

## ANALYTICAL REPORT

Job Number: 160-18555-1

Job Description: EA and Cabrera - Hill AFB WR111

For:

EA Engineering, Science, and Technology  
7995 E. Prentice Ave, Suite 206E  
Greenwood Village, CO 80111  
Attention: Pamela J Moss



Approved for release.  
Jessica H DeHerrera  
Project Manager I  
9/9/2016 5:28 PM

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09/09/2016

The test results in this report relate only to the samples in this report and meet all requirements of NELAP, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is 4025.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

**TestAmerica Laboratories, Inc.**

TestAmerica St. Louis 13715 Rider Trail North, Earth City, MO 63045  
Tel (314) 298-8566 Fax (314) 298-8757 [www.testamericainc.com](http://www.testamericainc.com)



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## Definitions/Glossary

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

### Qualifiers

#### Rad

Qualifier	Qualifier Description
U	Undetected at the Limit of Detection.

### Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

## **CASE NARRATIVE**

**Client: EA Engineering, Science, and Technology**

**Project: EA and Cabrera - Hill AFB WR111**

**Report Number: 160-18555-1**

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

### **RECEIPT**

The samples were received on 08/09/2016; the samples arrived in good condition. The temperature of the coolers at receipt was 18.0 C. Thermal preservation is not required for the requested analyses; therefore, corrective action is deemed unnecessary. The client was notified on 8/9/16.

### **ISOTOPIC THORIUM (ALPHA SPECTROMETRY)**

Samples WR111-Composite Air Sample-BZ (160-18555-1), WR111-Composite Air Sample-Low Vol (160-18555-2) and WR111-Composite Air Sample-High Vol (160-18555-3) were analyzed for Isotopic Thorium (Alpha Spectrometry) in accordance with DOE A-01-R. The samples were prepared on 08/26/2016 and analyzed on 09/07/2016 and 09/09/2016.

The following samples are filters. Due to the matrix of the samples, a laboratory control sample and laboratory control sample duplicate were used for duplicity. WR111-Composite Air Sample-BZ (160-18555-1), WR111-Composite Air Sample-Low Vol (160-18555-2) and WR111-Composite Air Sample-High Vol (160-18555-3).

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

## Detection Summary

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

**Client Sample ID: WR111-Composite Air Sample-BZ**

**Lab Sample ID: 160-18555-1**

☐ No Detections.

**Client Sample ID: WR111-Composite Air Sample-Low Vol**

**Lab Sample ID: 160-18555-2**

☐ No Detections.

**Client Sample ID: WR111-Composite Air Sample-High Vol**

**Lab Sample ID: 160-18555-3**

☐ No Detections.

This Detection Summary does not include radiochemical test results.

TestAmerica St. Louis

# Client Sample Results

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

## Client Sample ID: WR111-Composite Air Sample-BZ

Date Collected: 08/08/16 15:00

Date Received: 08/09/16 09:20

## Lab Sample ID: 160-18555-1

Matrix: Filter

### Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-230	0.563		0.192	0.198	1.00	0.0784	pCi/Sample	08/26/16 13:26	09/07/16 14:44	1
Thorium-232	0.155		0.102	0.103	1.00	0.0842	pCi/Sample	08/26/16 13:26	09/07/16 14:44	1
<b>Tracer</b>	<b>%Yield</b>	<b>Qualifier</b>	<b>Limits</b>					<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
Thorium-229	91.7		30 - 110					08/26/16 13:26	09/07/16 14:44	1

## Client Sample ID: WR111-Composite Air Sample-Low Vol

Date Collected: 08/08/16 15:00

Date Received: 08/09/16 09:20

## Lab Sample ID: 160-18555-2

Matrix: Filter

### Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-230	1.73		0.338	0.367	1.00	0.109	pCi/Sample	08/26/16 13:26	09/07/16 14:44	1
Thorium-232	0.683		0.213	0.221	1.00	0.105	pCi/Sample	08/26/16 13:26	09/07/16 14:44	1
<b>Tracer</b>	<b>%Yield</b>	<b>Qualifier</b>	<b>Limits</b>					<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
Thorium-229	94.3		30 - 110					08/26/16 13:26	09/07/16 14:44	1

## Client Sample ID: WR111-Composite Air Sample-High Vol

Date Collected: 08/08/16 15:00

Date Received: 08/09/16 09:20

## Lab Sample ID: 160-18555-3

Matrix: Filter

### Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-230	11.5		0.895	1.32	1.00	0.0977	pCi/Sample	08/26/16 13:26	09/09/16 10:34	1
Thorium-232	4.25		0.543	0.650	1.00	0.0840	pCi/Sample	08/26/16 13:26	09/09/16 10:34	1
<b>Tracer</b>	<b>%Yield</b>	<b>Qualifier</b>	<b>Limits</b>					<b>Prepared</b>	<b>Analyzed</b>	<b>Dil Fac</b>
Thorium-229	82.4		30 - 110					08/26/16 13:26	09/09/16 10:34	1

## Tracer/Carrier Summary

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

**Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)**

**Matrix: Filter**

**Prep Type: Total/NA**

		Percent Yield (Acceptance Limits)					
Lab Sample ID	Client Sample ID	Th-229 (30-110)					
160-18555-1	WR111-Composite Air Sample-E	91.7					
160-18555-2	WR111-Composite Air Sample-L	94.3					
160-18555-3	WR111-Composite Air Sample-t	82.4					
LCS 160-266788/2-A	Lab Control Sample	90.8					
LCSD 160-266788/3-A	Lab Control Sample Dup	95.3					
MB 160-266788/1-A	Method Blank	91.0					

### Tracer/Carrier Legend

Th-229 = Thorium-229



# QC Sample Results

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

## Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Lab Sample ID: MB 160-266788/1-A

Matrix: Filter

Analysis Batch: 268472

Client Sample ID: Method Blank

Prep Type: Total/NA

Prep Batch: 266788

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-230	0.2572		0.133	0.135	1.00	0.107	pCi/Sample	08/26/16 13:26	09/07/16 14:44	1
Thorium-232	0.01193	U	0.0328	0.0328	1.00	0.0770	pCi/Sample	08/26/16 13:26	09/07/16 14:44	1
Tracer	MB %Yield	MB Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	91.0		30 - 110					08/26/16 13:26	09/07/16 14:44	1

Lab Sample ID: LCS 160-266788/2-A

Matrix: Filter

Analysis Batch: 268654

Client Sample ID: Lab Control Sample

Prep Type: Total/NA

Prep Batch: 266788

Analyte		Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	%Rec	%Rec. Limits
Thorium-230		8.03	8.995		1.08	1.00	0.0881	pCi/Sam	112	81 - 118
Tracer	LCS %Yield	LCS Qualifier	Limits							
Thorium-229	90.8		30 - 110							

Lab Sample ID: LCSD 160-266788/3-A

Matrix: Filter

Analysis Batch: 268655

Client Sample ID: Lab Control Sample Dup

Prep Type: Total/NA

Prep Batch: 266788

Analyte		Spike Added	LCSD Result	LCSD Qual	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	%Rec	%Rec. Limits	RER	RER Limit
Thorium-230		8.03	8.750		1.06	1.00	0.0929	pCi/Sam	109	81 - 118	0.11	1
Tracer	LCSD %Yield	LCSD Qualifier	Limits									
Thorium-229	95.3		30 - 110									

## QC Association Summary

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

**Rad**

**Prep Batch: 266788**

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-18555-1	WR111-Composite Air Sample-BZ	Total/NA	Filter	ExtChrom	
160-18555-2	WR111-Composite Air Sample-Low Vol	Total/NA	Filter	ExtChrom	
160-18555-3	WR111-Composite Air Sample-High Vol	Total/NA	Filter	ExtChrom	
MB 160-266788/1-A	Method Blank	Total/NA	Filter	ExtChrom	
LCS 160-266788/2-A	Lab Control Sample	Total/NA	Filter	ExtChrom	
LCSD 160-266788/3-A	Lab Control Sample Dup	Total/NA	Filter	ExtChrom	

# Lab Chronicle

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

## Client Sample ID: WR111-Composite Air Sample-BZ

Date Collected: 08/08/16 15:00

Date Received: 08/09/16 09:20

## Lab Sample ID: 160-18555-1

Matrix: Filter

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	ExtChrom			266788	08/26/16 13:26	SCB	TAL SL
Total/NA	Analysis	A-01-R		1	268475	09/07/16 14:44	ALD	TAL SL

## Client Sample ID: WR111-Composite Air Sample-Low Vol

Date Collected: 08/08/16 15:00

Date Received: 08/09/16 09:20

## Lab Sample ID: 160-18555-2

Matrix: Filter

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	ExtChrom			266788	08/26/16 13:26	SCB	TAL SL
Total/NA	Analysis	A-01-R		1	268476	09/07/16 14:44	ALD	TAL SL

