. 1.0, *Model WM 3112 HEA High Efficiency Neutron Counter (HENC) System, Hardware Reference Manual*
- LA 94C 10162, *HE Waste Drum Assay System Hardware Reference Manual*
- ASTM Publication No. C 1030, *Standard Test Method for Determination of Plutonium Isotopic Composition by Gamma-Ray Spectroscopy*, Annual Book of ASTM Standards, Vol. 12.01
- MCS-HENC1-NDA-1001, *Calibration and Validation Report*
- MCS-HENC2-NDA-1001, *Calibration and Validation Report*
- LANL-NDA-1003-Lead-Lined, *Lead-Lined Calibration and Validation Report*

Referenced Documents

- CCP-PO-002, *CCP Transuranic Waste Certification Plan*

- CCP-PO-003, *CCP Transuranic Authorized Methods For Payload Control (CCP CH-TRAMPAC)*
- 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-103, *CCP Data Reviewing, Validating, and Reporting Procedure for the High Efficiency Neutron Counter Using NDA2000*

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 HENC with integral HPGe detector, cadmium or tin/copper gamma-ray filter, and the AAS option.

2.3.2 Canberra Neutron Multiplicity Counter, Model 2150, or equivalent.

2.3.3 Canberra Digital Signal Processor, Model 9660, or equivalent.

2.3.4 Software:

- NDA2000, Waste Assay
- Genie 2000, Gamma Acquisition and Analysis

2.3.5 Stack Indicator Lights (Red – emergency stop, Yellow – system in motion, Green – assay in progress, and Blue – AAS exposed).

2.3.6 Performance Check Drum(s) and Check Source(s).

2.3.7 Weekly Interfering Matrix Measurement Drum(s).

2.3.8 Input and output conveyors with photoeyes.

2.3.9 Personal computer with appropriate software and peripherals.

2.4 Precautions and Limitations

2.4.1 The HENC will start without an audible warning. The HENC 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)

2.4.2 The Gamma Detector includes a Dewar flask that must be filled periodically with LN. Caution will be exercised to prevent injury from the extremely cold temperature.

2.4.3 Only qualified personnel will handle radioactive sources.

2.4.4 The HENC contains heavy moving parts, and the HENC Operator will ensure that there are no personnel in the equipment bay during normal System operations, unless approved by on-duty HENC Operator.

2.4.5 Immediately prior to starting a measurement at HENC #1, a drum shall be in the Load photoeye, an additional drum may be in the Unload photoeye, and no other drum shall be between the Load and Unload photoeyes (unless in manual operations).

2.4.6 Immediately prior to starting a measurement at HENC #2, a drum shall be in the Load photoeye and no other drum shall be between the Load and Unload photoeyes, ensuring the Unload photoeye is clear of a drum (unless in manual operations).

2.4.7 HENC chamber doors may be manually opened or closed to facilitate proper positioning for startup or shutdown of operations.

2.5 Definitions

- 2.5.1 **Add-a-Source (AAS)** - A ^{252}Cf source ($\sim 10^5$ neutrons/second [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.
- 2.5.2 **Half-life** - The time necessary for the number of nuclei of a specific radioactive isotope to decay to one-half of its initial value.
- 2.5.3 **Lower Limit of Detection (LLD)** - That radioactivity level which, if present, yields a measured value greater than the critical level with 95 percent probability, where the critical level is that value which measurements of the background will exceed with five percent probability.
- 2.5.4 **Daily** - Once each day the instrument is used.
- 2.5.5 **Operational Week** - Any week (seven consecutive days) the instrument is used. Weekly Interfering Matrix Drum Measurements will be performed each operational week.
- 2.5.6 **FGE** - Fissile Gram Equivalent.
- 2.5.7 **PE-Ci** - Plutonium-Equivalent Curies.
- 2.5.8 **QC** - Quality Control.
- 2.5.9 **TMU** - Total Measurement Uncertainty.
- 2.5.10 **Investigate (In) flag** - A value on the Last Results Report that exceeds ± 2 sigma, but is less than or equal to ± 3 sigma.
- 2.5.11 **Action (Ac) flag** - A value on the Last Results Report that exceeds ± 3 sigma.

