Controlled
Copy

CCP-TP-139

Revision 2

CCP
In Situ Object Counting System
Nondestructive Assay
Operating Procedure

EFFECTIVE DATE: 05/26/2009

D.K. Ploetz

PRINTED NAME

APPROVED FOR USE

RECORD OF REVISION

Revision Number	Date Approved	Description of Revision
0	04/26/2006	Initial issue.
1	01/16/2007	Revised to be consistent with changes in the Waste Isolation Pilot Plant Hazardous Waste Facility Permit.
2	05/26/2009	Revised to add note before step 4.4.2 regarding assaying remote-handled (RH) drums. Additional changes identified during the procedure validation.

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1.0 PURPOSE

This procedure describes the steps used to operate the Canberra In Situ Object Counting System (ISOCS) for performing portable assays and reporting the necessary information to the Savannah River Site (SRS) for use in determining disposal options (i.e., designation for further transuranic [TRU] characterization or disposal as low-level waste [LLW]). The ISOCS is operated by Central Characterization Project (CCP) personnel to determine the gamma-emitting radionuclide content and fissile content of a sample item.

1.1 Scope

The ISOCS may be used to measure plutonium and other gamma-emitting isotopes in drums, boxes, and other items designated by the Nondestructive Assay (NDA) Expert Analyst (EA).

2.0 REQUIREMENTS

2.1 References

Baseline Documents

- User's Manual, *ISOCS Calibration*, Canberra Industries, Inc.
- User's Manual, *InSpector Spectroscopy System Basic Operation*, Canberra Industries, Inc.
- Hardware Manual, *ISOXSHLD ISOCS Shield System*, Canberra Industries, Inc.

Referenced Documents

- CCP-QP-002, *CCP Training and Qualification Plan*
- CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*
- CCP-QP-008, *CCP Records Management*

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 High Purity Germanium (HPGe) Detector and collimator shielding.

2.3.2 Radionuclide source for measurement control calibration verification checks.

2.3.3 ISOCS cart and Inspector2K analyzer with laptop computer.

2.3.4 Liquid Nitrogen (LN) supply and transfer system.

2.3.5 ISOCS Operations Logbook for recording instrument background check and sample item measurement information.

2.3.6 Filters of Cadmium or Tin for reducing low energy radiation levels.

2.4 Precautions and Limitations

2.4.1 Due to the portable nature of this instrumentation, the NDA Operator must follow the appropriate criticality prevention or control program applicable to the location of work being performed.

2.4.2 Due to the presence of high voltages (with low currents) at several points in the ISOCS, **ONLY** personnel trained in accordance with this procedure are allowed to make or break electrical (power or signal) connections. Damage to equipment may result if operated by untrained personnel.

2.4.3 LN is used for cooling purposes. The appropriate controls (e.g., face shield, safety glasses, cryogenic gloves) should be used when transferring LN to the portable dewar.

2.5 Prerequisite Actions

2.5.1 Ensure the detector dewar has LN and/or has been cooled for a minimum of four hours before use.

2.5.2 Ensure appropriate power requirements are satisfied at the measurement location.

2.6 Definitions

2.6.1 None.

3.0 RESPONSIBILITIES

3.1 NDA Operator

3.1.1 Complies with all site safety requirements and procedures.

3.1.2 Performs NDA operations in accordance with this procedure.

3.1.3 Maintains an accurate ISOCS Operations Logbook.

3.1.4 Generates nonconformance reports (NCRs) in accordance with CCP-QP-005, *CCP TRU Nonconforming Item Reporting and Control*, as necessary.

3.2 NDA Lead Operator (LO)

3.2.1 Ensures that operations are performed in a manner consistent with this procedure as well as site safety requirements.

3.2.2 Provides oversight and direction to the NDA Operator.

3.2.3 Generates NCRs in accordance with CCP-QP-005, as necessary.

3.3 NDA Expert Analyst (EA)

3.3.1 Reviews the data to ensure the data meet the reporting requirements designated by Host site personnel.

3.3.2 Revises the ISOCS models, as required, to provide the most accurate analysis results.

3.3.3 Generates the ISOCS Radioassay Data Sheet.

3.3.4 Generates NCRs in accordance with CCP-QP-005, as necessary.

3.4 Facility Records Custodian

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

4.0 PROCEDURE

4.1 Beginning of Daily Operations

CAUTION

Due to the presence of high voltages (with low currents) at several points in the ISOCS, **ONLY** personnel trained in accordance with this procedure are allowed to make or break electrical (power or signal) connections. Damage to equipment may result if operated by untrained personnel.