## Client Sample ID: WR111-Composite Air Sample-High Vol

Date Collected: 08/08/16 15:00

Date Received: 08/09/16 09:20

## Lab Sample ID: 160-18555-3

Matrix: Filter

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Prep	ExtChrom			266788	08/26/16 13:26	SCB	TAL SL
Total/NA	Analysis	A-01-R		1	268746	09/09/16 10:34	ALD	TAL SL

### Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

# Certification Summary

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

## Laboratory: TestAmerica St. Louis

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Alaska	State Program	10	MO00054	06-30-17
California	State Program	9	2886	03-31-18
Connecticut	State Program	1	PH-0241	03-31-17
Florida	NELAP	4	E87689	06-30-17
Illinois	NELAP	5	003757	11-30-16 *
Iowa	State Program	7	373	12-01-16 *
Kansas	NELAP	7	E-10236	10-31-16 *
Kentucky (DW)	State Program	4	90125	12-31-16
L-A-B	DoD ELAP		L2305	04-06-19
Louisiana	NELAP	6	04080	06-30-17
Louisiana (DW)	NELAP	6	LA160008	12-31-16
Maryland	State Program	3	310	09-30-17
Missouri	State Program	7	780	06-30-17
Nevada	State Program	9	MO000542016-1	07-31-17
New Jersey	NELAP	2	MO002	06-30-17
New York	NELAP	2	11616	03-31-17
North Dakota	State Program	8	R207	06-30-17
NRC	NRC		24-24817-01	12-31-22
Oklahoma	State Program	6	9997	08-31-17
Pennsylvania	NELAP	3	68-00540	02-28-17 *
South Carolina	State Program	4	85002001	06-30-16 *
Texas	NELAP	6	T104704193-15-9	07-31-17
USDA	Federal		P330-07-00122	01-09-17
Utah	NELAP	8	MO000542016-8	07-31-17
Virginia	NELAP	3	460230	06-14-17
Washington	State Program	10	C592	08-30-17
West Virginia DEP	State Program	3	381	08-31-16 *

## Laboratory: TestAmerica Denver

The certifications listed below are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
A2LA	DoD ELAP		2907.01	10-31-17
Utah	NELAP	8	CO00026	07-31-16 *

\* Certification renewal pending - certification considered valid.

TestAmerica St. Louis

# Method Summary

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

Method	Method Description	Protocol	Laboratory
A-01-R	Isotopic Thorium (Alpha Spectrometry)	DOE	TAL SL

**Protocol References:**

DOE = U.S. Department of Energy

**Laboratory References:**

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

## Sample Summary

Client: EA Engineering, Science, and Technology  
Project/Site: EA and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-18555-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-18555-1	WR111-Composite Air Sample-BZ	Filter	08/08/16 15:00	08/09/16 09:20
160-18555-2	WR111-Composite Air Sample-Low Vol	Filter	08/08/16 15:00	08/09/16 09:20
160-18555-3	WR111-Composite Air Sample-High Vol	Filter	08/08/16 15:00	08/09/16 09:20

# REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica St. Louis Job No.: 160-18555-1

SDG No.: \_\_\_\_\_

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
82232-334_00001	06/03/60		Eckert & Ziegler, Lot 82232-334		(Purchased Reagent)		Am-241	7.281 Bq
							Pu-239	7.137 Bq
							Thorium-230	7.63 Bq
82233-334_00001	06/03/60		Eckert & Zigler, Lot 82233-334		(Purchased Reagent)		Am-241	5.114 Bq
							Pu-239	6.064 Bq
							Thorium-230	4.95 Bq
82234-334_00001	06/02/60		Eckert & Zigler, Lot 82234-334		(Purchased Reagent)		Am-241	5.652 Bq
							Pu-239	5.936 Bq
							Thorium-230	5.685 Bq
82236-334_00001	06/02/60		Eckert & Ziegler, Lot 82236-334		(Purchased Reagent)		Am-241	6.891 Bq
							Pu-239	6.664 Bq
							Thorium-230	7.107 Bq
82237-334_00003	06/01/60		Eckert & Ziegler, Lot 82237-334		(Purchased Reagent)		Am-241	5.608 Bq
							Pu-239	6.424 Bq
							Thorium-230	5.856 Bq
82241-334_00001	06/08/60		Eckert & Ziegler, Lot 82241-334		(Purchased Reagent)		Am-241	6.638 Bq
							Pu-239	6.797 Bq
							Thorium-230	6.629 Bq
82242-334_00001	06/08/60		Eckert & Ziegler, Lot 82242-334		(Purchased Reagent)		Am-241	7.145 Bq
							Pu-239	6.414 Bq
							Thorium-230	6.583 Bq
82244-334_00001	06/09/60		Eckert & Zigler, Lot 82244-334		(Purchased Reagent)		Am-241	6.897 Bq
							Pu-239	6.717 Bq
							Thorium-230	7.352 Bq
82245-334_00001	06/09/60		Eckert & Ziegler, Lot 82245-334		(Purchased Reagent)		Am-241	5.528 Bq
							Pu-239	5.437 Bq
							Thorium-230	6.727 Bq
82246-334_00001	06/09/60		Eckert & Ziegler, Lot 82246-334		(Purchased Reagent)		Am-241	6.002 Bq
							Pu-239	5.353 Bq
							Thorium-230	5.57 Bq
Th-229_00021	08/01/17	07/20/16	0.1M HNO3, Lot n/a	500 mL	Th-229_00017	15 mL	At-217	67.2296 dpm/mL
							Thorium-229	67.2296 dpm/mL
.Th-229_00017	08/01/17	08/20/14	0.1M HNO3, Lot n/a	100 mL	Th-229_00016	5.0464 g	At-217	2240.99 dpm/mL
							Thorium-229	2240.99 dpm/mL
..Th-229_00016	08/06/64		Analytics, Lot 97790		(Purchased Reagent)		At-217	740.127 Bq/g
							Thorium-229	740.127 Bq/g
Th-230_00029	10/06/16	09/22/14	1M HNO3, Lot 0	200 mL	Th-230_00019	4 mL	Gross Alpha	44.5646 dpm/mL
							Thorium-230	44.5646 dpm/mL

# REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica St. Louis Job No.: 160-18555-1

SDG No.: \_\_\_\_\_

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration		
					Reagent ID	Volume Added				
.Th-230_00019	11/08/16	08/13/13	1M HNO3, Lot n/a	100 mL	Th-230_00018	5.0731 mL	Gross Alpha	2228.23 dpm/mL		
							Thorium-230	2228.23 dpm/mL		
..Th-230_00018	08/08/63	Eckert & Ziegler Analytics, Lot 92776			(Purchased Reagent)		Gross Alpha	43922.5 dpm/g		
							Thorium-230	43922.5 dpm/g		



Reagent

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**82232-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82232-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 3-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	7.630E+00	4420-4800	7.540E+04	0.7	1.1	2.6
Pu-239	7.137E+00	4950-5240	2.410E+04	0.7	1.1	2.6
Am-241	7.281E+00	5280-5600	4.326E+02	0.7	1.1	2.6
Total Activity	2.210E+01	3000-8000		0.4	1.1	2.3

**\*Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

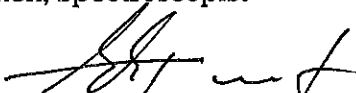
Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

  
A. Chen, Spectroscopist

QA Approved:

  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82233-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82233-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 3-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	4.950E+00	4420-4800	7.540E+04	0.8	1.1	2.7
Pu-239	6.064E+00	4950-5240	2.410E+04	0.7	1.1	2.6
Am-241	5.114E+00	5280-5600	4.326E+02	0.8	1.1	2.7
Total Activity	1.616E+01	3000-8000		0.1	1.1	2.2

**\*Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)




**Comments:**

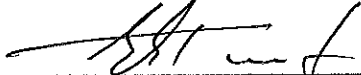
Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

  
A. Chen, Spectroscopist

QA Approved:

  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82234-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82234-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis

**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 2-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	5.685E+00	4420-4800	7.540E+04	0.9	1.1	2.8
Pu-239	5.936E+00	4950-5240	2.410E+04	0.9	1.1	2.8
Am-241	5.652E+00	5280-5600	4.326E+02	0.9	1.1	2.8
Total Activity	1.732E+01	3000-8000		0.5	1.1	2.4

\***Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)




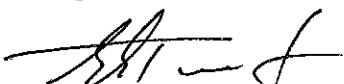


**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

**CAUTION:** Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:   
A. Chen, Spectroscopist

QA Approved:   
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82236-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82236-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 2-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	7.107E+00	4420-4800	7.540E+04	0.7	1.1	2.6
Pu-239	6.664E+00	4950-5240	2.410E+04	0.8	1.1	2.7
Am-241	6.891E+00	5280-5600	4.326E+02	0.7	1.1	2.6
Total Activity	2.071E+01	3000-8000		0.4	1.1	2.3

**\*Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)

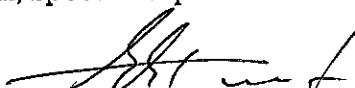


**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:   
A. Chen, Spectroscopist

QA Approved:   
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82237-334\_00003**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82237-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 1-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				u <sub>A</sub>	u <sub>B</sub>	U
Th-230	5.856E+00	4420-4800	7.540E+04	1.0	1.1	3.0
Pu-239	6.424E+00	4950-5240	2.410E+04	0.9	1.1	2.8
Am-241	5.608E+00	5280-5600	4.326E+02	1.0	1.1	3.0
Total Activity	1.793E+01	3000-8000		0.6	1.1	2.5

**\*Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)

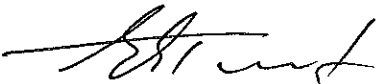


**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:   
A. Chen, Spectroscopist

QA Approved:   
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82241-334\_00001**



## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82241-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 8-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	6.629E+00	4420-4800	7.540E+04	0.8	1.1	2.7
Pu-239	6.797E+00	4950-5240	2.410E+04	0.8	1.1	2.7
Am-241	6.638E+00	5280-5600	4.326E+02	0.8	1.1	2.7
Total Activity	2.011E+01	3000-8000		0.4	1.1	2.3

\*Uncertainty: U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."