3.0 RESPONSIBILITIES

3.1 HENC Operator

3.1.1 Operates and controls access to the HENC.

3.1.2 Performs all procedural steps, unless otherwise specified.

3.1.3 Starts documentation for the HENC data.

3.2 HENC Expert Analyst (EA)

3.2.1 Provides the technical supervision for the operation of the system.

3.2.2 Provides guidance in the event of abnormal conditions.

3.2.3 Ensures that, over a six-month period, the operating range of the HENC is tested in each applicable surrogate waste matrix.

3.3 HENC Lead Operator (LO)

3.3.1 Provides supervision for the operation of the system and guidance in the event of abnormal conditions in consultation with the HENC EA.

3.3.2 Notifies the VPM of operational abnormalities.

3.4 Vendor Project Manager (VPM)

3.4.1 Oversees Central Characterization Project (CCP) 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*.

4.0 PROCEDURE

NOTE

Slight operational differences exist between the HENC #1 and the HENC #2. The differences will be explicitly called out in the procedural steps.

Upon direction from the HENC EA, the HENC Operator may extend count times or request repeated counts on any count type.

NOTE

Should an abnormal situation occur that would cause a deviation from this procedure, **AND** the abnormal condition can **NOT** be corrected **OR** resolved by this procedure, the HENC Operator will STOP HENC operations, **AND** notify the HENC EA or LO. The HENC LO will notify the VPM. Any abnormality will be recorded in the HENC Operational Logbook. In the event that either of the HENC Systems can **NOT** be loaded **AND** operated in an automatic mode (e.g., the Programmable Logic Controller (PLC) and conveyor system are **NOT** functioning), then the HENC may be manually operated. Manual operation of the HENC can be performed from the PLC cabinet under the direction of the HENC EA or LO **OR** it may be performed using NDA2000. Manual operations will be tracked in the respective HENC Operational Logbook.

Manual loading and unloading may be performed during normal operations using NDA2000 in order to facilitate more efficient operations.

HENC Operator

4.1 Pre-Startup Actions

4.1.1 Verify that power is ON to the following components:

- [A] Nuclear Instrumentation Module (NIM) Bin(s) and High Voltage Power Supply
- [B] Computer, monitor, and printer

NOTE

There are four EMERGENCY STOP Buttons on both HENC units: one is on the PLC Cabinet; one is on the input conveyor, one is on the output conveyor, and one is at the computer station in the Control Room.

NOTE

The mechanism control Override/Reset key is used to operate either switch on the PLC Cabinet.

4.1.2 Equipment Bay

- [A] Verify the HENC PLC Cabinet has been supplied with power by observing the POWER ON light is illuminated.
-

NOTE

Turning ON the HENC PLC Cabinet will cause the status light stack to cycle the yellow, green, and blue lights, which indicates a PLC error has occurred. The PLC error will reset during the performance of step 4.1.2[F]. The HENC Operator shall STOP HENC operations **AND** notify the HENC EA or LO if the PLC error does **NOT** clear.

- [B] Place the MECHANISM CONTROL Switch in MANUAL position.
- [C] Press the EMERGENCY STOP Button to ensure it is operational.
- [D] Pull the EMERGENCY STOP Button OUT to reset the Emergency Stop feature.
- [E] Re-energize the HENC PLC Cabinet as follows:
- [E.1] Turn the OVERRIDE/RESET Key on the HENC PLC Cabinet, then release.
 - [E.2] Verify the HENC PLC Cabinet has been supplied with power by observing the POWER ON light is illuminated.
- [F] Turn the OVERRIDE/RESET Key on the HENC PLC Cabinet again, **AND** release to move the AAS to the STORAGE position.

- [G] Verify the AAS interlock is operational as follows:
 - [G.1] Place the AAS Control Switch to Position 1.
 - [G.2] Verify the Position 1 indicator light is illuminated.
 - [G.3] Partially OPEN the Front Door.
 - [G.4] Verify the AAS STORAGE indicator light is illuminated.
 - [G.5] Place the AAS Control Switch in the STORAGE position.
 - [G.6] CLOSE the Front Door.
 - [G.7] Place the MECHANISM CONTROL Switch in the COMPUTER position.
- [H] Verify the HPGe Detector has the required amount of LN by observing that the High Voltage Inhibit Indicator is GREEN.
- [I] Verify that the Neutron NIM Bin and High Voltage Power Supply are ON (HENC #1 only).
- [J] **IF** any of the steps in 4.1.2[B] through 4.1.2[I] are **NOT** met, **THEN** SUSPEND WORK, **AND** immediately notify the HENC EA or LO.