CAUTION

Changes of control settings **NOT** in accordance with the recommendations of the various operating manuals for the detectors or electronics may result in severe damage to the instrument.

NOTE

The NDA Operator, performing the daily operations below, has a level of proficiency such that routine instrument troubleshooting adjustments (i.e., adjustment of instrument gain, offset) can be performed without need for intervention by the NDA LO. In all cases, when a simple instrument adjustment of this type becomes necessary, these actions, as well as the reasons why they were taken, must be documented in the ISOCS Operations Logbook. In the event that the ISOCS instrument requires a higher level of troubleshooting effort, the NDA LO must be notified and must collaborate with the NDA Operator such that any ISOCS instrument operations problems are resolved and the ISOCS instrument is restored to its correct operating condition. These actions must also be documented in the ISOCS Operations Logbook.

NOTE

The LN fill cycle should be performed routinely. If the detector has been allowed to warm up to ambient temperature, allow at least four hours after the cool down prior to any assay measurements.

NDA Operator

4.1.1 Ensure power is on to the computer and Inspector2K.

4.1.2 Enter user name and password, as needed.

4.1.3 Select the Gamma Acquisition and Analysis window, as required.

4.1.4 Select FILE on the menu bar, **AND** select OPEN DATA SOURCE.

4.1.5 Select the DETECTOR Button.

4.1.6 Highlight the appropriate detector number, **AND** select OPEN.

4.1.7 Select MCA on the menu bar, then select the ADJUST option.

4.1.8 Select the HVPS Button.

4.1.9 Select the STATUS ON Button to turn on the detector high voltage.

4.1.10 Select the EXIT button to exit the adjust operation page.

4.1.11 Wait at least five minutes for the detector to stabilize.

4.2 Performance of Initial Area Quality Control Background Measurement

NOTE

Quality Control (QC) Background measurements should include the primary quantification region (typically the Pu-239 measurement range) to ensure that a Pu-239 background DOES **NOT** exist. In addition, other expected problem background ranges, such as Am-241 and Cs-137, may need to be included to ensure the measurement quality. The background count time for QC Background assays will be determined by the NDA EA. In addition to the daily QC Background measurement the EA may request a one hour environmental background.

4.2.1 Ensure detector is **NOT** pointing at any known gamma-emitting sources.

4.2.2 Select the ANALYZE option from the menu bar, **AND** then select EXECUTE SEQUENCE.

4.2.3 **IF** a Daily Background is to be performed,
THEN select QC BACKGROUND.

4.2.4 **IF** a one hour Environmental Background is to be performed, **THEN** select 'TRBOX 3600'.

4.2.5 Enter the appropriate information in the EDIT SAMPLE INFORMATION screen, **AND** select OK.

4.2.6 On the LOAD CALIBRATION FILE screen, select the appropriate calibration file, **AND** select LOAD.

4.2.7 Select 'Up One Level' button.

4.2.8 Open Camfiles.

4.2.9 On the SAVE DATASOURCE screen, select 'Create New Folder' and enter the appropriate folder name (e.g., ISOCS MM-DD-YY), **AND** select OPEN.

NOTE

Initial measurements will be performed to establish, as necessary, acceptable upper levels or acceptable ranges of performance for select performance parameters, such as background, resolution, etc. Acceptable upper levels and ranges will be documented by the EA.

4.2.10 Enter the appropriate file name (e.g., QC BKGD MM-DD-YY) and select OK.

4.2.11 **AFTER** the run is complete,
THEN review the background check to ensure the background level is an acceptable range.

[A] **IF** the initial background measurement exceeds the acceptable upper level,
THEN perform the following:

[A.1] Check the immediate vicinity of the process area where the background measurement was performed to ensure that all extraneous radiation sources are removed from the area.

