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CCP-TP-166

Revision 3

CCP
Drum Waste Assay System
Imaging Passive/Active Neutron Operations

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PRINTED NAME

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 incorporate editorial comments from the U.S. Department of Energy (DOE), Carlsbad Field Office (CBFO) Certification Audit A-08-06 and Environmental Protection Agency (EPA) Inspection Number EPA-ORNL-CCP-CH-11.07-8 of November 2007.
2	12/05/2008	Revised to accommodate installation of a new neutron generator. Also made minor editorial changes.
3	02/26/2010	Revised in response to U.S. Environmental Protection Agency (EPA) ORNL-CH-NDA-09-002CR. References to control charts removed. Extended the Pu-240 passive mode operating range. Editorial changes made.

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1.0 PURPOSE

This procedure describes the operation of the Drum Waste Assay System (DWAS) Imaging Passive/Active Neutron (IPAN) waste assay system for nondestructive assay (NDA) of waste. This procedure is applicable to sorting at the 100 nanocuries per gram (nCi/g) level with a range of weapons-grade (WG) plutonium (Pu) loading from a measurement-specific lower limit of detection (LLD) to 14.710 grams (g) Pu-239 effective for active mode and to 75.513 g Pu-240 effective for passive mode (CCP-DWAS/IPAN/SGS-08-001, *DWAS IPAN Calibration Validation and Confirmation for Extended Passive Mode Operating Range*).

1.1 Scope

This procedure contains specific instructions to operate the system. The assays performed in this procedure meet the requirements of CCP-PO-002, *CCP Transuranic Waste Certification Plan*, for shipment of waste drums to the Waste Isolation Pilot Plant (WIPP).

2.0 REQUIREMENTS

2.1 References

Baseline Documents

- CCP-PO-001, *CCP Transuranic Waste Characterization Quality Assurance Project Plan*
- CCP-PO-003, *CCP Transuranic Authorized Methods for Payload Control (CCP CH-TRAMPAC)*
- American Society for Testing of Materials (ASTM) Standard C1133-03, *Standard Test Method for Nondestructive Assay of Special Nuclear Material in Low Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning*
- ASTM Standard C1207-03, *Standard Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting*
- ASTM Standard C1493-01, *Standard Test Method for Nondestructive Assay of Nuclear Material in Waste by Passive and Active Neutron Counting Using a Differential Die-Away System*

- ASTM Standard C1592-04, *Standard Guide for Nondestructive Assay Measurements*
- BII-5183-ADD-001, *Imaging Passive/Active Neutron System (IPAN) Drum Waste Assay System (DWAS) Algorithm Definition Document*
- BII-TMU-5183-001, *IPAN DWAS TMU Report*
- MCS-SGS-0101-CAL-001, *SGS Calibration Report*
- NUREG/CR-5550, LA-UR-90-732, *Passive Nondestructive Assay of Nuclear Materials*

Referenced Documents

- CCP-PO-002, *CCP 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-140, *CCP Equipment Maintenance*
- CCP-DWAS/IPAN/SGS-08-001, *DWAS IPAN Calibration Validation and Confirmation for Extended Passive Mode Operating Range*
- BII-5183-CVR-001, *IPAN DWAS Calibration and Validation Report*

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 IPAN Assay Chamber

- Turntable
- Neutron Generator System
- Helium-3 (He-3) Neutron Detectors

2.3.2 Data Acquisition System Electronics Rack (See Attachment 1, Hardware and Software Settings Form, for a listing of equipment).

2.3.3 Control Cabinet

2.3.4 Analysis Computer and ancillary equipment, such as monitors and printers

2.3.5 Interfering and non-interfering surrogate waste drums

2.4 Software

2.4.1 DWAS.EXE

2.4.2 DWASAnalysis.EXE

2.4.3 DNGI.EXE (DWAS Neutron Gamma Integration)

2.4.4 FRAM44.EXE (Fixed energy, Response function Analysis with Multiple efficiencies)

2.5 Precautions and Limitations

2.5.1 Radiological Hazards and Precautions

[A] The assay room will **NOT** be entered during neutron generator operation. The neutron generator will **NOT** be approached during neutron generator operation. The system is capable of producing 1.00E+06 neutrons per pulse at 14 million electron volt (MeV). The system is designed to be operated from the control room only. Practices are designed to maintain radiation exposures as low as reasonably achievable (ALARA) for all personnel in other nearby areas as determined by qualified Host site Health Physics Experts.

2.5.2 Physical Hazards and Precautions

[A] During normal operation, motion of the system will start without audible warning. Access to the assay room shall be controlled by the NDA Operator during normal operation and when performing maintenance and repairs.

[B] Neutrons are produced during neutron generator operation. During neutron generator operation, the assay room must be properly secured and the indicators of neutron generator operation must be verified. Indicators of the neutron generator not operating must be verified prior to entering the assay room.

2.5.3 Technical Hazards

[A] The instrument will be located in an area with a low ambient radiation background. The movement of radioactive materials in the vicinity of the system will be minimized while a measurement is in progress.

2.5.4 Operating Personnel Emergency Instructions

[A] Aborting System Operation

[A.1] **IF** the NDA Operator encounters a potential safety hazard during operations,
THEN the large red Emergency Stop button will be pressed. Emergency Stop buttons are located in the control room and assay room. The NDA Operator will notify the NDA Lead Operator (LO) to assess the potential safety hazard.

[A.2] **IF** a hazardous condition is identified by the NDA LO,
THEN a description of the hazardous condition and the resolution will be recorded in the NDA Operational Logbook, in accordance with CCP-QP-011, *CCP Notebooks and Logbooks*.

[A.3] **IF** the hazardous condition is electrical,
THEN the Power switch for the affected unit will be turned to OFF position, **AND** the following Power switches will be turned to OFF position, as required:

- Data Acquisition System Electronics Rack
- Control Cabinet
- Analysis Computer Systems

[B] The cause of the hazardous condition will be investigated, the NDA LO will be contacted, and the Vendor Project Manager (VPM) will be notified. In case of Emergency shutdown **OR** power loss, the power to all electronics will be turned OFF in accordance with step 4.7.1. Once the problem is remedied, normal start up can be performed. There is NO requirement for resetting the system.