HENC LO

- [J.1] Notify the VPM.

HENC Operator

- [K] Record any abnormality in the HENC Operational Logbook.

4.1.3 Software Startup

NOTE

Neither Genie 2000 nor NDA2000 will run properly if the Special Virtual Data Manager (VDM) is running in the background. The Special VDM automatically starts the first time either Genie 2000 **OR** NDA2000 invokes VDM **AND** must be closed. If the HENC Operator attempts to start Genie 2000 **OR** NDA2000 software while the Special VDM is running, then an error message will be displayed. Once closed, either Genie 2000 **OR** NDA2000 will start the Standard VDM, and the software will run properly until the computer is restarted.

[A] Open NDA2000 **AND** perform the following:

[A.1] Right-click on the GENIE 2000 VDM on the taskbar at the bottom of the screen.

[A.2] Click on ABOUT... to determine whether the Special VDM **OR** the Standard VDM is running, **AND** click on OK.

[A.3] **IF** the Special VDM is running, **THEN** right-click on GENIE 2000 VDM on the taskbar at the bottom of the computer screen, **AND** click on CLOSE.

(a) Exit the NDA2000 Operations program window, **AND** CLOSE the NDA2000 program operations.

(b) Open NDA 2000 and return to step 4.1.3 [A.1]

4.2 Emergency Shutdown Operations

4.2.1 **IF** an operational emergency (e.g., fire, evacuation alarm, etc.) occurs while the system is in operation, **THEN** press any one of the EMERGENCY STOP Buttons, follow directions given in emergency notifications, **AND** notify the HENC EA or LO as soon as practical.

HENC LO

[A] Notify the VPM.

HENC Operator

4.2.2 **IF** an electrical problem occurs,
THEN press any one of the EMERGENCY STOP Buttons, **AND**
if safe to do so, perform the following:

[A] Immediately turn OFF the power switch located on the door
of the HENC PLC cabinet.

[B] Turn OFF the switches to the following equipment as
necessary:

[B.1] Neutron Multiplicity Counter and NIM Bins

[B.2] Digital Signal Processor

[B.3] Computer, monitor, and printer

[C] Notify the HENC EA or LO.
HENC LO

[C.1] Notify the VPM.

HENC Operator

4.2.3 Record any abnormal condition in the HENC Operational Logbook.

4.3 Environmental Background Check

NOTE

The Environmental Background Check is performed on a daily basis, typically at the beginning of measurement operations.

The NDA2000 Operations screen will present information about the status of the measurement and how much time is remaining. A STOP ASSAY window is available to allow the HENC Operator to STOP **OR** ABORT the measurement for any reason. The HENC EA or LO will be notified immediately upon the termination of any measurement operation.

The Environmental Background Check will be reviewed, and evaluated daily to determine the continued acceptability of the Assay System and to monitor performance trends.

4.3.1 Verify all personnel have left the Equipment Bay.

- 4.3.2 Ensure the empty drum is loaded, as necessary.
 - 4.3.3 At HENC #1, verify the drum to be measured is in the Load photoeye, an additional drum may be in the Unload photoeye, **AND** that no other drum is between the Load and Unload photoeyes (unless in manual operations).
 - 4.3.4 At HENC #2, verify the drum to be measured is in the Load photoeye, **AND** that no other drum is between the Load and Unload photoeyes, ensuring the Unload photoeye is clear of a drum (unless in manual operations).
 - 4.3.5 Click on the first toolbar icon (a green light), **AND** select Environmental Background from the drop-down menu.
 - 4.3.6 On the Assay - Routine screen, **IF** the drum is already loaded, **THEN** click (✓) the Disable Load/Unload field.
 - 4.3.7 Click on the Start Assay Button at the bottom of the screen.
 - 4.3.8 Start the Environmental Background Check by selecting Done.
-

NOTE

When the assay is complete, the computer will analyze the data and print a report. The Assay Warning Log window is displayed if any errors or warnings have occurred during the assay. Subsequent operations are automatic, with the acquisition results being analyzed, compared to acceptance criteria, and stored.