[A.2] Perform a second instrument area background check in accordance with step 4.2.1 through step 4.2.11.

[B] **IF** the second background check CAN **NOT** be brought into an acceptable measured level and again exceeds the acceptable upper level,
THEN STOP measurements, **AND** notify the NDA LO.

[B.1] Investigate and resolve the problem.

[B.2] Document information in the ISOCS Operations Logbook prior to the ISOCS being released to perform routine item measurements.

4.2.12 If results are acceptable, print, sign and date.

4.2.13 Once printed, clear contents of report window.

4.3 Calibration Check Operations

NOTE
A calibration check source measurement must be performed at the beginning of the shift of operations in accordance with step 4.3.1 through step 4.3.10. The calibration check will serve to verify correct ISOCS instrument operations for sample batch item measurements done during the shift of operations. The calibration check must include, at a minimum, the energy response (peak centroid), resolution full width at half maximum (FWHM), and efficiency (peak net area). The designated distance at which the source will be placed for measurement will be specified by the EA.

4.3.1 Place the calibration check source at a designated distance from the detector end cap as specified by the NDA EA.

4.3.2 Select the ANALYZE option from the menu bar, and then select EXECUTE SEQUENCE.

4.3.3 Select DSC.

4.3.4 Enter the appropriate information in the EDIT SAMPLE INFORMATION screen, **AND** select OK.

4.3.5 On the LOAD CALIBRATION FILE screen, select the appropriate calibration file, **AND** select LOAD.

4.3.6 On the SAVE DATASOURCE screen, open appropriate folder and enter the appropriate file name (e.g., DSC MM-DD-YY), **AND** select OK.

4.3.7 **AFTER** the run is complete, then check that the results from this measurement are within acceptable control limits (+/- 2 sigma), **THEN** GO TO Section 4.4 or Section 4.5, as appropriate.

4.3.8 **IF** the results exceed the acceptable control limits, (+/- 2 sigma), **THEN** verify source positioning, **AND** rerun the QC check a second time in accordance with step 4.3.1 through step 4.3.7.

NOTE

The NDA LO and NDA Operator must collaboratively resolve any problems and document the condition in the ISOCS Operations Logbook prior to the ISOCS instrument being released to perform measurements.

4.3.9 **IF** the second calibration source check is again reported above the acceptable control limits,
THEN STOP measurements, **AND** contact the NDA LO for direction to resolve the problem.

[A] Under the direction of the NDA LO, attempt to resolve the problem utilizing routine instrument troubleshooting techniques (i.e. instrument gain adjustment, instrument zero offset adjustment), **AND** document in the ISOCS Operations Logbook.

4.3.10 Upon resolution of the problem and approval from the NDA LO, perform a QC check measurement in accordance with step 4.3.1 through step 4.3.7.

4.3.11 If results are acceptable, print, sign and date.

4.3.12 Once printed, clear contents of report window.

4.3.13 Remove the calibration check source and secure it.

4.4 Drum Assays

NOTE

The ISOCS shield system employs lead shields, mechanical filters, and collimators to adjust the angle of view and amount of radiation reaching the detector. These adjustments are factors in the ISOCS analysis and may be adjusted, as necessary, during performance of the measurement.

4.4.1 Before starting the drum assay, record the following information on Attachment 1, NDA Item Description Sheet Drum Geometry:

[A] Dimensions on Drum (inches [in])Item Identification (ID)

[B] Weight (kilograms [kgs]) (provided by the Host site)

[C] Material Description (as identified in acceptable knowledge [AK])

[D] Detector Distance (in)

[E] Detector Filters (initial)

[F] Contact Dose Rate (millirem per hour [mrem/h])

[G] Comments (as appropriate)

NOTE

If assaying higher activity containers, such as RH containers, then an initial detector to container distance of greater than 24 in. may be used. The distance may be adjusted until the system meets specified dead time requirements, as described below. The final distance, and any filters used, will be recorded as described in this procedure.

4.4.2 Place the drum on the rotator, **AND** place the detector at a predetermined distance (typically 24 in.) from the side of the drum and centered vertically on the drum height.