(Certificate continued on reverse side)

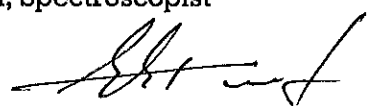


**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

**CAUTION:** Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:   
A. Chen, Spectroscopist

QA Approved:   
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82242-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82242-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis

**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 8-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	6.583E+00	4420-4800	7.540E+04	0.9	1.1	2.8
Pu-239	6.414E+00	4950-5240	2.410E+04	0.9	1.1	2.8
Am-241	7.145E+00	5280-5600	4.326E+02	0.9	1.1	2.8
Total Activity	2.018E+01	3000-8000		0.6	1.1	2.5

\***Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

  
A. Chen, Spectroscopist

QA Approved:

  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82244-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82244-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 9-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	7.352E+00	4420-4800	7.540E+04	0.8	1.1	2.7
Pu-239	6.717E+00	4950-5240	2.410E+04	0.9	1.1	2.8
Am-241	6.897E+00	5280-5600	4.326E+02	0.9	1.1	2.8
Total Activity	2.101E+01	3000-8000		0.6	1.1	2.5

\*Uncertainty: U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."


(Certificate continued on reverse side)




**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:   
A. Chen, Spectroscopist

QA Approved:   
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010





Reagent

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**82245-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82245-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 9-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	6.727E+00	4420-4800	7.540E+04	1.0	1.1	3.0
Pu-239	5.437E+00	4950-5240	2.410E+04	1.1	1.1	3.1
Am-241	5.528E+00	5280-5600	4.326E+02	1.1	1.1	3.1
Total Activity	1.773E+01	3000-8000		0.8	1.1	2.7

\*Uncertainty: U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by:

  
A. Chen, Spectroscopist

QA Approved:

  
E. A. Taskaev, QA Manager Alternate

Date: 06-24-2010



Reagent

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**82246-334\_00001**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

82246-334

24.1 mm Diameter x 0.65 mm Thick Stainless Steel Disk

**Customer:** Test America/St. Louis  
**P.O. No.:** 2355182, Item 1

This standard radionuclide source was prepared by electrodeposition onto a stainless steel disk. Total alpha activity was determined with a ZnS scintillation detector. Radionuclide activities and impurities were calculated from the total activity and the fraction of activity for each radionuclide determined by alpha spectroscopy. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 1, February, 1979, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

**Reference Date:** 9-Jun-2010 12:00 PM EST

Isotope	Activity (Bq)	Energy Range (keV)	Half-Life, years	Uncertainty* Type (%)		
				$u_A$	$u_B$	U
Th-230	5.570E+00	4420-4800	7.540E+04	1.0	1.1	3.0
Pu-239	5.353E+00	4950-5240	2.410E+04	1.0	1.1	3.0
Am-241	6.002E+00	5280-5600	4.326E+02	1.0	1.1	3.0
Total Activity	1.696E+01	3000-8000		0.7	1.1	2.6

\***Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

(Certificate continued on reverse side)



**Comments:**

Diameter of active area: 19 mm. Disk mounted on customer supplied disk 31.8 mm diameter x 0.45 mm thick stainless steel disk.

CAUTION: Active material deposited on the unmarked surface. Handle carefully to prevent scratching or damaging the active surface of this source (i.e., use Teflon coated forceps). Store in the container provided when not in use.

Source Calibrated by: \_\_\_\_\_

A. Chen, Spectroscopist

QA Approved: \_\_\_\_\_

E. A. Taskaev, QA Manager Alternate

Date: 06.24.2010



Reagent

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**Th-229\_00016**

## CERTIFICATE OF CALIBRATION

### Standard Radionuclide Source

97790

Th-229 5 mL Liquid in Flame Sealed Vial

**Customer:** TestAmerica - St. Louis  
**P.O. No.:** 2573570, Item 1      **Product Code:** 8229



430569  
ID: Th-229\_00016  
Exp:08/06/14 Pripd:SCB Opm:08/20/14  
Th-229 Ampoule

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty* , %			Reference Date (12:00 PM EST)
			$u_A$	$u_B$	U	
Th-229	2.681E+06	3.761E+03	0.5	1.5	3.1	08/06/2014

\***Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

**Comments:**

Impurities:  $\alpha$ -impurities: Th-228 2.83E-01 Bq, Th-230 2.33E+01 Bq, Th-232 1.51E0 Bq;  $\gamma$ -impurities (other than decay products) <0.1%.  
5.08156 g 0.5M HNO<sub>3</sub> solution. Carrier free.

Source Prepared by: \_\_\_\_\_

Z. Dimitrova, Radiochemist

QC Approved: \_\_\_\_\_

A. Chen, Spectroscopist

Date: 06 AUG 14







## U.S. DEPARTMENT OF COMMERCE

National Institute of Standards & Technology  
Gaithersburg, MD 20899

# Certificate of Participation

*Eckert & Ziegler Analytics*  
*Atlanta, Georgia*

is a participant for the period January 1, 2014, through December 31, 2014, in a radioactivity measurements assurance program conducted by the National Institute of Standards and Technology, in cooperation with NRMAT Incorporated. Continued participation is evidenced by dated Reports of Traceability issued for particular radionuclides, which indicate the deviation of the participant's reported value from that measured by the National Institute of Standards and Technology. The significance of these Reports is addressed below.\*

For the Director,

A handwritten signature in black ink, appearing to read "Michael P. Unterweger".

Michael P. Unterweger, Leader  
Radioactivity Group  
Physical Measurement Laboratory

\*As guidance for the proper use of Reports of Traceability, it should be emphasized that the National Institute of Standards and Technology is concerned only with fostering good measurements capability and consistency with the national measurements system. The assurance of the proper application of that capability to the ultimate consumer products is the responsibility of each manufacturer of these products and of the Federal regulatory agencies.

A continuing traceability program in radioactivity demonstrates, to the degree established by the periodic assays of calibrated radioactivity samples, a continuing competence to maintain the methods and standards necessary for accurate measurement. Such a program cannot, however, endorse each and every measurement nor the final product, any more than a spot check can vouch for every unchecked item. Care should be taken, therefore, not to imply such endorsement. The proper use of this Report is governed by section 200.114 of Title 15 of the Code of Federal Regulations. These regulations may be met if Reports are quoted only in their entirety. Excerpts out of context may be misleading.

## **Recommended Procedure for Opening the Flame Sealed Vial**

- 1) If the solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the standard.
- 2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood.
- 3) Shake the vial to wet the entire inside surface of the vial. Return the vial to the upright position.
- 4) Check that all of the liquid has drained out of the neck of the vial. If necessary, gently tap the neck to speed the process.
- 5) The Wheaton vials we use are pre-scored.
- 6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.
- 7) Hold the vial upright and wrap with soft tissue, such as Chem Wipes, around the tip of the vial and secure with tape (see picture). Snap off the top of the vial by pressing the pre-scored part of the neck away towards you while pulling the tip of the vial away from you.
- 8) Transfer the solution from the vial using a pycnometer or pipet with a dispenser handle. **NEVER PIPETTE BY MOUTH.**
- 9) Seal any unused solution in a flame sealed glass vial, if possible, to minimize the evaporation loss.

Reagent

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**Th-229\_00021**

Standard ID Number: Th-229\_00021  
True Value = 67.217 Dpm/mL  
Date Analyzed: 8/1/2016

Radionuclide:  
Th-229

	Replicates	
#1	<u>65.43</u>	Dpm/mL
#2	<u>62.76</u>	Dpm/mL
#3	<u>66.9</u>	Dpm/mL

Mean = 65.03

1 sigma = 2.09878536

1.96 sigma = 4.113619

True Value minus 5% = 63.85615

(True Value - 5%)

True Value plus 5% = 70.57785

(True Value + 5%)

**Accuracy:**

Mean value within 5% of Certified (True) Value? Yes (Acceptance Criteria)

**Precision:**

1.96 sigma Value Within 10% of Mean Value? Yes (Acceptance Criteria)

Standard Reverification Acceptable?