3.0 RESPONSIBILITIES

NOTE

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

3.1 NDA Operator

3.1.1 Performs verification assays, production assays, calibration assays, raw data collection, and raw data management.

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

3.2 NDA Lead Operator (LO)

3.2.1 Provides supervision of the overall operation of the system and is responsible for the technical quality of the NDA examination process.

3.2.2 Generates or reviews Attachment 1 in concurrence with the NDA Expert Analyst (EA).

3.2.3 Generates or reviews the validated Attachment 2, Verification Assay Results Sheet.

3.3 NDA Expert Analyst (EA)

3.3.1 Generates or reviews Attachment 1 in concurrence with the NDA LO.

3.3.2 Generates or reviews the validated Attachment 2 and provides direction for abnormal or failed quality control (QC) checks.

3.3.3 Reviews, as necessary, weekly interfering matrix/source measurements and 100 percent of waste drum data generated by this procedure.

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 records generated by this procedure in accordance with CCP-QP-008, *CCP Records Management*.

4.0 PROCEDURE

4.1 System Initialization and Verification

NOTE

System Initialization includes start up, safety interlock checks, radiological surveys, and maintenance, as required.

4.1.1 General Radiological Precautions

WARNING

Neutrons are produced during neutron generator operation. During neutron generator operation, the assay room must be properly secured and the indicators of neutron generator operation must be verified. By verifying the indicators for neutron generator operation, use of a survey meter will **NOT** be required when entering the room following neutron generator operation.

[A] Secure the assay room doors, including the following:

[A.1] Verify the exterior doors are locked or secured.

[B] Prior to entering the assay room, verify the neutron generator is **NOT** operating as follows:

[B.1] Verify there is **NOT** a source voltage wave displayed on the Oscilloscope in the control room.

4.1.2 System Start Up

[A] Trailer main power and lighting start up (as required):

[A.1] Turn external main breaker switch, located at the outside main power connection to the trailer, to ON position.

[A.2] Turn main breaker switch, located at the main breaker panel inside the assay room, to ON position.

[A.3] Turn all breakers from the main breaker panel to ON position.

4.1.3 Electronics Start Up

[A] To start up the system electronics and begin the software operations, perform the following, as required:

[A.1] Turn Control Cabinet power, located on control cabinet door in the assay room, to ON position.

[A.2] Turn Data Acquisition System Electronics Rack power to ON position at Power Distribution Units #1 and # 2 (PDU #1 and #2) located at the top of the electronics rack.

[A.3] Place remote/local switch in the Local position (PDU #1 and #2).

[A.4] Turn CAMAC crate power to ON.

[A.5] Turn Detector High-Voltage Power to ON.

[A.6] Turn High-Voltage to ON.

[A.7] Verify the Detector Bias Light Emitting Diode display reads 1300VDC+/- 5VDC, **AND** adjust as needed.

[A.8] Turn Oscilloscope power to ON.

[A.9] Turn Neutron Generator Controller power to ON.

NOTE

To avoid generating neutrons during system standby **OR** while unauthorized personnel may have unsupervised access to the control room, the High-Voltage Power Supplies, computer, and monitor will be turned to the OFF position.

[A.10] Turn High-Voltage Power Supplies power to ON position (two units located in lower electronics rack).

[A.11] Turn Analysis computer ON (may include monitor and ancillary equipment).

[A.12] Double-click on the DWAS Software icon and the DWAS windows application main menu window is displayed.

[A.13] Refer to the SIL for the site, **AND** verify that the software is the latest authorized version for operations.

[A.14] **IF** software is not on the SIL,
THEN STOP WORK **AND** notify the VPM and NDA LO.

4.1.4 Safety Interlock Check

NOTE
Safety interlock checks will be performed daily and after initial setup.

NOTE
The placement of the Man. Start/Ext. Start switch to the Ext. Start position, AND the placement of the Run/Source Only/1 Pulse switch to the Run position will need to be verified prior to each assay of the day.

[A] Verify the neutron generator interlock with the system door open as follows:

[A.1] Set the Neutron Generator Controller, Run/Source Only/1 Pulse switch in the Source Only position.

[A.2] Place the Man. Start/Ext. Start switch in the Man. Start position.

[A.3] Press the Start Seq button.

[A.4] Verify the Oscilloscope DOES **NOT** display a Source Feedback Waveform.

(a) **IF** the Oscilloscope DOES display a wave form,
THEN contact the NDA LO.

[A.5] **WHEN** complete,
THEN place the Man. Start/Ext. Start switch to the Ext. Start position, **AND** place the Run/Source Only/1 Pulse switch to Run.

[B] Verify functionality of the door travel interlock as follows:

[B.1] CLOSE the door using the diagnostic programmable logic control (PLC) commands.

[B.2] Depress the Pressure Switch labeled S16.

[B.3] Verify that door movement stops when depressed.

[B.4] Reset the system logic control (SLC) 5/04 to clear the system failure using the diagnostic PLC commands.

[B.5] Set the door to CLOSED position using the diagnostic PLC commands.

[C] **IF** either interlock fails,
THEN perform the following, as required:

[C.1] Shutdown the system in accordance with Section 0.

[C.2] Secure the trailer.

[C.3] Notify NDA LO and VPM for appropriate disposition.

[D] Record the results of the Safety Interlock Check in the NDA Operational Logbook in accordance with CCP-QP-011.