4.4.3 Initiate drum rotation.

4.4.4 Select the ANALYZE option from the menu bar, then select EXECUTE SEQUENCE.

4.4.5 Select the appropriate .asf file for the item being assayed.

4.4.6 Enter the appropriate information in the EDIT SAMPLE INFORMATION screen, **AND** select OK.

4.4.7 On the LOAD CALIBRATION FILE screen, select the appropriate calibration file, **AND** select LOAD.

4.4.8 Select ‘Up One Level’ button.

4.4.9 Open Camfiles and select the appropriate folder.

4.4.10 On the SAVE DATASOURCE screen, enter the appropriate file name, **AND** select OK.

4.4.11 **IF** the detector dead time is greater than 30 percent, **THEN** check for a large 59.5 Kilo Electron Volt (keV) peak.

[A] **IF** the peak is large, **THEN** add one or more detector filters such that the reported detector dead time during spectral acquisition is now less than 30 percent.

[A.1] **IF** this DOES **NOT** reduce the dead time, **THEN** increase the detector distance.

[A.2] Record any filters or changes in detector distance on Attachment 1, Comments section.

4.4.12 After assay is complete, STOP drum rotation.

4.4.13 Clear contents of report window.

4.4.14 Print name, sign, and date Attachment 1.

4.4.15 Repeat Sections 4.4.1 through 4.4.14, as needed.

4.5 Box Assays

NOTE

The ISOCS shield system employs lead shields, mechanical filters, and collimators to adjust the angle of view and amount of radiation reaching the detector. These adjustments are factors in the ISOCS analysis and may be adjusted, as necessary, during performance of the measurement.

4.5.1 Before starting the box assay, record the following information on Attachment 2, NDA Item Description Sheet Box Geometry.

[A] Dimensions on Box (in)

[B] Item Identification (ID)

[C] Weight (kgs) (Provided by Host site)

[D] Material Description (As identified in AK)

[E] Detector Distance (in)

[F] Detector Filters (initial)

[G] Contact Dose Rate (mrem/h)

[H] Comments (as appropriate)

4.5.2 Select the ANALYZE option from the menu bar, then select EXECUTE SEQUENCE.

4.5.3 Select the appropriate .asf file for the item being assayed.

4.5.4 Enter the appropriate information in the EDIT SAMPLE INFORMATION screen, **AND** select OK.

4.5.5 On the LOAD CALIBRATION FILE screen, select the appropriate calibration file, **AND** select LOAD.

4.5.6 Select 'Up One Level' button.

4.5.7 Open Camfiles and select the appropriate folder.

4.5.8 On the SAVE DATASOURCE screen, enter the appropriate file name, **AND** select OK.

4.5.9 **IF** the detector dead time is greater than 30 percent,
THEN check for a large 59.5 keV peak.

[A] **IF** the peak is large,
THEN add one or more detector filters such that the reported detector dead time during spectral acquisition is now less than 30 percent%.

[A.1] **IF** this DOES **NOT** reduce the dead time,
THEN increase the detector distance.

[A.2] Record any filters or changes in detector distance on Attachment 2, Comments section.

4.5.10 **AFTER** the count sequence STOPS,
THEN rotate the box by 180 degrees, **OR** move the ISOCS to the opposite side of the box.

4.5.11 Clear contents of report window.

4.5.12 Select the ANALYZE option from the menu bar, then select EXECUTE SEQUENCE.

4.5.13 Select the appropriate .asf file for the item being assayed.

4.5.14 Enter the appropriate information in the EDIT SAMPLE INFORMATION screen, **AND** select OK.

4.5.15 On the LOAD CALIBRATION FILE screen, select the appropriate calibration file, **AND** select LOAD.

4.5.16 Select 'Up One Level' button.

4.5.17 Open Camfiles and select the appropriate folder.

4.5.18 On the SAVE DATASOURCE screen, enter the appropriate file name, **AND** select OK.

4.5.19 **IF** the detector dead time is greater than 30 percent,
THEN check for a large 59.5 keV peak.

[A] **IF** the peak is large,
THEN add one or more detector filters such that the reported detector dead time during spectral acquisition is now less than 30 percent.

[A.1] **IF** this DOES **NOT** reduce the dead time,
THEN increase the detector distance.