Yes

Note: Criteria for reverification of radiological standards is taken from the DoD/DOE Consolidated QSM and LANL Statements of Work

1st Reviewed By/Date: ALD 8/2/16

2nd Reviewed By/Date: DM 8-3-16



**Reagent ID: Th-229\_00021**

Description: Th-229 Tracer  
No. of Bottles: 1  
Storage Location: RAD Actinide STDs  
Reagent Volume: 500.000 mL  
Creation Date: 07/20/2016  
Open Date:  
Container(s): 957642  
Comment:

Expiration Date: 12/01/2016  
Laboratory: TestAmerica St. Louis  
Prepared By: Bernsen, Sarah C  
Solvent: 0.1M HNO3  
Solvent Lot: n/a

### Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
At-217	Th-229_00017	08/05/2016	2240.98600	dpm/mL	67.22958	dpm/mL
Th-229	Th-229_00017	08/05/2016	2240.98600	dpm/mL	67.22958	dpm/mL

### Source Reagents

Reagent	Description	Type	Expiration	Vendor	Vendor Lot #	Vendor Cat Lot #	Volume Used	Volume Units
Th-229_00017	Th-229 Parent		08/05/16				15.00000	mL

## Decay Calculations

## Raw Sample/Standard Information

Initial Date/Time (t <sub>0</sub> ):	8/6/2014 0:00		
Decayto Date/Time (t):	8/1/16 0:00		
Initial Activity (A <sub>0</sub> ):	67.23 dpm		
Initial Aliquot:	1 mL		
Initial Conc:	67.229 dpm/mL		
*Soln. Density:	1 g/mL		
Nuclide:	Th-229		
Half-Life (days):	2897163	decay days	fraction
**Decay Factor:	0.9998	726.00	0.00025
Decay Corr Activity:	6.7217E+01 dpm		
Decay Corr Conc:	6.7217E+01 dpm/mL		

## Conversion/Calculations

Final Activity Unit:	dpm
Activity Unit Factor:	1.00000
Final Volume Unit:	mL
Volume Unit Factor:	1.000
Final Concentration:	6.7217E+01 dpm/mL
Aliquot Volume:	1.0000E+00 mL
Final Activity (A):	6.7217E+01 dpm

\*\* Uses basic decay equation:  $A = A_0 * \exp(-\ln(2)*(t-t_0)/(\text{half-life}))$

\* Soln. Density to be used when converting from liquid expressed in mass (g) units to liquid units (mL), and is only applied in that case.

Sample Name: Verification 1  
Spectrum #1 Analysis #1

Type: Sample

### Sample

Sample Volume : 0.10 Sample Units: mL  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Sample Collection Date:  
Comment:

### Batch

Batch Name: Th-229\_00021  
AnalysisResultsID: 172960  
Description:

Client Name: Undefined  
Client Contact:  
Analyst: 60040

### Tracer

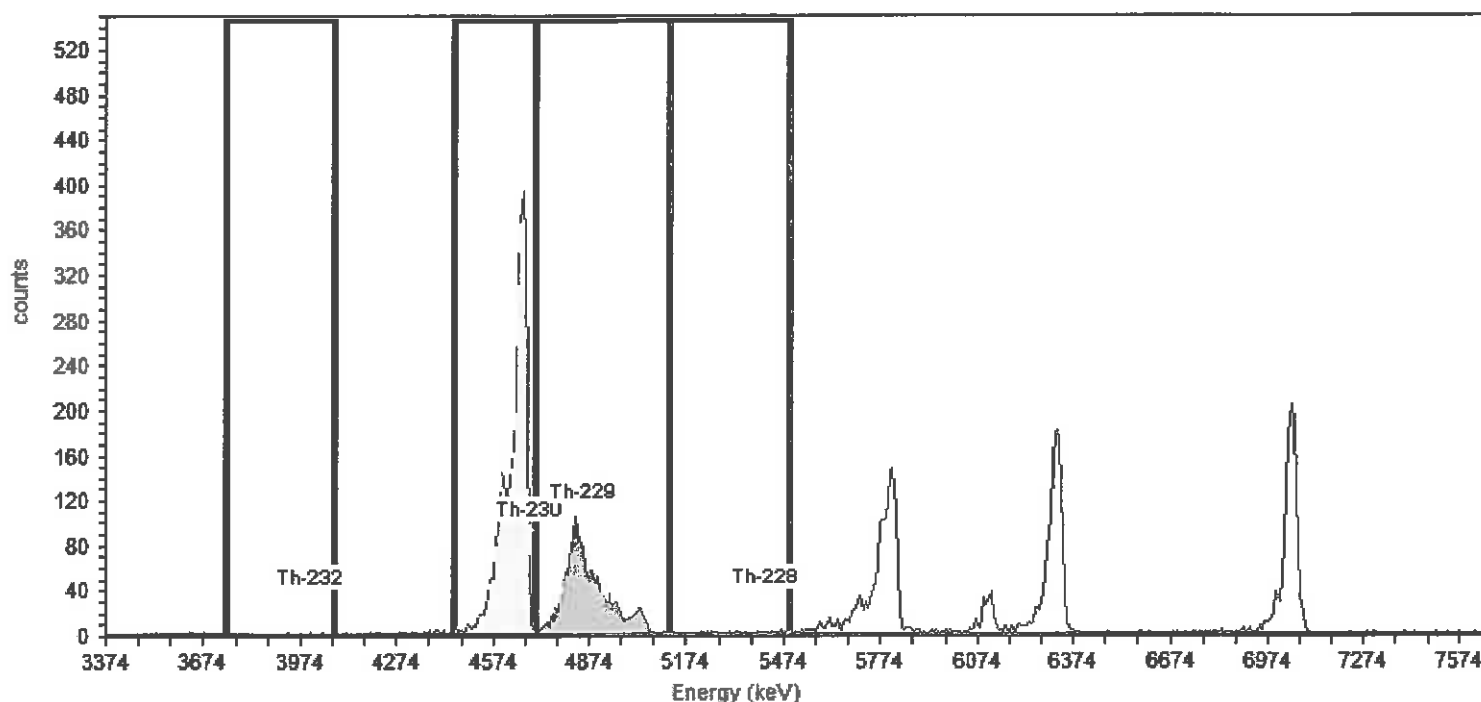
Tracer Name: Th-230\_00029  
Tracer Activity: 44.56 DPM / mL x (Vol.) 0.30 mL = 13.37 DPM  
Tracer Ref. Date: 8/8/2013 11:19:32AM

Tracer Nuclide: Th-230  
Tracer Recovery: 97.09%

### Acquisition

Detector: AV170 SN: 50-112 G7  
Acquisition Start Date: 8/1/2016 2:01:38PM  
Live Time: 960.00 min.  
Real Time: 960.01 min.  
Background Date: 7/25/2016 1:14:05PM  
Bkgd Info: Sample: ICB;AV170; Det: AV170; Spectrum #1; 7/25/2016 1:14:05 PM

Energy Calibration: IC-9795;AV170-20151016  
Efficiency Calibration:IC-9795;AV170-20151016  
Calibration Date: 10/17/2015 2:36:50PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 25.95% +/- 0.34% TPU(2 sigma)



### General Analysis

Analysis Method: Interactive ROI Analysis  
Decay Correction:8/1/2016 2:00:42PM  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	9.9	100.2	4	0.0000	4.00	1.650E-001 DPM/mL
Th-230	4688.0	4,687.5	0.5	4448.3	4701.9	22.4	99.7	3225	1.0000	3224.00	1.298E+002 DPM/mL
Th-229	4848.0	4,845.3	2.7	4701.9	5119.5	98.2	99.6	1580	3.0000	1577.00	6.543E+001 DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	28.8	99.8	30	18.0000	12.00	4.973E-001 DPM/mL

Sample Name: Verification 2  
Spectrum #1 Analysis #1  
:  
Sample Collection Date:  
Comment:

### Sample

Sample Volume : 0.10  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Batch Name: Th-229\_00021  
AnalysisResultsID: 172958  
Description:

### Batch

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Name: Th-230\_00029  
Tracer Activity: 44.56 DPM / mL x (Vol.) 0.30 mL = 13.37 DPM  
Tracer Ref. Date: 8/8/2013 11:19:32AM