4.1.5 Software Initialization

NOTE

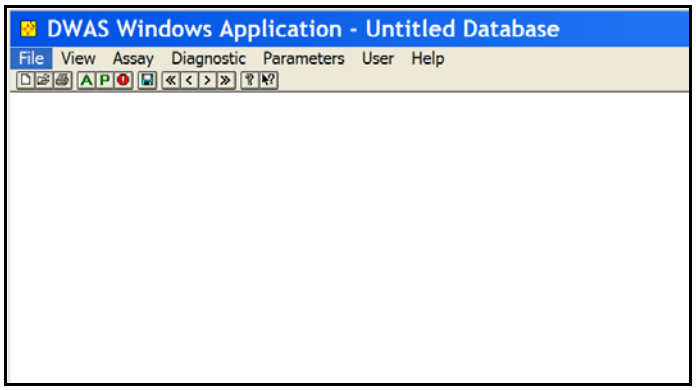
Prior to any measurements, a DWAS raw data file (hereafter referred to as a "database") must be initialized. Subsequent assay data from the background and source instrument performance checks and drum measurements will automatically be saved to this database. The data file is used by the FRAM44 and DWAS Neutron Gamma Integration (DNGI) software to generate the NDA Radioassay Data Sheet. A typical database will contain all measurements from one work shift typically including the following:

- Daily background and source instrument performance measurements.
- Production assay measurements.
- Weekly interfering matrix/source measurements, as required.

The name of an initialized database is displayed at the top of the main menu screen. If a database has **NOT** been initialized, this is indicated by displaying "Untitled Database" at the top of the main menu display (refer to Figure 4, Main Menu).

The convention for naming a database file is Year, Month, and Day (e.g., 050630. *). The software will automatically provide a file extension of *.ASY.

Figure 1. Main Menu



[A] From the Main Menu, initialize a new database by choosing the Save As command under the File menu to save the database under an appropriate file name.

NOTE

To optimize system performance or for use of compatible components, alternate settings may be required, as determined by the NDA LO. Alternative components or settings will be indicated in the NDA Operational Logbook and documented on Attachment 1.

[B] Verify all software and hardware settings are correct referencing Attachment 1.

[C] **IF** performing calibration,
THEN contact NDA LO for appropriate settings.

4.2 Instrument Performance Background Measurement

NOTE

The Instrument Performance Background Measurement will be performed daily before any standard or production assay measurements. The background measurement is performed with an empty drum.

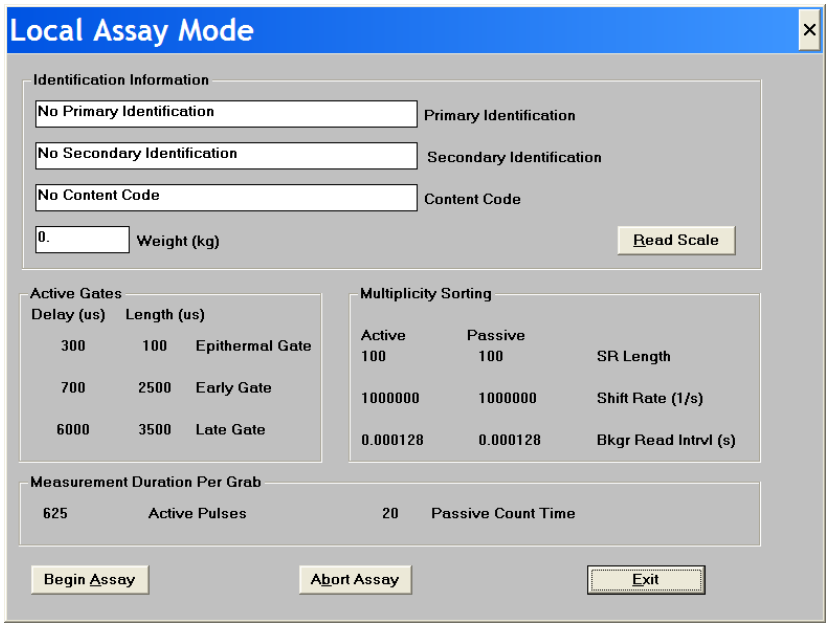
4.2.1 Load the verification drum (no sources) onto the conveyor, as required.

4.2.2 Load the verification drum into the center of the assay chamber, as required.

4.2.3 Select the Assay pull down menu.

4.2.4 Select the Local Mode Assay command to display the Local Assay Mode window (see Figure 5, Local Assay Mode).

Figure 2. Local Assay Mode



4.2.5 Enter the proper drum identifiers in the Primary Identification (“Background Verification”), Secondary Identification (if applicable), Content Code (if applicable), and Weight (Net Weight).

4.2.6 Select the Begin Assay button.

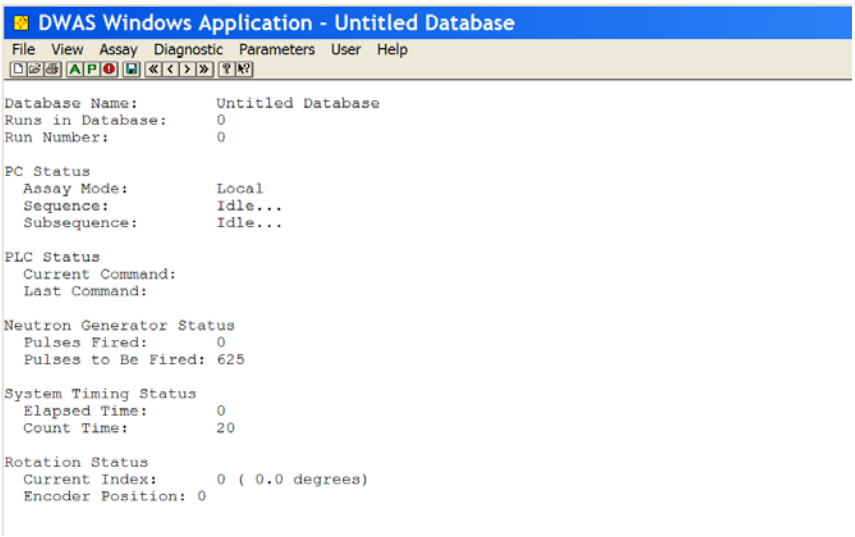
NOTE

The functional status of the components shown in the System Status screen (See Figure 3) will be verified at the beginning of each assay.