[A.2] Record any filters or changes in detector distance on Attachment 2, Comments section.

4.5.20 **WHEN** assay is complete,
THEN clear contents of report window.

4.5.21 Print name, sign, and date Attachment 2.

4.5.22 Repeat sections 4.5.1 through 4.5.21, as needed.

WARNING

When filling the detector Dewar with LN, safety glasses, face shield and cryogenic gloves must be worn.

4.6 Detector LN Transfer (as required)

4.6.1 Don the Host site required PPE for transferring LN.

4.6.2 Connect the LN transfer hose between the LN supply tank and the detector Dewar to be filled.

4.6.3 Open the valve on the LN supply tank to allow the LN to flow to the detector Dewar.

4.6.4 **WHEN** the fill is complete,
THEN close the valve of the LN supply tank.

4.6.5 **WHEN** LN transfer is complete, allow the LN transfer hose to warm up,
THEN disconnect the LN transfer hose from the detector Dewar.

4.6.6 Doff the Host site required PPE.

4.7 Shutdown ISOCS System

NOTE

The shutdown sequence shall be performed as required.

4.7.1 Select MCA, then select ADJUST.

4.7.2 Select HVPS Button.

4.7.3 Select OFF.

4.7.4 Select EXIT.

4.7.5 Select FILE.

4.7.6 Select CLOSE.

4.7.7 Select FILE option.

4.7.8 Select EXIT.

4.7.9 Shut down the Windows Operating System.

4.8 Post-Performance Activities

4.8.1 Data Review, Disposition, and Records Storage

NOTE

Once the ISOCS measurements for the required items and packages are completed for the shift of operations, a complete copy of the electronic spectral data and report files, along with the hardcopy report file results, are forwarded by the NDA Operator to the Canberra ftp site for independent technical review and expert analysis by the NDA EA.

Prior to review of ISOCS item assay results, the NDA EA will carefully review all area background check data and check source calibration data to determine if there are any nonconformances. The NDA Operator will check each day's results prior to performing any measurements. If there are any nonconformance out-of-tolerance calibration items identified in the area background and calibration source check measurements bracketing the sample item batch measurements, then all ISOCS item data will be listed as pending for the batch prior to resolution.

The NDA Operator documents this information utilizing QC charts for each ISOCS and collaborates with the NDA EA and the NDA LO on a continuous basis such that only correctly calibrated and qualified ISOCS instruments are utilized to perform measurements in the field.

Once the NDA LO has resolved all of the NCR items and issues associated with the sample batch, the NDA LO is responsible for directing the final path forward for the sample batch in question. These actions will be documented in the CCP NCR database.

All NCR issues will be handled in a collaborative effort between the NDA LO and the NDA EA in such a manner that the most technically conservative and defensible approach is taken to resolve these problems.

NDA LO

[A] Ensure any NCRs generated are addressed, as necessary.

[B] Provide background information (i.e., supplemental AK, waste stream information) to the NDA EA for the review of the pending sample batch, **AND** ensure each item in the batch is documented with limiting conditions and data qualifying assumptions.

NDA EA

[C] Review each of the sample item assay reports and spectral file information.

[D] Include nuclides identified (i.e., above background and the associated uncertainty) for each ISOCS measured item in the Radioassay Data Sheet.

NOTE

When possible, this analysis will include an evaluation to ensure reasonable agreement between the low (129 keV) and high (413.5 keV) energy Pu-239 gamma peaks. ISOCS models should be revised to ensure that quantitative results from each of these peaks (if present) agree to within plus or minus 20 percent. Other evaluation parameters may also be considered to improve the ISOCS model, such as agreement between Am-241 peaks or other key nuclides of interest. The new ISOCS calculation will be used by the NDA EA to generate a new analysis report.

[E] Evaluate whether there are attenuation and/or self-absorption problems.

NOTE

Depending on the complexity of the initial ISOCS item review required, additional analysis may be required for a particular measured item. This is done jointly by the NDA EA with input from the NDA LO, on a case-by-case basis, prior to final reporting of ISOCS results.

[F] Generate an ISOCS Radioassay Data Sheet (see Attachment 3, ISOCS Radioassay Data Sheet [Example], for an example) with the final results reported at the 95 percent confidence level for each sample item in the data.