Results of the measurement may contain several types of Deviations/Flags (e.g., Ab, Be, In, Ac).

Quality Assurance (QA) boundary values are established by the HENC EA during instrument setup, and are described in the Calibration and Validation Report.

- 4.3.9 Review the Last Results Report (for an example, see Attachment 1, Last Results Report) upon completion of the measurement.
- 4.3.10 **IF** the results on the Last Results Report indicate **NO** flags, **THEN** verify all entries are correct, **AND** sign and date the report.

4.3.11 **IF** any values on the printed report indicate a flag,
THEN perform the following:

- [A] Verify all entries are correct, AND sign and date the Last Results Report.
- [B] Record the flag in the HENC Operational Logbook.
- [C] SUSPEND WORK, AND immediately notify the HENC EA or LO.
- [D] Perform the instructions provided by the HENC EA or LO.
- [E] Repeat steps 4.3.1 through 4.3.9 NO more than two additional times.
- [F] **IF** the Environmental Background Check exceeds the boundaries after two additional runs,
THEN perform the following:
 - [F.1] Initiate an NCR in accordance with CCP-QP-005.
 - [F.2] Investigate the cause of the out of boundary condition as directed by the NDA EA or LO.
 - [F.3] The HENC EA will take appropriate actions that are consistent with Attachment 1, Table A-4.2, Range of Applicability, of CCP-PO-002, *CCP Transuranic Waste Certification Plan*.

HENC LO

- [F.4] Notify the VPM.

OPERATOR

4.3.12 Ensure the measurements **AND** any warnings or errors are recorded in the HENC Operational Logbook.

4.3.13 Ensure the empty drum is unloaded, as necessary.

4.4 Daily Quality Control (QC) Check

NOTE

The QC Checks are performed on a daily basis, typically at the beginning of measurement operations. The neutron AAS and the gamma-ray line sources will be used for the QC Check measurements.

The NDA2000 Operations screen will present information about the status of the measurement and how much time is remaining. A STOP ASSAY window is available to allow the HENC Operator to STOP **OR** ABORT the measurement for any reason. The HENC EA or LO will be notified immediately upon the termination of any measurement operation.

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

4.4.1 Neutron Instrument Check

- [A] Verify that all personnel have left the Equipment Bay.
- [B] Ensure the empty drum is loaded, as necessary.
- [C] At HENC #1, verify the drum to be measured is in the Load photoeye, an additional drum may be in the Unload photoeye, AND that no other drum is between the Load and Unload photoeyes (unless in manual operation).
- [D] At HENC #2, verify the drum to be measured is in the Load photoeye, AND that no other drum is between the Load and Unload photoeyes, ensuring the Unload photoeye is clear of a drum (unless in manual operations).
- [E] Click on the first toolbar icon (a green light), AND select QC Check (Neutron AAS) from the drop-down menu.
- [F] On the Assay - Routine screen, **IF** the drum is already loaded,
THEN check (√) the Disable Load/Unload field.
- [G] Click on the Start Assay Button at the bottom of the screen.

-
- [H] On the Item Information screen, enter the following data:
 - [H.1] Under Basic Information Item ID: set as QC – empty drum.
 - [H.2] Under Container Information Gross Weight: set to 0.1 kilogram (kg).
 - [I] Start the QC Check (Neutron AAS) by selecting Done.
-

NOTE

When the assay is complete, the computer will analyze the data and print a report, and the NDA2000 OPERATIONS window will close. The Assay Warning Log window will be displayed if any errors or warnings have occurred during the assay. Subsequent operations are automatic, with the acquisition results being analyzed, compared against predetermined criteria, and stored.

Results of the measurement may contain several types of Deviations/Flags (e.g., Ab, Be, In, Ac).

- [J] Review the Last Results Report upon completion of the measurement.
- [K] **IF** the results on the Last Results Report indicate NO flags, **THEN** verify all entries are correct, AND sign and date the report.
- [L] **IF** any of the values on the printed report indicate a In flag, **THEN** perform the following:
 - [L.1] Verify all entries are correct, **AND** sign and date the Last Results Report.
 - [L.2] Record the flag in the HENC Operational Logbook.
 - [L.3] SUSPEND WORK, AND immediately notify the HENC EA or LO.
 - [L.4] Perform the instructions provided by the HENC EA or LO.
 - [L.5] Repeat steps 4.4.1[A] through 4.4.1[J] **NO** more than two additional times.