NOTE

The system status screen will automatically be displayed at the start of each assay (see Figure 3, System Status Screen).

Figure 3. System Status Screen



4.2.7 Verify the functional status of the components included in the following: (Notify the NDA LO if the status is not acceptable).

- PC status (current mode and sequences).
- PLC status (commands and requests).
- Neutron Generator status (preset pulses, and pulses fired).
- System Timing status (preset time of assay and current time of assay).
- Rotation status (degrees package has rotated).

4.2.8 **WHEN** the Instrument Performance Background Measurement is complete,
THEN calculate the data using the DWASAnalysis.EXE software **AND** display the Final Report (see Attachment 3, Final Report, for an example).

4.2.9 **IF** Attachment 2 has expired **OR** requires re-initialization,
THEN repeat Section 4.6 to perform system re-initialization/decay corrections.

4.2.10 Compare the Raw Coincidence Count Rate measurement result with results on the Attachment 2, **AND** print the Final Report.

NOTE

Variations in background measurements do not necessarily indicate unacceptable system performance. An upper and lower bound have been determined and when outside these bounds the background must be reviewed to determine possible impact on system performance. Statistical bounds for background measurements are set at 3 sigma. This is **NOT** to be confused with the Action and Warning Limits associated with the Instrument Performance Source Check.

4.2.11 **IF** the results are outside either the upper or lower bounds indicated on the validated Attachment 2,
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 a Nonconformance Report (NCR).

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

[B] **IF** an NCR is required,
THEN initiate an NCR in accordance with CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*, **AND** **DO NOT** resume operations until the NCR disposition instructions are complete.

[C] **IF** an NCR is **NOT** required,
THEN mitigate the problem as instructed by the NDA LO, note the resolution in the NDA Operational Logbook in accordance with CCP-QP-011, **AND** repeat the Background Measurement.

4.2.12 **IF** data are acceptable and within prescribed limits as identified on the Attachment 2,
THEN print the Final Report.

4.2.13 Print name, sign, and date the Final Report.

4.2.14 Place the Final Report in the Batch Data Report (BDR) Holding File.

4.2.15 Notify the drum handlers that the verification drum is ready for unloading, **AND** unload the drum, as required.

4.3 Instrument Performance Source Measurement

NOTE

The Instrument Performance Source Measurement will be performed daily before any standard or production assay measurements. The source verification drum used is an empty, dedicated drum that travels with the system and is assembled with the following sources or equivalents and configuration:

- ~0.2% Uranium-235 (U-235), depleted uranium (U-238)
- Cf-252

NOTE

Specific sources that are used are indicated on the validated Attachment 2 including Source Identification and associated serial number.

All sources are placed in the outermost source tube at a radius of 9 inches (~23 centimeters [cm]) for source verification measurements (the source tube bottoms out at source mid-height of the drum, approximately 15 inches [~38 cm]). Alternative positions may be required as indicated by the NDA LO and documented on the Final Report. The background verification drum is the same drum with the sources removed.

4.3.1 Position the verification drum on the conveyor.

4.3.2 Remove all sources from the associated storage container, **AND** place the sources in the outermost source tube in the verification drum with four spacers below the source.

4.3.3 Load the verification drum into the center of the assay chamber.

4.3.4 Select the Assay pull down menu.

4.3.5 Select the Local Mode Assay command.

4.3.6 Enter the proper drum identifiers in the Primary ID ("Calibration Verification"), Secondary ID (if applicable), Content Code (if applicable), and Weight (Net Weight).

4.3.7 Select the Begin Assay button.

4.3.8 **WHEN** the Instrument Performance Source Measurement is complete,
THEN calculate the data using the DWASAnalysis.EXE software,
AND display the Final Report.

4.3.9 **IF** Attachment 2 has expired **OR** requires re-initialization,
THEN repeat Section 4.6 to perform system re-initialization/decay corrections.

4.3.10 Compare the Pu-239 eff and Pu-240 eff values with the values provided on Attachment 2.

4.3.11 **IF** the results are outside the Warning Limits, but less than or equal to the Action Limits, indicated on Attachment 2,
THEN notify the VPM and NDA LO, **AND** repeat the measurement no more than two times.

4.3.12 **IF** neither of the two rerun performance check(s) result in data that are equal to or within the warning limits,
THEN perform the following:

[A] STOP WORK, **AND** notify the NDA LO and VPM.

[B] Initiate a Nonconformance Report (NCR) in accordance with CCP-QP-005 . AND DO NOT resume operations until the approved NCR disposition is complete and calibration verification has been performed.

[C] Record the conditions in the NDA Operational Logbook in accordance with CCP-QP-011.

4.3.13 **IF** the results are outside the Action Limits indicated on Attachment 2,
THEN STOP WORK, **AND** perform the following:

[A] Notify the NDA LO and VPM.

[B] Initiate an NCR in accordance with CCP-QP-005 **AND** DO **NOT** resume operations until the approved NCR disposition is complete and calibration verification has been performed.

[C] Record the conditions in the NDA Operational Logbook in accordance with CCP-QP-011.

4.3.14 **IF** the results are acceptable,
THEN print the Final Report.

4.3.15 Print name, sign, and date the Final Report.

4.3.16 Place the Final Report in the BDR Holding File.

4.3.17 Remove the sources from the drum, **AND** secure in the associated storage container.

4.3.18 Notify the drum handlers that the verification drum is ready for unloading, **AND** unload the drum, as required.

4.4 Weekly Interfering Matrix Drum Assay

NOTE

It is **NOT** required to perform the weekly interfering matrix/source measurements at the beginning of the operational week. These measurements must be performed each operational week at the earliest feasible time.

Surrogate waste drums will reflect the type of waste (i.e., homogeneous solids or heterogeneous debris waste) currently being assayed. To verify calibration, radioactive 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 LO and NDA EA will coordinate to develop a schedule for these measurements.

4.4.1 Contact the NDA LO to determine the appropriate matrix/source drum combination, **AND** document the matrix/source drum combination in the NDA Operational Logbook in accordance with CCP-QP-011.