[F.1] Print name, sign, and date the ISOCS Radioassay Data Sheet.

[F.2] Forward the ISOCS Radioassay Data Sheet to the NDA Operator.

NDA Operator

[G] Review the ISOCS Radioassay Data Sheet, **AND** resolve any issues identified with the NDA EA.

[G.1] Print name, sign, and date the ISOCS Radioassay Data Sheet

[G.2] Forward the ISOCS Radioassay Data Sheet to the NDA LO.

[H] Print background measurement and calibration check reports.

NDA LO

[I] Perform the final review for completeness of the ISOCS Radioassay Data Sheet, **AND** print name, sign, and date the ISOCS Radioassay Data Sheet to approve the data.

[J] Forward all records generated by this procedure to the Facility Records Custodian.

NOTE

As a minimum, a report set will include a background measurement, calibration check, and assay measurement. A report set will typically be submitted on a weekly basis.

Facility Records Custodian

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

5.0 RECORDS

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

5.1.1 QA/Lifetime

[A] Attachment 1, NDA Item Description Sheet Drum Geometry, if applicable

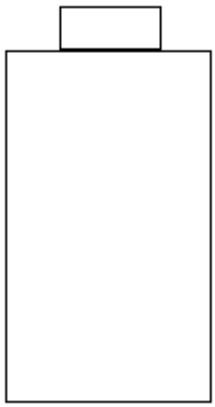
[B] Attachment 2, NDA Item Description Sheet Box Geometry, if applicable

[C] ISOCS Radioassay Data Sheet

[D] Background Measurement Reports

[E] Calibration Check Reports

Attachment 1 – NDA Item Description Sheet Drum Geometry



Put Dimensions on Drum (in)

Item ID: _____

Weight (kgs):_____ (provided by Host site)

Material Description:_____

Detector Distance (in):_____

Detector Filters: _____

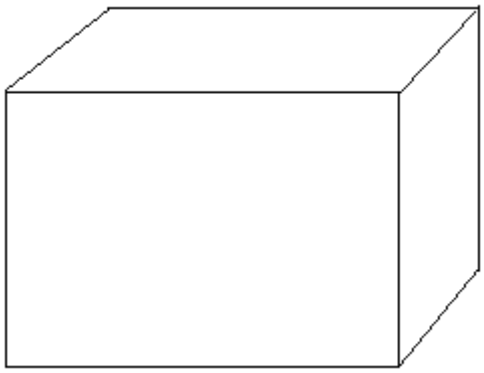
Contact Dose Rate (mrem/h): _____

Comments: _____
_____
_____
_____
_____

NDA Operator:

_____ _____ _____
Printed Name Signature Date

Attachment 2 – NDA Item Description Sheet Box Geometry



Put Dimensions on Box (in)

Item ID: _____

Weight (kgs):_____ (provided by Host site)

Material Description:_____

Detector Distance (in):_____

Detector Filters: _____

Contact Dose Rate (mrem/h): _____

Comments: _____
_____
_____
_____
_____

NDA Operator:

_____ _____ _____
Printed Name Signature Date

Attachment 3 – ISOCS Radioassay Data Sheet (Example)

Radioassay Data Sheet

Mobile Characterization Services, LLC

Header Information

Batch Number:	BN-001
Container ID:	Drum-001
Assay Method:	ISOCS Assay
Assay Software:	Genie 2000 V3.0a, Geometry Composer V4.1a
RDS Spreadsheet Version:	SRS RDS V_0.xls
Procedure and Revision:	CCP-TP-0139 Rev. 1
Assay Date/Time:	1/2/2005 0:00:00
Container Net Weight:	400 kg

Calculated Totals

Waste Classification (TRU or LLW):	TRU			
TRU Activity Concentration:	6.06E+04	+/-	6.80E+03	nCi/g
Total Plutonium Mass:	6.45E+01	+/-	1.45E+01	g
Total Fissile Gram Equivalent:	6.38E+01	+/-	1.45E+01	FGE
Pu-239 Equivalent Activity:	2.44E+01	+/-	2.72E+00	PE-Ci
Total Decay Heat:	7.88E-01	+/-	8.87E-02	W