[M] **IF** the values on the Last Results Report indicate an Ac flag
OR a third In flag,
THEN SUSPEND WORK, **AND** notify the HENC EA **OR** LO.

[M.1] Verify all entries are correct, **AND** sign and date the
Last Results Report.

[M.2] Record the flag in the HENC Operational Logbook.

[M.3] Initiate an NCR in accordance with CCP-QP-005.

[M.4] Investigate the cause of the out of boundary
condition as directed by the HENC EA or LO.

[M.5] The HENC EA will take appropriate actions that are
consistent with Attachment 1, Table A-4.2, Range of
Applicability, of CCP-PO-002, *CCP*.

HENC LO

[M.6] Notify the VPM

OPERATOR

[N] Ensure the measurements **AND** any warnings or errors are
recorded in the HENC Operational Logbook.

[O] Ensure the drum is unloaded, as necessary.

4.4.2 Gamma Instrument Check

[A] Verify that all personnel have left the Equipment Bay.

[B] Ensure the foam drum with gamma sources is loaded, as
necessary.

[C] At HENC #1, verify the drum to be measured is in the Load
photoeye, an additional drum may be in the Unload
photoeye, **AND** that no other drum is between the Load and
Unload photoeyes (unless in manual operation).

[D] At HENC #2, verify that the drum to be measured is in the
Load photoeye, **AND** that no other drum is between the Load
and Unload photoeyes, ensuring the Unload photoeye is
clear of a drum (unless in manual operations).

- [E] Click on the first toolbar icon (a green light), AND select QC Check [Gamma Eu-152] from the drop-down menu.
- [F] On the Assay – Routine screen, check (√) the Disable Load/Unload field.
- [G] Click on the Start Assay Button at the bottom of the screen.
- [H] On the Item Information screen, enter the following data:
 - [H.1] Under Basic Information Item ID: set as QC – foam drum.
 - [H.2] Under Container Information Gross Weight: set to 3.74 kg.
- [I] Start the QC Check [Gamma Eu-152] by selecting Done.

NOTE

When the assay is complete, the computer will analyze the data and print a report, and the NDA2000 OPERATIONS window will close. The Assay Warning Log window will be displayed if any errors or warnings have occurred during the assay. Subsequent operations are automatic, with the acquisition results being analyzed, compared against predetermined criteria, and stored.

Results of the measurement may contain several types of “Deviations/Flags” (e.g., Ab, Be, In, Ac).

- [J] Review the Last Results Report upon completion of the measurement.
- [K] **IF** the results on the Last Results Report indicate **NO** flags, **THEN** verify all entries are correct, **AND** sign and date the report.
- [L] **IF** any of the values on the printed report indicate a In flag, **THEN** perform the following:
 - [L.1] Verify all entries are correct, **AND** sign and date the Last Results Report.
 - [L.2] Record the flag in the HENC Operational Logbook.

[L.3] SUSPEND WORK, **AND** immediately notify the HENC EA or LO.

[L.4] Perform the instructions provided by the HENC EA or LO.

[L.5] Repeat steps 4.4.2[A] through 4.4.2[J] **NO** more than two additional times.

[M] **IF** the values on the Last Results Report indicate an Ac flag **OR** a third In flag, **THEN** SUSPEND WORK, **AND** notify the HENC EA **OR** LO.

[M.1] Verify all entries are correct, **AND** sign and date the Last Results Report.

[M.2] Record the flag in the HENC Operational Logbook.

[M.3] Initiate an NCR in accordance with CCP-QP-005.

[M.4] Investigate the cause of the out of boundary condition as directed by the HENC EA or LO.

[M.5] The HENC EA will take appropriate actions that are consistent with Attachment 1, Table A-4.2, Range of Applicability, of CCP-PO-002.

HENC LO

[M.6] Notify the VPM

OPERATOR

[N] Ensure the measurements, **AND** any warnings or errors are recorded in the HENC Operational Logbook.

[O] Ensure the foam drum is unloaded, as necessary.