NOTE

The EA will confirm an appropriate surrogate matrix drum based on the associated Acceptable Knowledge (AK) Summary Report.

The EA will confirm the appropriate source loading (i.e., upper or lower one-half of operating range).

The EA or designee will record and track the weekly interfering matrix/source drum information to verify that over a six-month period appropriate surrogate matrix drum(s) have been assayed using both a source representing the upper one-half of the operating range and a source representing the lower one-half of the range.

4.4.2 Load the matrix drum onto the conveyor and into the system.

4.4.3 Select the Assay pull down menu from the main menu, **AND** select the Local Mode Assay command to display the Local Assay Mode display window.

4.4.4 Enter the proper drum identifiers in the Primary ID, Secondary ID (if applicable), Content Code (if applicable), Weight (Net Weight).

4.4.5 Select the Begin Assay button.

NOTE

The system status screen will automatically be displayed at the start of the assay.

4.4.6 **IF** the system DOES **NOT** perform the assay in the proper sequence **OR** any failure messages are displayed,
THEN abort the assay using the Abort Assay button on the main menu screen, **AND** contact NDA LO.

NDA LO

4.4.7 Correct the problem and document the resolution in the NDA Operational Logbook in accordance with CCP-QP-011.

Operator

4.4.8 Reinitiate the assay.

4.4.9 **WHEN** the assay is complete,
THEN calculate the data using the DWASAnalysis.EXE software, and display the Final Report.

NOTE

Qualified system ranges for MOD and ABSMOD have been determined during calibration and are implemented in the system software configuration files. The ranges are provided in BII-5183-CVR-001, *IPAN DWAS Calibration and Validation Report*. All out of range conditions are flagged automatically by the software and are indicated by a warning in the Radioassay Data Sheet.

4.4.10 Check the following results for non-zero numbers **AND** verify that the ABSMOD and MOD Indices are within their corresponding set ranges:

- Absorber Index
- Moderator Index
- Raw Coincidence Count Rate
- Total Passive Count Time

- Total Fissile Signal
- Total Active Count Time

4.4.11 **IF** any of the listed outputs are zero,
THEN contact the NDA LO.

4.4.12 **IF** out of range conditions are present (i.e., ABSMOD, MOD)
THEN contact the NDA LO.

NDA LO

4.4.13 Correct the problem and document the resolution in the NDA Operational Logbook in accordance with CCP-QP-011.

Operator

4.4.14 Re-initiate the assay.

4.4.15 Unload the drum.

NOTE

Waste containers not on the AK Tracking Spreadsheet will **NOT** be assayed.

4.5 Production Assay Measurements

4.5.1 Complete the following steps, as required.

[A] Load the drum onto the conveyor and into the system.

[B] Verify the drum identifier matches the site paperwork presented (i.e., the source generator manifest), as required.

[C] Verify the container is on the AK Tracking Spreadsheet, **AND** verify the waste stream number is correct.

[D] **IF** the container is not on AK Tracking Spreadsheet, **OR** the waste stream is **NOT** correct,
THEN STOP WORK and notify the VPM and NDA LO.

4.5.2 Select the Assay pull down menu from the main menu, **AND** select the Local Mode Assay command to display the Local Assay Mode display window.

4.5.3 Enter the proper drum identifiers in the Primary ID (Drum ID), Secondary ID (Waste Stream Number), Content Code (if applicable), Weight (Net Weight) obtained from the Non-Destructive Examination (NDE) or Visual Examination (VE) Data Sheet.

4.5.4 Select the Begin Assay button.

4.5.5 **IF** the system DOES **NOT** perform the assay in the proper sequence **OR** any failure messages are displayed,
THEN abort the assay using the Abort Assay button on the main menu screen, **AND** contact NDA LO.

NDA LO

4.5.6 Correct the problem and document the resolution in NDA Operational Logbook in accordance with CCP-QP-011.

Operator

4.5.7 Re-initiate the assay.

4.5.8 **WHEN** the assay is complete,
THEN calculate the data using the DWASAnalysis.EXE software,
AND display the Final Report.

NOTE

Qualified system ranges for MOD and ABSMOD have been determined during calibration and are implemented in the system software configuration files. The ranges are provided in BII-5183-CVR-001, *IPAN DWAS Calibration and Validation Report*. All out of range conditions are flagged automatically by the software and are indicated by a warning in the Radioassay Data Sheet.

4.5.9 Check the following results for non-zero numbers **AND** verify that the ABSMOD and MOD Indices are within their corresponding set ranges:

- Absorber Index
- Moderator Index
- Raw Coincidence Count Rate
- Total Passive Count Time
- Total Fissile Signal
- Total Active Count Time

4.5.10 **IF** any of the listed outputs are zero,
THEN contact the NDA LO.

4.5.11 **IF** out of range conditions are present (i.e. ABSMOD, MOD)
THEN contact the NDA LO.

4.5.12 **IF** all values are in range,
THEN notify the drum handlers that the waste drum is ready for unloading, **AND** unload the drum, as required.

4.5.13 Repeat steps 4.5.1 through 4.5.12 for each Production assay.

4.5.14 Upon completion of the day's activities, prepare database for submission to the NDA EA for analysis and technical review.

4.6 System Re-Initialization/Decay Correction

NOTE

The system must be re-initialized to determine action and warning limits for instrument performance source measurements and background boundaries for instrument performance background measurements. Re-initializations or decay corrections require a new validated Attachment 2. New sheets are generated by a qualified NDA EA or the NDA LO and reviewed either by the NDA LO or another qualified NDA EA. Section 4.3 will be referred to for appropriate response to action and warning limits. Re-initialization of control parameters may be required after changes to system components or after 30 or more instrument performance measurements, as determined by the NDA LO.

Decay of the californium-252 (Cf-252) check source requires the qualified NDA EA to perform periodic decay corrections for Pu-240 Effective Mass (Pu-240 eff), as required.