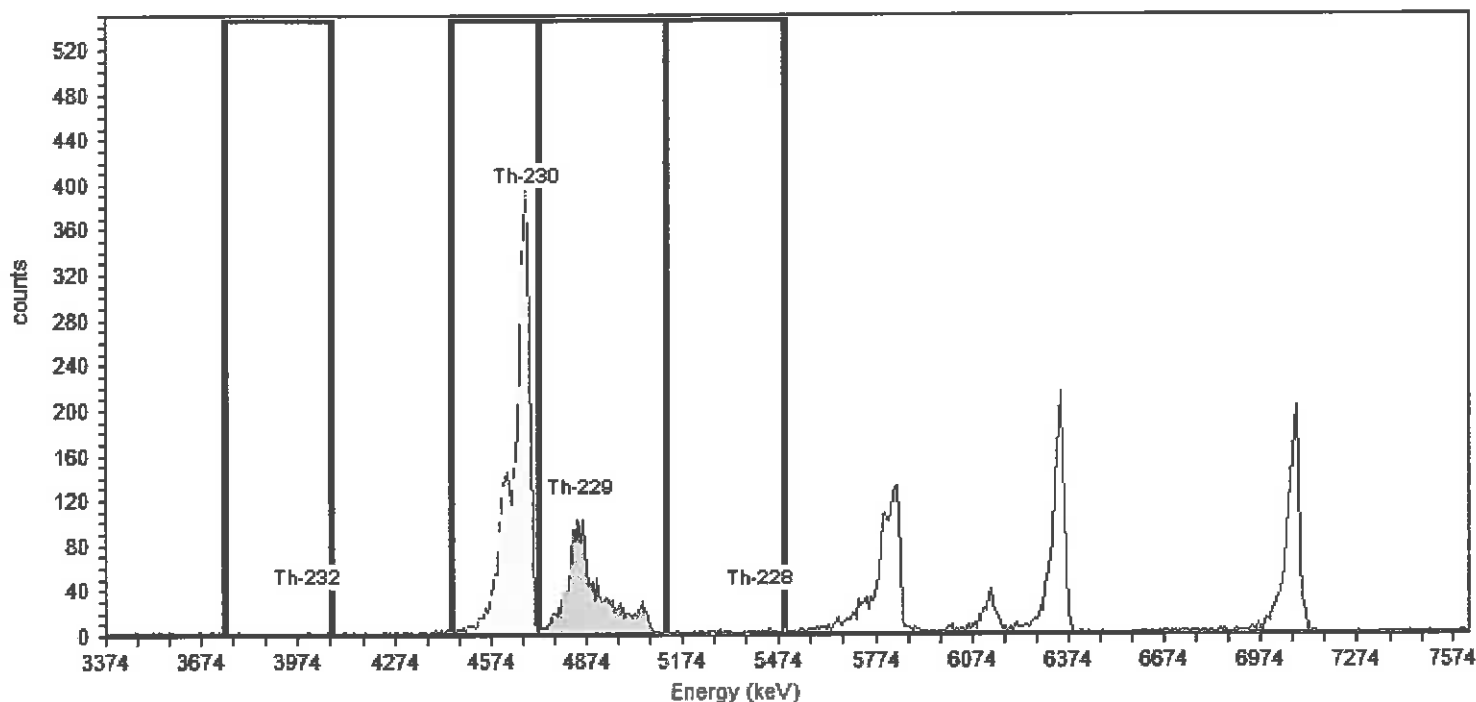
### Tracer

Tracer Nuclide: Th-230  
Tracer Recovery: 105.76%

Detector: AV171 SN: 50-112 Y2  
Acquisition Start Date: 8/1/2016 2:01:38PM  
Live Time: 960.00 min.  
Real Time: 960.00 min.  
Background Date: 7/22/2016 3:43:34PM  
Bkgd Info: Sample: ICB;AV171; Det: AV171; Spectrum #1; 7/22/2016 3:43:34 PM

### Acquisition

Energy Calibration: IC-9817;AV171-20151016  
Efficiency Calibration:IC-9817;AV171-20151016  
Calibration Date: 10/17/2015 2:36:53PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 24.59% +/- 0.30% TPU(2 sigma)



### General Analysis

Analysis Method: Interactive ROI Analysis  
Decay Correction:8/1/2016 2:00:42PM  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity Units
Th-229	4848.0	4,845.3	2.7	4724.2	5119.5	77.3	99.6	1565	4.0000	1561.00	6.276E+001 DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	16.4	99.8	40	19.0866	20.65	8.294E-001 DPM/mL
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	322.3	100.2	4	2.0000	1.85	7.397E-002 DPM/mL
Th-230	4688.0	4,687.5	0.5	4448.3	4724.2	31.3	99.7	3327	0.0000	3327.00	1.414E+002 DPM/mL



Sample Name: Verification 3  
Spectrum #1 Analysis #1  
:  
Sample Collection Date:  
Comment:

Type: Sample

### Sample

Sample Volume : 0.10 Sample Units: mL  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Batch Name: Th-229\_00021  
AnalysisResultsID: 172954  
Description:

### Batch

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Name: Th-230\_00029  
Tracer Activity: 44.56 DPM / mL x (Vol.) 0.30 mL = 13.37 DPM  
Tracer Ref. Date: 8/8/2013 11:19:32AM

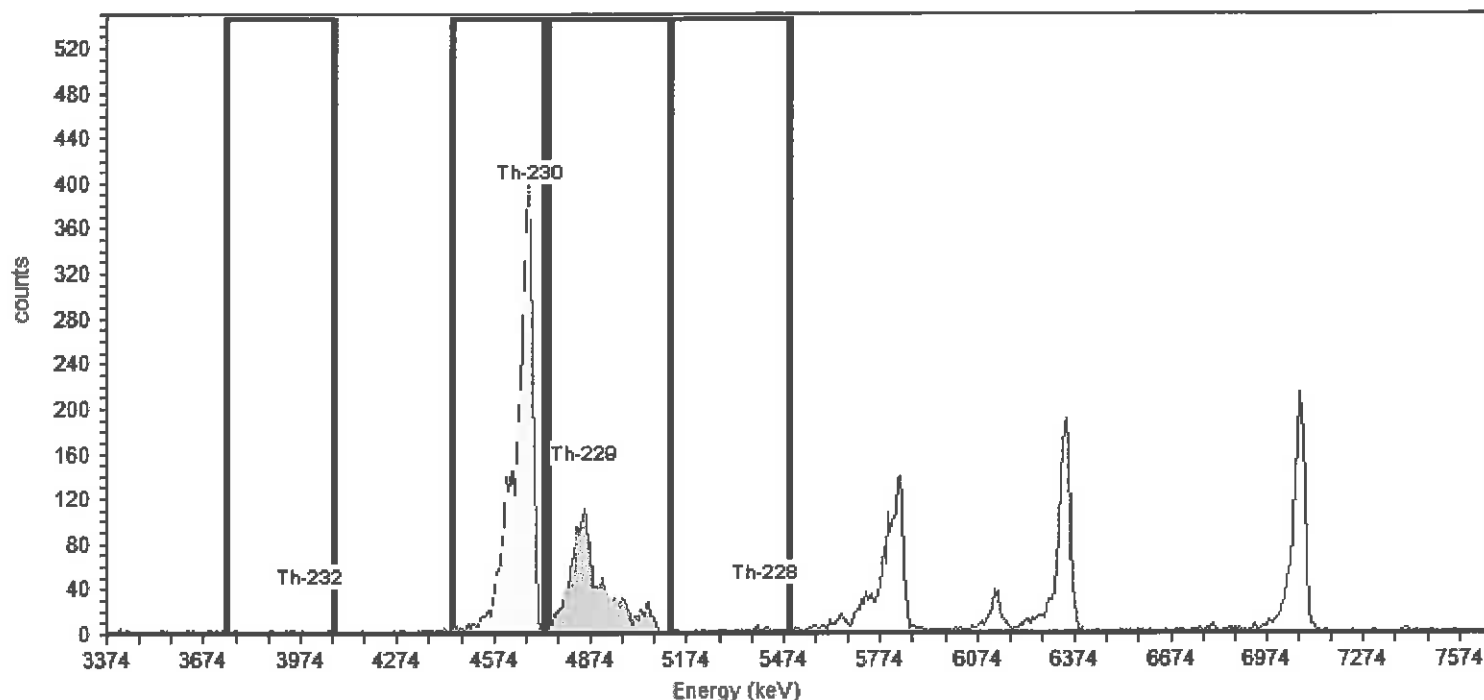
### Tracer

Tracer Nuclide: Th-230  
Tracer Recovery: 101.01%

Detector: AV173 SN: 50-112 Y4  
Acquisition Start Date: 8/1/2016 2:01:39PM  
Live Time: 960.00 min.  
Real Time: 960.00 min.  
Background Date: 7/25/2016 1:14:05PM  
Bkgd Info: Sample: ICB;AV173; Det: AV173; Spectrum #1; 7/25/2016 1:14:05 PM

### Acquisition

Energy Calibration: IC-9885;AV173-20151016a  
Efficiency Calibration:IC-9885;AV173-20151016a  
Calibration Date: 10/17/2015 2:37:06PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 25.59% +/- 0.38% TPU(2 sigma)



### General Analysis

Analysis Method: Interactive ROI Analysis  
Decay Correction:8/1/2016 2:00:42PM  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	10.3	100.2	8	2.0000	5.57	2.243E-001 DPM/mL
Th-230	4688.0	4,687.5	0.5	4440.8	4731.7	47.8	99.7	3309	2.0000	3307.00	1.350E+002 DPM/mL
Th-229	4848.0	4,845.3	2.7	4739.1	5119.5	76.7	99.6	1657	3.0000	1654.00	6.690E+001 DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	105.5	99.8	42	12.9361	28.98	1.171E+000 DPM/mL

Th-229 Tracer (New)  
 Aliquot Only by coppt.