Applied Isotopic Mass Distributions Default 1

Pu-238	0.0002
Pu-239	0.9327
Pu-240	0.0626
Pu-241	0.0040
Pu-242	0.0005

Summary of Assay Results

Nuclide	Activity (Ci)			Concentration nCi/g		
Pu-238	4.72E-02	+/-	1.08E-02	1.18E+02	+/-	2.70E+01
Pu-239	4.00E+00	+/-	9.13E-01	1.00E+04	+/-	2.28E+03
Pu-240	1.96E-01	+/-	4.49E-02	4.91E+02	+/-	1.12E+02
Pu-241	5.68E+00	+/-	1.30E+00	1.42E+04	+/-	3.24E+03
Pu-242	2.71E-05	+/-	6.19E-06	6.77E-02	+/-	1.55E-02
Am-241	2.00E+01	+/-	2.56E+00	5.00E+04	+/-	6.40E+03

Comments

Errors are quoted at 1 sigma.
Pu-239 values are based on the MDA.
Am-241 values are based on the MDA.

Signatures

NDA EA:

Printed Name	Signature	Date

NDA Operator:

Printed Name	Signature	Date

NDA LO:

Printed Name	Signature	Date

Attachment 3 – ISOCS Radioassay Data Sheet (Example) (continued)

```
**********************************************************************
*****        G A M M A   S P E C T R U M   A N A L Y S I S         *****
**********************************************************************


Filename: C:\Canberra\SRS Data\23118218.A04

Report Generated On              : 4/5/2006    1:43:46 PM

Sample Title                     :
Sample Description               :
Sample Identification            : BX3226
Sample Type                      : N/A
Sample Geometry                  :

Peak Locate Threshold            :  5.00
Peak Locate Range (in channels)  :    50 -  4096
Peak Area Range (in channels)    :    50 -  4096
Identification Energy Tolerance  :    1.000 keV

Sample Size                      :  8.750E+002 kg

Sample Taken On                  : 9/20/2005   9:49:09 AM
Acquisition Started              : 9/20/2005   9:49:07 AM

Live Time                        :     1176.9 seconds
Real Time                        :     1185.0 seconds

Dead Time                        :   0.69 %

              Energy Calibration Used Done On       : 2/17/2003
              Efficiency Calibration Used Done On   : 1/31/2005
              Efficiency ID                         : NONE
```

Attachment 3 – ISOCS Radioassay Data Sheet (Example) (continued)