4.6.1 **IF** re-initializing the control parameters,
THEN perform the following:

[A] Perform five instrument performance background measurements and five source measurements per Section 4.2 and 4.3.

[B] Transmit the results to the NDA EA for analysis.

4.6.2 Determine the Action Limits, Warning Limits, and Background Boundaries associated with the validated Attachment 2 as follows:

[A] Action limits: +/- 3-sigma from the average.

[B] Warning limits: +/- 2-sigma from the average.

[C] Background Boundaries: +/- 3-sigma from the average.

NOTE

Initial measurement controls should be established with no fewer than five instrument performance measurements. The establishment of adequate control parameters at the +/- 2-sigma Warning Limits, +/- 3-sigma Action Limits, and Background Boundaries should continue to be evaluated as additional measurements are taken. Typically, 30 measurements are considered adequate. The NDA LO may determine additional measurements are required.

NOTE

To determine the standard deviation in the Pu-240 eff (which is subject to the decay of Cf-252 check source), each data point is decay corrected back to the first date of initialization indicated on the validated Attachment 2. All decay corrections are computed and verified manually using the equation indicated in the following steps.

4.6.3 **IF** performing a decay correction for Pu-240 eff,
THEN create a new Attachment 2 as follows:

[A] Correct the Pu-240 eff by multiplying by the following factor:

(a) Exponential ([0.693 x T] / [365.25 x 2.65]) where,
T = number of days elapsed since the first date of initialization.

[B] Record the following on the Attachment 2:

- Effective Date
- Expiration Date
- Site
- Reference number
- Date(s) of Verification Assays

- Data Acquisition Software Version including: DWAS.EXE, *.amx, and *.pmx
- Source Identifications
- Number of Verification Assays used (Background and Source)
- Raw Coincidence Count Rate Upper and Lower Bounds
- Pu-239 Effective Mass (Pu-239 eff) Upper and Lower Action and Warning Limits
- Pu-240 Effective Mass Upper and Lower Action and Warning Limits
- Comments, as needed

NOTE

The indication of “Decay Correction” or “Reinitialization” on Attachment 2 denotes the reason for generation of a new Attachment 2. It is not to be confused with the requirement to perform step 4.6.3[A].

[C] Indicate on the Attachment 2 whether the Pu-240 eff has been decay corrected **OR** that the values have been reinitialized by circling one of them.

[D] Obtain the required signatures.

[E] Place the validated Attachment 2 in a holding file for daily NDA Operator reference.

4.6.4 Hardware and Software Settings, as required

NOTE

In accordance with the responsibilities outline in Section 3.0 of this procedure, the NDA EA may also, in concurrence with the NDA LO, generate the Attachment 1 and have the NDA LO perform the review function.

<u>NDA LO</u>

[A] Generate the Attachment 1 in concurrence with the NDA EA.

[B] Print name, sign, and date the Attachment 1.

[C] Forward the Attachment 1 to the NDA EA for review.

NDA EA

[D] Review the Attachment 1, **AND** print name, sign, and date.

[E] Submit the Attachment 1 to the Facility Records Custodian.

Facility Records Custodian

[F] Receive, process, and transmit the completed Attachment 1 in accordance with CCP-QP-008.

4.6.5 Required Monitoring and Radiological Surveys

NOTE

During active assays, the neutron generator source voltage waveform displayed on the oscilloscope will be monitored to verify stable neutron generator operation referring to Figure 4, Normal; Figure 5, Low Gain; and Figure 6, High Gain. If either a low gain or high gain condition exists, the neutron generator will **NOT** be run. To abort the neutron generator operation, the Abort Button on the Neutron Generator Controller will be pressed.

Figure 4. Normal

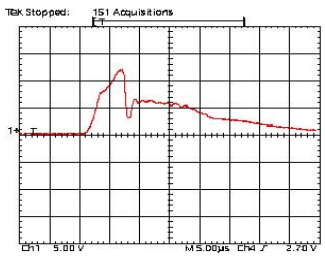


Figure 5. Low Gain

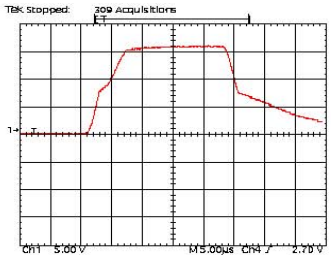
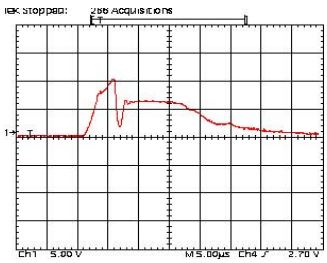


Figure 6. High Gain



NOTE

To generate neutrons using the neutron generator, the following sequence will be performed at the Neutron Generator Controller.

[A] **IF** periodic radiological surveys are required to verify boundary radiation levels,
THEN complete the following:

[A.1] Set-up system geometry as follows:

(a) **IF NOT** CLOSED,
THEN CLOSE the door using the diagnostic PLC commands.

(b) Extend the detectors using the diagnostic PLC commands.

[A.2] Place the Man. Start/Ext. Start switch in the Man. Start position.

[B] Place the Run/Source Only/1 Pulse switch in the Run position.

[C] Press the Start Seq button.

[D] **WHEN** survey is complete,
THEN press the Abort button.

[E] Repeat steps 4.6.5[A] through 4.6.5[D] as necessary to complete the required surveys.

[F] **WHEN** complete,
THEN reset Man. Start/Ext. Start switch to Ext. Start position.

4.6.6 General Maintenance

[A] Perform maintenance in accordance with CCP-TP-140, *CCP Equipment Maintenance*, as required.

NOTE

Once all scheduled assays for each day have been completed, the system will be shut down as required. The following components may be shut down in any order.

4.7 System Shut Down

4.7.1 Close any open programs, **AND** shut down the computer using the software.

[A] Turn High-Voltage Power Supplies to OFF (two units).

[B] Turn Neutron Generator Controller (located in the electronics rack) to OFF.

[C] Turn Oscilloscope (located in center electronics rack) to OFF.