Batch No.:

Balance ID:

Note: If a second beaker is not used, marked the 1st box and initial & date next to the N/A.  
 i.e. Mark the 1st box if a tracer is not added to the sample(s) then  
 initial and date next to the N/A

No.	Sample Number	Aliquot (g/mL)	Crucible ID	Dilution
1	VER 1		170	
2	13		171	
3	13		173	
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

<b>Tracer</b>	<input type="checkbox"/> N/A	Initials / Date
Isotope:	Th-230	
Std Sol'n No.:	Th-230-	
Vol (mL):	0.3	
Ref Activity (dpm/mL):		
Act Ref Date:		

Samples Spiked and Traced By:  
 SB 7/25/16  
 Initials / Date

Verification Signature & Date:  
 lm 7-25-16  
 Initials / Date

## LCS Standard

☐ N/A

Initials / Date

Isotope: Th-229  
 Std Sol'n ID.: Th-229-00021  
 Vol (mL): 0.1  
 Ref Activity (dpm/mL): 67.229  
 Act Ref Date: 08-06-14

SOP's applied in preparing these samples, Mark box to left for all that apply:

<input type="checkbox"/> ST-RC-0003 Rev.	<input type="checkbox"/> ST-RC-0040 Rev.	<input type="checkbox"/> ST-RC-0110 Rev.
<input type="checkbox"/> ST-RC-0004 Rev.	<input type="checkbox"/> ST-RC-0041 Rev.	<input type="checkbox"/> ST-RC-0120 Rev.
<input type="checkbox"/> ST-RC-0014 Rev.	<input type="checkbox"/> ST-RC-0050 Rev.	<input type="checkbox"/> ST-RC-0232 Rev.
<input type="checkbox"/> ST-RC-0020 Rev.	<input type="checkbox"/> ST-RC-0090 Rev.	<input type="checkbox"/> ST-RC-0238 Rev.
<input type="checkbox"/> ST-RC-0021 Rev.	<input checked="" type="checkbox"/> ST-RC-0100 Rev.	<input type="checkbox"/> ST-RC-0240 Rev.
		<input type="checkbox"/> ST-RC-0241 Rev.
		<input checked="" type="checkbox"/> ST-RC-0242 Rev.
		<input type="checkbox"/> ST-RC-5016 Rev.
		<input type="checkbox"/>
		<input type="checkbox"/>

## Isotope(s)

<input type="checkbox"/> αβ	<input type="checkbox"/> Iso Pu	<input type="checkbox"/> Tc-99	<input type="checkbox"/> Iso Cm
<input type="checkbox"/> Iso Am	<input type="checkbox"/> Ra	<input checked="" type="checkbox"/> Iso Th	<input type="checkbox"/> Pu-241
<input type="checkbox"/> KPA	<input type="checkbox"/> Sr	<input type="checkbox"/> Iso U	<input type="checkbox"/> Th-229
<input type="checkbox"/> Np	<input type="checkbox"/> TAR	<input type="checkbox"/> C-14	<input type="checkbox"/> Cl-36

<b>Count Time</b>	<b>Matrix</b>
Long Count <input checked="" type="checkbox"/>	Soil <input type="checkbox"/>
Short Count <input type="checkbox"/>	H <sub>2</sub> O <input type="checkbox"/>

Prepared By:

Reviewed by:

Date:

Date:

Page 1

Reagent

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**Th-230\_00019**

# TestAmerica St. Louis

## Standards Preparation Logbook Record

Aug-13-2013

Logbook: \\Qstlmo01\Stdslg\RAD\_STD.std

RAD13-0028, Th-230 Ampoule

Analyst: marrss

Vendor: Analytics

Lot No.: 92776

Solvent: None

Date Prep./Opened: 08-13-2013

Date Expires(1): 08-08-2063 (50 Years)

Date Expires(2): 08-08-2063 (50 Years)

Activity: 3,728 E+03 Bq, Ref date: 08/08/2013, Solution mass: 5.09261g, Source ID: 92776

Component	Initial Conc (dpm/g)	Final Conc (dpm/g)
Th-230	43,922	43,922

TH-230-00019  
#181198

RAD13-0029, Th-230 Parent

Analyst: marrss

Solvent: ~~None~~ 1M HNO3 SUB 8/13/13

Volume (ml): 100.00

Date Prep./Opened: 08-13-2013

Date Expires(1): 08-08-2063 (50 Years)

Date Expires(2): 08-08-2063 (50 Years)

Parent Std No.: RAD13-0028, Th-230 Ampoule

Aliquot Amount (g): 5.0731

Parent Date Expires(1): 08-08-2063 Parent Date Expires(2): 08-08-2063

Component	Initial Conc (dpm/g)	Final Conc (dpm/mL)
Th-230	43,922	2,228.2

Reviewed By: \_\_\_\_\_

SUB

Page 1 of 1

TH-230 Parent



**Reagent ID:** Th-230\_00019

Description:	Th-230 Parent	Expiration Date:	08/08/2063
No. of Bottles:	1	Laboratory:	TestAmerica St. Louis
Storage Location:	RAD Actinide STDs	Prepared By:	Bernsen, Sarah C
Reagent Volume:	100.000 mL	Solvent:	1M HNO3
Creation Date:	08/13/2013	Solvent Lot:	n/a
Container(s):	181198		
Comment:			

### Reagent Analyte Information

Analyte	Source ID	Source Expiration Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
Th-230	Th-230_00018	08/08/2063	43922.46	dpm/g	2228.23072	dpm/mL

### Source Reagents

Reagent	Description	Type	Expiration	Vendor	Vendor Lot #	Vendor Cat Lot #	Volume Used	Volume Units
Th-230_00018	Th-230 Ampoule	ASTD	08/08/63	Eckert & Ziegler	92776		5.07310	mL



# Eckert & Ziegler

## Analytics

1380 Seaboard Industrial Blvd.  
Atlanta, Georgia 30318  
Tel 404•352•8677  
Fax 404•352•2837  
www.analyticsinc.com

### CERTIFICATE OF CALIBRATION

#### Standard Radionuclide Source

92776

Th-230 5 mL Liquid in Flame Sealed Vial

**Customer:** TestAmerica  
**P.O. No.:** 2532686, Item 1      **Product Code:** 8230-5FSA-4kBq

This standard radionuclide source was prepared gravimetrically from a master solution, calibrated by Eckert & Ziegler Analytics. The master solution was calibrated by liquid scintillation counting. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Isotope	Half-Life, Days	Activity (Bq)	Uncertainty*, %			Reference Date (12:00 PM EST)
			$u_A$	$u_B$	U	
Th-230	2.753E+07	3.728E+03	0.1	0.9	1.8	08/08/2013

\***Uncertainty:** U - Relative expanded uncertainty,  $k = 2$ . See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

#### Comments:

Impurities:  $\alpha$ -impurities 0.04%;  $\gamma$ -impurities (other than decay products) < 0.1%.  
5.09261 g 0.5M HNO<sub>3</sub> solution. Carrier free.

Source Prepared by:

R. Ormsby, Radiochemist

QA Approved:

J.D. McCorvey, Counting Room Manager

Date: 6 AUG-13

RAD13-0029  
Th-230 Parent  
marrss  
None  
Prep/Opened: 8/13/2013  
Exp(1): 8/8/2063  
Exp(2): 8/8/2063



181198  
ID: Th-230\_00019  
Exp: 08/08/63 Prip: SH Ctl. 08/13/13  
Th-230 Parent



Reagent

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**Th-230\_00029**



**Reagent ID: Th-230\_00029**

Description: Th-230 Spike- Actinides  
No. of Bottles: 1  
Storage Location: RAD Actinide STDs  
Reagent Volume: 200.000 mL  
Creation Date: 09/22/2014  
Open Date:  
Container(s): 759598  
Comment: re-certified from Th-230\_00025

Expiration Date: 10/06/2016  
Laboratory: TestAmerica St. Louis  
Prepared By: Bernsen, Sarah C  
Solvent: 1M HNO3  
Solvent Lot: 0

**Reagent Analyte Information**

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
Gross Alpha	Th-230_00019	08/08/2063	2228.23100	dpm/mL	44.56461	dpm/mL
Th-230	Th-230_00019	08/08/2063	2228.23100	dpm/mL	44.56461	dpm/mL

**Source Reagents**

Reagent	Description	Type	Expiration	Vendor	Vendor Lot #	Vendor Cat Lot #	Volume Used	Volume Units
Th-230_00019	Th-230 Parent		08/08/63				4.00000	mL