4.5 Weekly Interfering Matrix Drum Measurements

NOTE

At least once per operational week, the HENC EA will ensure that an interfering matrix will be used to assess the long-term stability of the NDA instrument's matrix correction. Surrogate waste containers will reflect the type of waste, (i.e., homogeneous solids or debris waste) currently being assayed. The make-up of these containers are described in Section 4.7.

4.5.1 Obtain a 55-gallon drum with a surrogate waste matrix and sources.

4.5.2 Perform the measurement on the drum per Section 4.6.

HENC EA

4.5.3 Plot the results of the Weekly Interfering Matrix Drum Measurement on the appropriate Control Chart (see Attachment 3, Control Chart, for an example), **AND** forward the Control Chart to the HENC Operator for inclusion in the Batch Data Report (BDR).

4.6 Waste Drum Assays

NOTE

The NDA2000 OPERATIONS screen will present information about the status of the measurement and how much time is remaining. A STOP ASSAY window is available to allow the HENC Operator to STOP **OR** ABORT the measurement for any reason. The HENC EA or LO will be notified immediately upon the termination of any measurement operation.

Section 4.6 will be repeated for each container to be measured.

NOTE

Upon direction from the HENC EA, the HENC Operator may enable Count to Precision or may extend the Gamma and/or Neutron count times.

4.6.1 Review the published AK spreadsheet to determine if Material Type (MT) -83 is present in the drum and/or if the drum is lead-lined.

4.6.2 Verify all personnel have left the Equipment Bay.

4.6.3 Ensure the waste drum is loaded, as necessary.

- 4.6.4 At HENC #1, verify the drum to be measured is in the Load photoeye, an additional drum may be in the Unload photoeye, AND that no other drum is between the Load and Unload photoeyes (unless in manual operations).
- 4.6.5 At HENC #2, verify that the drum to be measured is in the Load photoeye, AND that no other drum is between the Load and Unload photoeyes, ensuring the Unload photoeye is clear of a drum (unless in manual operations).
- 4.6.6 **IF** MT-83 is present in the drum,
THEN GO TO step 4.6.11.
- 4.6.7 **IF** the drum is **NOT** lead-lined,
THEN click on the first Toolbar icon (a green light), **AND** select Item Count from the drop-down menu, **AND** go to step 4.6.9.
- 4.6.8 **IF** the drum is lead-lined,
THEN click on the first Toolbar icon (a green light), **AND** select Lead-Lined from the drop-down menu, **AND** go to step 4.6.9.
- 4.6.9 On the Assay - Routine screen, verify the following:
- [A] **IF** the drum is already loaded,
THEN check (√) the Disable Load/Unload field.
 - [B] **IF** the drum IS NOT lead-lined,
THEN under Container Type: set to 55- gallon drum.
 - [C] **IF** the drum is lead-lined,
THEN under Container Type: set to Lead-Lined
- 4.6.10 GO TO step 4.6.14.
- 4.6.11 **IF** the drum is **NOT** lead-lined,
THEN click on the first toolbar icon (a green light), **AND** select Item Count from the drop-down menu, **AND** go to step 4.6.13.
- 4.6.12 **IF** the drum IS lead-lined,
THEN click on the first Toolbar icon (a green light), **AND** select Lead-Lined from the drop-down menu, **AND** go to step 4.6.13.

4.6.13 On the Assay – Routine Screen, verify the following:

- [A] Under Precision Counting, Select Count to Precision on the Neutron Tab.
- [B] **IF** the drum is loaded,
THEN check (√) the Disable Load/Unload field.
- [C] **IF** the drum IS NOT lead-lined,
THEN under Container type: set to 55-gallon drum.
- [D] **IF** the drum is lead-lined,
THEN under Container Type: set to Lead-Lined.
- [E] Under Neutron Presets: Count Time set to 3600 s. on the Neutron Tab.

4.6.14 Click on the Start Assay Button at the bottom of the screen.

NOTE

Steps 4.6.15[A] through [F] may be performed in any order.

4.6.15 On the Item Information screen, perform the following:

- [A] Under Basic Information Item ID: enter the drum number and/or other descriptive information.

NOTE

The BDR Number will be obtained from the HENC EA or LO.