[D] Turn High-Voltage to OFF, prior to turning High-Voltage Power to OFF.

[E] Turn CAMAC crate to OFF.

[F] Turn monitor OFF.

[G] Turn computer OFF.

[H] Turn Electronics Rack power to OFF at PDU #1 and #2.

[I] Turn Control Cabinet power to OFF (located in the assay room).

4.7.2 Trailer Main Power and Lighting Shut Down (as required)

[A] From the Main Breaker Panel, turn all breakers to OFF position.

[B] Turn internal main breaker switch (located at the main breaker panel inside the assay room) to OFF position.

[C] Turn external main breaker switch (located at the outside main power connection to the trailer) to OFF position.

5.0 RECORDS

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

5.1.1 QA/Nonpermanent

[A] Attachment 1, Hardware and Software Settings Form

[B] Six-Month Interfering Matrix Report

5.1.2 QA/Lifetime

[A] Attachment 2, Verification Assay Results Sheet (Flows into CCP-TP-168)

[B] Final Reports (Flows into CCP-TP-168)

- Instrument Performance Background Measurements
- Instrument Performance Source Measurements

Attachment 1 – Hardware and Software Settings Form Page 1 of 2

Revision Number:_____		
Run-Time parameters	Name of NDA Operator	NDA Operator's Name
	Selection of Active Matrix	Automatic
	Selection of Passive Matrix	Automatic
	Pulses per grab	625
	Stepper motor comm.	Com 4: 9600,n,8,1
	Time per grab	20
Gates and Timings		
Active gates	Delay (us)	Length (us)
Epithermal	300	100
Early	700	2500
Late	6000	3500
Active/Passive PMCCM parameters		
	Shift register length	100 us
	Shift rate	1000000 (1/s)
	Background read interval	0.000128 s
Comments:		

Attachment 1 – Hardware and Software Settings Form (Continued) Page 2 of 2

Revision Number: _____		
TC 952A	1300V ± 5 V	Power on, High voltage on
Neutron Generator Controller	Reservoir/Getter = Approx. 5.5 (typical range is 4.5 to 6.5)	
Sorensen HVPS	Source = 500V ± 5 V	
	Target = 350 V ± 5 V or as determined by NDA LO.	
CAMAC Crate	Slots 1&2, LeCroy 2323A	Channel A, Positive trigger
		Channel B, Negative trigger
		CAMAC, On
	Slots 3&4, LeCroy 2323A	Channel A, Positive trigger
		Channel B, Negative trigger
		CAMAC, On
	Slots 5&6, LeCroy 2323A	Channel A, Positive trigger
		Channel B, Negative trigger
		CAMAC, On
	Slots 15&16, PSC PMCCM	Ext RD
	Slots 24 &25, Kinetic Systems 3922 Parallel Bus Crate Controller	Crate Address, 0
		On line
Comments:		

Prepared By: (Print/Sign/Date)_____

Reviewed By: (Print/Sign/Date)_____

Attachment 2 – Verification Assay Results Sheet Page 1 of 2

Re-Initialization / Decay Correction

Effective Date: _____ Expiration Date:_____

Site:_____

Reference number:_____

Background and Source Verification (Identification and Tolerances)

Date(s) of Verification Assays:_____ Data Acquisition Software:_____ Source Identifications:_____ Number of Verification Assays: Background_____ Source_____
Comments:

	Pu-239 Effective Mass g Pu-239 (Source)	Pu-240 Effective Mass g Pu-240 (Source)
Upper Action Limit (3 σ)		
Upper Warning Limit (2 σ)		
Lower Warning Limit (2 σ)		
Lower Action Limit (3 σ)		

	Raw Coincidence Count Rate (No Source Background)
Upper Bound (3 σ)	
Lower Bound (3 σ)	

Prepared By: (Print/Sign/Date) _____

Reviewed By: (Print/Sign/Date) _____

Attachment 2 – Verification Assay Results Sheet (Continued) (EXAMPLE) Page 2 of 2

Pu240 Effective Mass Decay Corrections

Attachment 2 (Page 2 of 2)

8/27/09 thru11/18/09

	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Date	8/27/09	8/28/09	8/29/09	8/30/09	8/31/09	9/1/09	9/2/09	9/3/09	9/4/09	9/5/09	9/6/09	9/7/09	9/8/09	9/9/09
Upper Action limit	12.599	12.590	12.581	12.572	12.563	12.554	12.545	12.536	12.527	12.518	12.509	12.500	12.491	12.482
Upper Warning limit	12.484	12.476	12.467	12.458	12.449	12.440	12.431	12.422	12.413	12.404	12.395	12.386	12.377	12.369
Lower Warning limit	12.027	12.018	12.010	12.001	11.992	11.984	11.975	11.967	11.958	11.950	11.941	11.932	11.924	11.915
Lower Action limit	11.913	11.904	11.895	11.887	11.878	11.870	11.861	11.853	11.844	11.836	11.827	11.819	11.810	11.802

	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Date	9/10/09	9/11/09	9/12/09	9/13/09	9/14/09	9/15/09	9/16/09	9/17/09	9/18/09	9/19/09	9/20/09	9/21/09	9/22/09	9/23/09
Upper Action limit	12.473	12.464	12.455	12.446	12.437	12.428	12.419	12.410	12.402	12.393	12.384	12.375	12.366	12.357
Upper Warning limit	12.360	12.351	12.342	12.333	12.324	12.315	12.307	12.298	12.289	12.280	12.271	12.263	12.254	12.245
Lower Warning limit	11.907	11.898	11.890	11.881	11.873	11.864	11.856	11.847	11.839	11.830	11.822	11.813	11.805	11.796
Lower Action limit	11.794	11.785	11.777	11.768	11.760	11.751	11.743	11.734	11.726	11.718	11.709	11.701	11.692	11.684