**St. Louis Radiological Standard Reverification Form**

Standard ID Number: Th-230\_00025  
True Value = 44.5646 DPM/L or g  
Date Analyzed: 10/6/2015

Radionuclide: Th-230

	Replicates	
#1	<u>45.26</u>	DPM/L or g
#2	<u>44.36</u>	DPM/L or g
#3	<u>46.993</u>	DPM/L or g

Mean = 45.53767

1 sigma = 1.338281

1.96 sigma = 2.623031

True Value minus 5% = 42.33637

(True Value - 5%)

True Value plus 5% = 46.79283

(True Value + 5%)

**Accuracy:**

Mean value within 5% of Certified (True) Value? Yes (Acceptance Criteria)

**Precision:**

1.96 sigma Value Within 10% of Mean Value? Yes (Acceptance Criteria)

**Standard Reverification Acceptable?**

Yes

Note: Criteria for reverification of radiological standards is taken from the DOE QSAS and LANL Statements of Work

Reviewed By/Date: RTM 10/11/2015

SOP Reference: STL-QA-0002, Current Revision

Th-230 Spike Ver.  
Aliquot Only

Batch No. : \_\_\_\_\_

Balance ID : \_\_\_\_\_

Note: If a section below is not used, marked the N/A box and initial & date next to the N/A  
i.e. Mark the N/A box if a tracer is not added to the sample(s) then  
initial and date next to the N/A

No	Sample Number	Aliquot (g / mL)	Crucible ID	Dilution
1	Ver. 1	0.3	115	
2	12	1	116	
3	13		117	
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				

Samples Spiked and Traced By:  
Initials: gub / Date: 9/26/15

Verification Signature & Date:  
Initials: MJS / Date: 9-26-15

Tracer	<input type="checkbox"/> N/A
Isotope:	<u>Th-229</u>
Std Sol'n No.:	<u>Th-229.00020</u>
Vol (mL):	<u>0.1</u>
Ref Activity (dpm/mL):	<u>67.229</u>
Act Ref Date:	<u>08-Dec-14</u>

LCS Standard	<input type="checkbox"/> N/A
Isotope:	<u>Th-230</u>
Std Sol'n ID.:	<u>Th-230.00025</u>
Vol (mL):	<u>0.3</u>
Ref Activity (dpm/mL):	<u>44.5646</u>
Act Ref Date:	<u>08-08-13</u>

SOP's applied in preparing these samples. Mark box to left for all that apply:

<input type="checkbox"/> ST-RC-0003 Rev.	<input type="checkbox"/> ST-RC-0040 Rev.	<input type="checkbox"/> ST-RC-0110 Rev.
<input type="checkbox"/> ST-RC-0004 Rev.	<input type="checkbox"/> ST-RC-0041 Rev.	<input type="checkbox"/> ST-RC-0120 Rev.
<input type="checkbox"/> ST-RC-0014 Rev.	<input type="checkbox"/> ST-RC-0050 Rev.	<input type="checkbox"/> ST-RC-0232 Rev.
<input type="checkbox"/> ST-RC-0020 Rev.	<input type="checkbox"/> ST-RC-0090 Rev.	<input type="checkbox"/> ST-RC-0238 Rev.
<input type="checkbox"/> ST-RC-0021 Rev.	<input type="checkbox"/> ST-RC-0100 Rev.	<input type="checkbox"/> ST-RC-0240 Rev.
		<input type="checkbox"/> ST-RC-0241 Rev.
		<input type="checkbox"/> ST-RC-0242 Rev.
		<input type="checkbox"/> ST-RC-5016 Rev.
		<input type="checkbox"/>
		<input type="checkbox"/>

Count Time	Matrix
Long Count <input type="checkbox"/>	Soil <input type="checkbox"/>
Short Count <input type="checkbox"/>	H <sub>2</sub> O <input type="checkbox"/>

Isotope(s)			
<input type="checkbox"/> αβ	<input type="checkbox"/> Iso Pu	<input type="checkbox"/> Tc-99	<input type="checkbox"/> Iso Cm
<input type="checkbox"/> Iso Am	<input type="checkbox"/> Ra	<input type="checkbox"/> Iso Th	<input type="checkbox"/> Pu-241
<input type="checkbox"/> KPA	<input type="checkbox"/> Sr	<input type="checkbox"/> Iso U	<input type="checkbox"/> Th-229
<input type="checkbox"/> Np	<input type="checkbox"/> TAR	<input type="checkbox"/> C-14	<input type="checkbox"/> Cl-36

Prepared By : \_\_\_\_\_

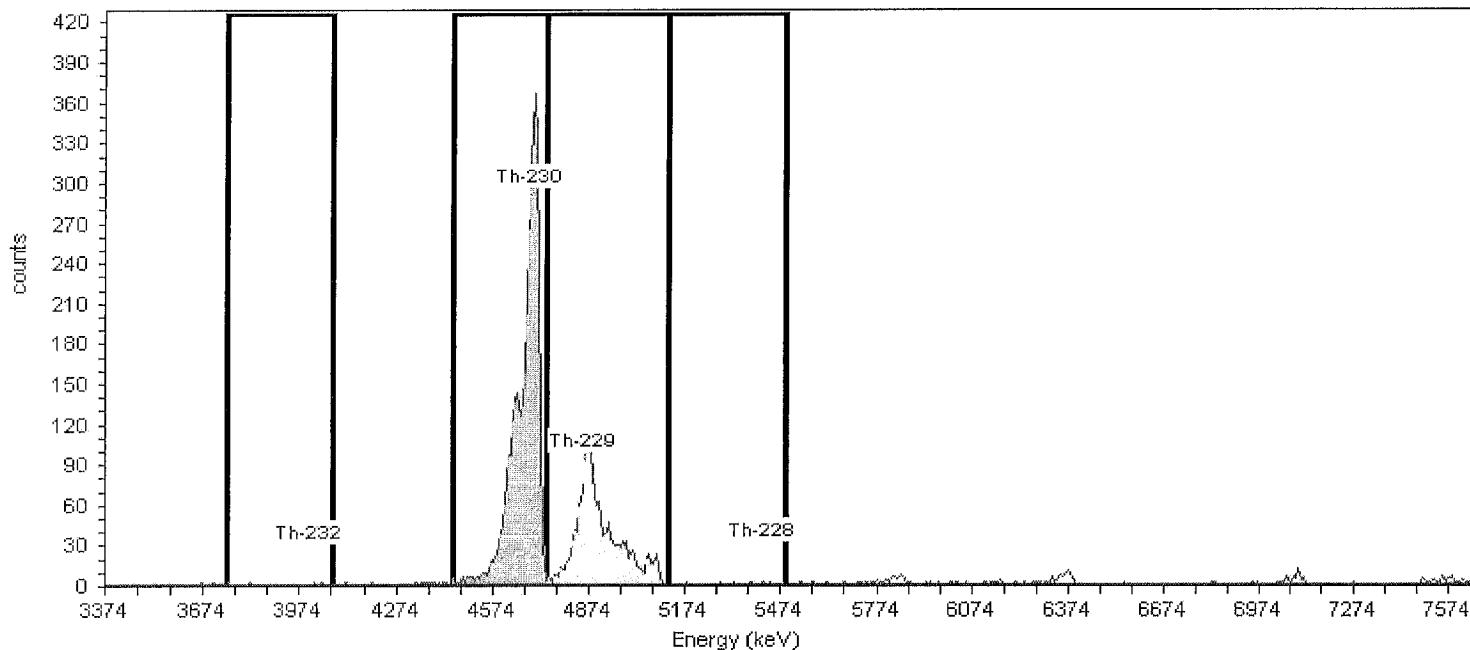
Date : \_\_\_\_\_

Reviewed by: \_\_\_\_\_

Date: \_\_\_\_\_

Page 1

<b>Sample</b>	
Sample Name: Verification 1	Spectrum #1 Analysis #1
SampleType: Sample	Sample Volume : 0.3000mL
:	Aliquot: N/A Aliquot Fraction: N/A
<b>Batch</b>	
Batch Name: Th-230_00025	Analyst: 60040
AnalysisID: 659246	
<b>Tracer</b>	
Tracer Name: Th-229_00020	Tracer Nuclide: Th-229
Tracer Activity: 67.23 DPM/mL x (Vol.)0.10 mL = 6.72 DPM	Tracer Recovery: 96.14%
Tracer Ref. Date: 8/6/2014 2:35:52PM	
<b>Acquisition</b>	
Detector: AV115	Calibration Name: IC-9817;AV115-20150603
Serial Number: 49-037E4	Calibration Date: 6/4/2015 1:31:22AM
Acquisition Start Date: 10/6/2015 11:28:29AM	Gain = 7.4575 keV / Ch
Live Time: 960.00 min.	Energy Cal: Offset = 3,366.95 keV
Real Time: 960.01 min.	Quadratic = 0.0000 keV / Ch <sup>2</sup>
Background Date: 10/3/2015 4:19:50PM	Efficiency: 25.44% +/- 0.31% TPU(2 sigma)
Background Info: Sample: ICB;AV115; Det: AV115; Spectrum #1; Oct-03-2015 16:19	