- [B] Under Basic Information Description 1: enter the BDR Number as PZZNDAXXXX, where P is the system identifier (1 identifies HENC#1 and 2 identifies HENC #2), ZZ is the Site identifier (e.g., LA for LANL), and XXXX is the sequential number.
- [C] Under Basic Information Description 2: enter any comment that may be pertinent to the measurement.
- [D] Under Basic Information: enter LANL TA-54.
- [E] Under Basic Information Comment: enter any comment that may be pertinent to the measurement.

- [F] Enter the following data furnished by Real-Time Radiography (RTR), Visual Examination (VE), AK, **OR** as directed by the HENC EA or LO:
- [F.1] Under Container Information Matrix Type: As appropriate.
 - [F.2] Under Container Information Percent Full: data furnished from the latest RTR **OR** VE.
 - [F.3] Under Container Information Gross Weight: Net Waste Weight data furnished from the latest RTR **OR** VE data.
 - [F.4] Under Neutron Information Sample Type: as appropriate.
 - [F.5] Under Neutron Information Declaration: as described in the AK Tracking Spreadsheet **OR** as directed by EA.

4.6.16 Start the Waste Drum Assay by selecting Done.

NOTE

When the Waste Drum Assay is complete, the computer will analyze the data and print a report. The Pu-239 FGE value will be calculated by the analysis software using FGE conversion factors from the latest revision of CCP-PO-003, *CCP Transuranic Authorized Methods For Payload Control (CCP CH-TRAMPAC)*. The NDA2000 OPERATIONS window will close. The Assay Warning Log window will be displayed if any errors or warnings have occurred during the assay. Subsequent operations are automatic, with the acquisition results being analyzed and stored.

NOTE

Based on the HENC EA's review and assessment of the assay, an NCR will be generated in accordance with CCP-QP-005 for the following conditions: Pu-239 FGE is greater than the standard waste box (SWB) limit in CCP-PO-002, Table 3.3.2.1 (sum + two times the TMU); PE-Ci value greater than the SWB limit in CCP-PO-002, Table 3.3.4 (all approved waste forms other than solidified/vitrified waste); or greater than the limit for solidified/vitrified waste in CCP-PO-002, Table 3.3.4.

4.6.17 Perform the following at completion of the measurement:

- [A] Review the Radioassay Data Sheet (for an example, see Attachment 2, Radioassay Data Sheet).
- [B] Verify all entries are correct.
- [C] Ensure the measurements **AND** any warnings or errors are recorded in the HENC Operational Logbook.
- [D] Ensure the waste drum is unloaded, as necessary.

4.7 Preparation of the Weekly Interfering Matrix Drum

NOTE

The Weekly Interfering Matrix Drum set is intended to represent the waste stream being characterized. A different drum will be prepared **AND** analyzed each week in sequential rotation, such that over a six-month period, all the drums will have been analyzed several times. If only one waste matrix type is to be measured during a six-month period, the schedule may be modified such that only Weekly Interfering Matrix Drums of that type are counted. A Six-Month Weekly Interfering Matrix Report will be prepared and submitted.

Data from the Weekly Interfering Matrix Drum Measurements will be analyzed by the HENC EA and compared to the known Plutonium contents of the drums. Results of the analysis will be included in the BDR(s) for that week. The results will be maintained in a spreadsheet by the HENC EA to identify any trends and to provide evidence that the program objectives have been met.

HENC EA

- 4.7.1 Review the applicable site AK Summary Report for the waste stream being characterized to determine the appropriate matrix and source loading for the Weekly Interfering Matrix Drum.
- 4.7.2 Ensure the Weekly Interfering Matrix schedule is prepared.
- 4.7.3 Forward all records generated by this procedure to the Facility Records Custodian.

Facility Records Custodian

- 4.7.4 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 (as listed in step 5.2.1) will be compiled into the BDR, in accordance with CCP-TP-103, *CCP Data Reviewing, Validating and Reporting Procedure for the High Efficiency Neutron Counter Using NDA2000*.

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

5.2.1 QA/Lifetime

[A] Last Results Report

- Background
- QC Check

[B] Radioassay Data Sheet

[C] Control Charts

5.2.2 QA/Nonpermanent

[A] Raw Data (CDs-Primary/Backup)

[B] Six Month Interfering Matrix Report

Attachment 3 – Control Chart (Example)