	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Date	9/24/09	9/25/09	9/26/09	9/27/09	9/28/09	9/29/09	9/30/09	10/1/09	10/2/09	10/3/09	10/4/09	10/5/09	10/6/09	10/7/09
Upper Action limit	12.348	12.339	12.331	12.322	12.313	12.304	12.295	12.286	12.278	12.269	12.260	12.251	12.242	12.234
Upper Warning limit	12.236	12.227	12.219	12.210	12.201	12.192	12.184	12.175	12.166	12.157	12.149	12.140	12.131	12.123
Lower Warning limit	11.788	11.779	11.771	11.762	11.754	11.746	11.737	11.729	11.720	11.712	11.703	11.695	11.687	11.678
Lower Action limit	11.676	11.667	11.659	11.651	11.642	11.634	11.625	11.617	11.609	11.600	11.592	11.584	11.576	11.567

	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Date	10/8/09	10/9/09	10/10/09	10/11/09	10/12/09	10/13/09	10/14/09	10/15/09	10/16/09	10/17/09	10/18/09	10/19/09	10/20/09	10/21/09
Upper Action limit	12.225	12.216	12.207	12.199	12.190	12.181	12.172	12.164	12.155	12.146	12.137	12.129	12.120	12.111
Upper Warning limit	12.114	12.105	12.096	12.088	12.079	12.070	12.062	12.053	12.045	12.036	12.027	12.019	12.010	12.001
Lower Warning limit	11.670	11.662	11.653	11.645	11.636	11.628	11.620	11.611	11.603	11.595	11.586	11.578	11.570	11.562
Lower Action limit	11.559	11.551	11.542	11.534	11.526	11.518	11.509	11.501	11.493	11.485	11.476	11.468	11.460	11.452

	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Date	10/22/09	10/23/09	10/24/09	10/25/09	10/26/09	10/27/09	10/28/09	10/29/09	10/30/09	10/31/09	11/1/09	11/2/09	11/3/09	11/4/09
Upper Action limit	12.103	12.094	12.085	12.077	12.068	12.059	12.051	12.042	12.033	12.025	12.016	12.008	11.999	11.990
Upper Warning limit	11.993	11.984	11.976	11.967	11.958	11.950	11.941	11.933	11.924	11.916	11.907	11.899	11.890	11.881
Lower Warning limit	11.553	11.545	11.537	11.528	11.520	11.512	11.504	11.495	11.487	11.479	11.471	11.462	11.454	11.446
Lower Action limit	11.443	11.435	11.427	11.419	11.411	11.402	11.394	11.386	11.378	11.370	11.362	11.353	11.345	11.337

	Mon	Tue	Wed	Thur	Fri	Sat	Sun	Mon	Tue	Wed	Thur	Fri	Sat	Sun
Date	11/5/09	11/6/09	11/7/09	11/8/09	11/9/09	11/10/09	11/11/09	11/12/09	11/13/09	11/14/09	11/15/09	11/16/09	11/17/09	11/18/09
Upper Action limit	11.982	11.973	11.965	11.956	11.947	11.939	11.930	11.922	11.913	11.905	11.896	11.888	11.879	11.870
Upper Warning limit	11.873	11.864	11.856	11.847	11.839	11.830	11.822	11.813	11.805	11.797	11.788	11.780	11.771	11.763
Lower Warning limit	11.438	11.430	11.421	11.413	11.405	11.397	11.389	11.381	11.372	11.364	11.356	11.348	11.340	11.332
Lower Action limit	11.329	11.321	11.313	11.305	11.297	11.288	11.280	11.272	11.264	11.256	11.248	11.240	11.232	11.224

Generated by: Ronald Whitson _____
Signature/Date

Reviewed by: John West _____
Signature/Date

Controlled
Copy

Attachment 3 – Final Report (Example)

```
Final Report                                                    07:58.09 Wednesday, August 29, 2007 - Page 1 of 1
DWASAnalysis.exe Imaging Passive Active Neutron Assay System Application Version: 1.20
BIL / MCS Mobile IPAN Drum Waste Assay System (DWAS)
Copyright BIL Solutions Inc. (2005)
Data Taken with DWAS.EXE Version:  3.02
On Machine: DWAS/IPAN/SGS

Libraries:
IPAN DWAS Active Calibration Version: IPAN DWAS ACTIVE CALIBRATION VER 1.1  9/7/2005
IPAN DWAS Passive Calibration Version: IPAN DWAS PASSIVE CALIBRATION VER 1.1  9/7/2005
IPAN TMU Version: 2.6

Radio Assay Procedure:        T-CH-252-P-OP-100 Rev.11
Primary ID:                   Calibration Verification
Secondary ID:                 Index # 1
Content Code:                 No Content Code
Drum Size:                    55-Gallon
Weight (kg):                  3.200000e+000
Database Name:                070829.P02
Starting Time:                Wed Aug 29 07:57:11 2007
Run Number:                   2
Active Grabs:                 16
Passive Grabs:                16

Intermediate Quantities:
Avg Flux per Grab (counts):   5.721125e+003
Abs Idx:                      2.355646e+001
Mod Index:                    1.271119e+000
AbsMod Index:                 2.655848e+001
Active Matrix:                #SIZ55 G #ABSOR 22.94 #MOD 1.16 Empty 001
Passive Matrix:               #SIZ55 G #ABSOR 22.94 #MOD 1.16 Empty 001

Assay Results:
                              Value            TMU (1-Sigma)
Total Fissile Signal:         1.703689e-001    2.978450e-003
Pu239 Effective Mass:         4.928992e-001    1.230892e-001  g-Pu239eff (Imaged Active Mass)
Passive Totals Rate cps:      1.257174e+003    2.103439e+000  cps
Raw Coincidence Count Rate:   2.818333e+002    2.029806e+000  cps
Pu240 Effective Mass:         2.056292e+001    5.227546e+000  g-Pu240eff (Passive Coincidence Mass)

Data Quality Indicators:
Matrix Selection: AUTOMATIC
Operator:                     SATTERFIELD
```

D. Satterfield 8/29/07
Signature Date

BLSmith BLSmith 8/29/07
Reviewed by (Printed Name and Signature) Date