NID/MDA Report for BX3226 4/5/2006 1:47:21 PM Page 2

********** NID/MDA Results **********

	Nuclide	Total Activity (uCi)	%Error	Concentration (uCi/g)	Mass g
	Pb-xray	3.259E-002 +/-	2.5%	1.239E-006	
	Pu-xray	< 2.103E+003 +/-	6.6%	< 7.997E-002	
	PULSER	3.371E-002 +/-	3.8%	1.282E-006	
?	NA-22	9.418E-007 +/-	69.3%	3.581E-011	1.490E-016
	K-40	1.851E-005 +/-	45.9%	7.037E-010	2.619E-006
	CO-60	9.954E-007 +/-	72.7%	3.785E-011	8.732E-016
	SB-125	< 1.047E-002 +/-	4.2%	< 3.980E-007	< 1.007E-011
	BA-133	< 2.377E-003 +/-	6.6%	< 9.037E-008	< 9.394E-012
	CS-134	< 1.720E-003 +/-	3.8%	< 6.540E-008	< 1.313E-012
?	CS-137	1.401E-005 +/-	22.1%	5.327E-010	1.592E-013
	EU-152	< 8.067E-003 +/-	3.1%	< 3.067E-007	< 4.532E-011
?	EU-154	2.689E-006 +/-	69.3%	1.023E-010	1.007E-014
X	TL-208				
	BI-214	< 3.442E-003 +/-	3.8%	< 1.309E-007	< 7.806E-017
	PB-214	6.184E-006 +/-	76.5%	2.351E-010	1.885E-019
	Ac-227	6.753E-005 +/-	59.0%	2.568E-009	9.225E-013
	AC-228	7.279E-006 +/-	34.9%	2.768E-010	3.250E-018
X	TH-232				
	U-232	1.323E-005 +/-	21.6%	5.031E-010	6.126E-013
	U-233	< 4.669E+001 +/-	4.6%	< 1.775E-003	< 4.784E-003
	U-235	< 4.212E-003 +/-	6.1%	< 1.602E-007	< 1.923E-003
	NP-237	1.933E-003 +/-	0.8%	7.350E-008	2.711E-006
	NP-237a	2.268E-003 +/-	8.5%	8.624E-008	3.181E-006
	PU-238	3.842E+000 +/-	11.8%	1.461E-004	2.221E-007
	Pu-238a	< 7.032E+003 +/-	3.2%	< 2.674E-001	< 4.065E-004
	PU-238b	3.614E+000 +/-	3.4%	1.374E-004	2.089E-007
	U-238	< 2.071E-001 +/-	2.8%	< 7.874E-006	< 6.091E-001
	PU-239	< 1.628E+002 +/-	4.3%	< 6.189E-003	< 2.588E-003
	PU-239A	< 3.340E+001 +/-	6.2%	< 1.270E-003	< 5.310E-004
	PU-239B	1.030E+000 +/-	9.4%	3.916E-005	1.638E-005
	Pu-240	< 6.068E+002 +/-	6.1%	< 2.307E-002	< 2.638E-003
	AM-241	7.080E-003 +/-	2.7%	2.692E-007	2.040E-009
?	AM-241B	3.276E+000 +/-	22.1%	1.246E-004	9.442E-007
	Am-241c	< 5.023E+001 +/-	6.3%	< 1.910E-003	< 1.447E-005
	Am-241D	< 7.889E+002 +/-	3.3%	< 3.000E-002	< 2.274E-004
	PU-241	< 1.329E+003 +/-	6.1%	< 5.052E-002	< 1.278E-005
	Pu-241b	< 4.236E+002 +/-	5.8%	< 1.611E-002	< 4.073E-006
	Am-243	< 1.723E-002 +/-	4.8%	< 6.553E-007	< 8.531E-008
	CM-243	< 1.748E-002 +/-	4.6%	< 6.646E-007	< 3.349E-010
	CM-244	< 1.858E+003 +/-	4.2%	< 7.065E-002	< 2.272E-005
	CM-245	< 2.595E-002 +/-	6.0%	< 9.867E-007	< 1.491E-007
	CF-249	< 2.224E-003 +/-	4.6%	< 8.456E-008	< 5.372E-010

Attachment 3 – ISOCS Radioassay Data Sheet (Example) (continued)

NID/MDA Report for BX3226 4/5/2006 1:47:21 PM Page 3

? = Nuclide is part of an undetermined solution
X = Nuclide rejected by the interference analysis
* = Nuclide was manually edited
< = MDA
@ = Half life too short for MDA calculation

Attachment 3 – ISOCS Radioassay Data Sheet (Example) (continued)

```
Date:           Wednesday, April 05, 2006
Description:    none
Comment:        none
File Name:      c:\genie2k\isocs\data\geometry\in-situ\simple_box\mda test.geo
Software:       ISOCS
Template:       SIMPLE_BOX, Version: default
Detector:       4878
Environment:    Temperature=  22 C, Pressure= 760 mmHg, Rel.Humidity=  30%
Integration:    Convergence= 1.00%, MDRPN= 2^(4) CRPN= 2^(4)
```

#	Geometry Compon.	Dimensions (inch): d1	d2	d3	d4	d5	d6	Material	D(g/cm3)	R.Conc.
1	Box	0.37	48.00	48.00	72.00			wood_oak	0.75	
2	Source-Top Layer	46.00						lpolyeth	0.50	1.00
3	Source-Bottom Layer							none		
4	Absorber1							none		
5	Absorber2							none		
6	Source-Detector	24.00								

```
Collimator:     50mm-180d_old
                oldISOCS_50mm_side_180deg_collimation_[no_collimator]
List of energies for efficiency curve generation:

100.0  150.0  200.0  300.0  500.0  700.0  1000.0 1400.0 2000.0
```