**General Analysis**

Analysis Method: Absolute ROI Analysis, Set Name = Th2007\_ROI  
Decay Correction: 10/6/2015 11:25:25AM  
MDA Constants:  $K\alpha = 1.65$ ,  $K\beta = 1.65$

Nuclide Library: Thorium  
MDA Source: Background

**Nuclide Summary (ROI)**

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	10.1	100.2	3	1.5414	1.88	0.027	DPM/mL
Th-230	4688.0	4,687.5	0.5	4448.3	4739.1	25.1	99.7	3180	1.0000	3179.00	45.260	DPM/mL
Th-229	4848.0	4,845.3	2.7	4739.1	5119.5	74.1	99.6	1575	2.0000	1573.00	21.544	DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	.3	99.8	7	5.0000	2.00	0.028	DPM/mL

Sample Name: Verification 2

SampleType: Sample

Sample Collection Date:

Batch Name: Th-230\_00025

AnalysisID: 659247

Tracer Name: Th-229\_00020

Tracer Activity: 67.23 DPM/mL x (Vol.)0.10 mL = 6.72 DPM

Tracer Ref. Date: 8/6/2014 2:35:52PM

Detector: AV116

Serial Number: 49-034G1

Acquisition Start Date: 10/6/2015 11:28:31AM

Live Time: 960.00 min.

Real Time: 960.01 min.

Background Date: 10/2/2015 2:19:00PM

Background Info: Sample: ICB;AV116; Det: AV116; Spectrum #1;

Oct-02-2015 14:19

### Sample

Spectrum #1 Analysis #1

Sample Volume : 0.3000mL

Aliquot: N/A Aliquot Fraction: N/A

### Batch

Analyst: 60040

### Tracer

Tracer Nuclide: Th-229

Tracer Recovery: 104.15%

### Acquisition

Calibration Name: IC-9884;AV116-20150603

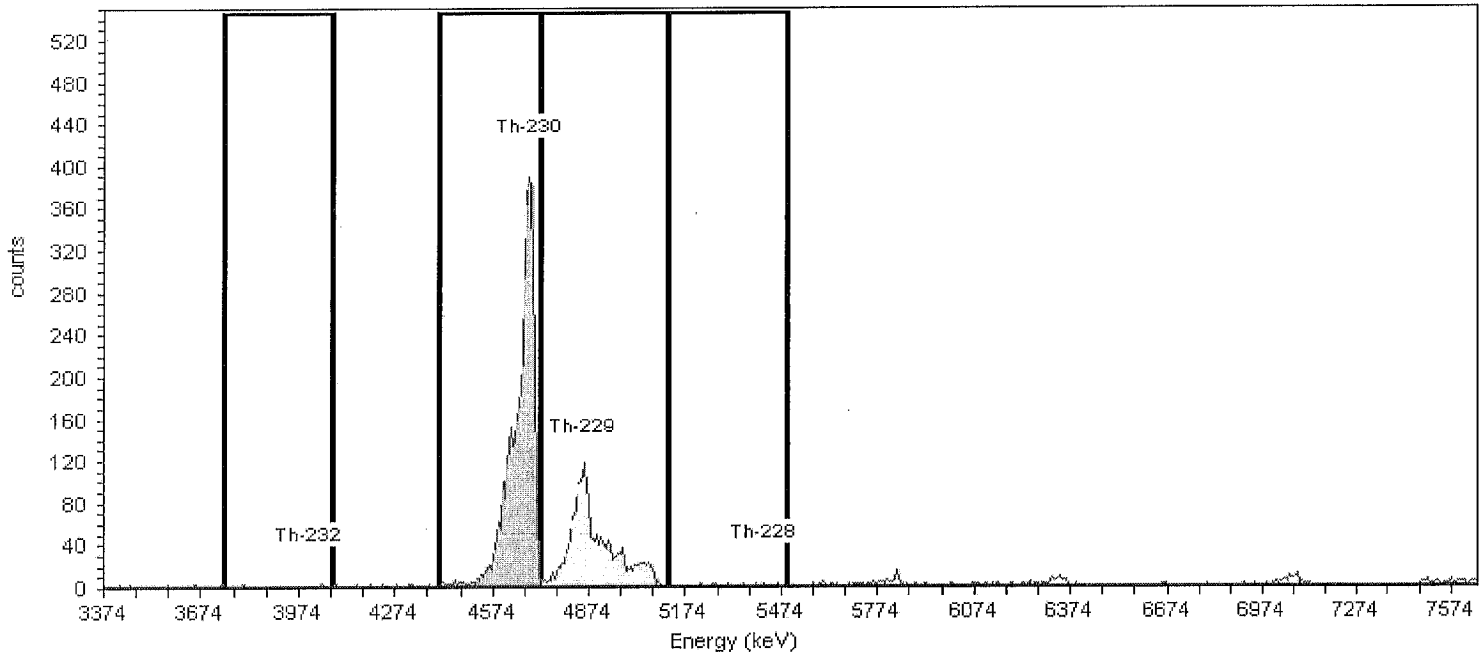
Calibration Date: 6/4/2015 1:31:31AM

Gain = 7.4575 keV / Ch

Energy Cal: Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency: 24.86% +/- 0.36% TPU(2 sigma)



### General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Th2007\_ROI

Decay Correction: 10/6/2015 11:25:25AM

MDA Constants:  $K\alpha = 1.65$ ,  $K\beta = 1.65$

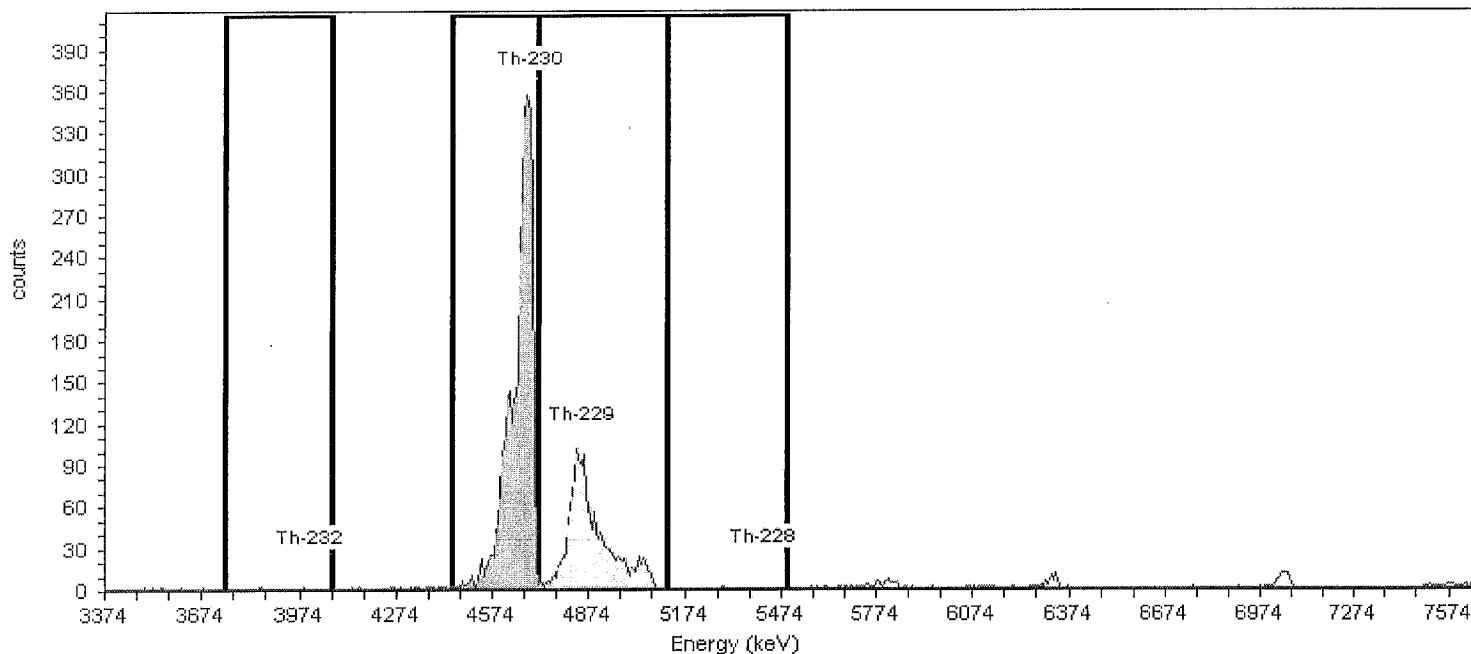
Nuclide Library: Thorium

MDA Source: Background

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	15.9	100.2	4	0.0000	3.57	0.048	DPM/mL
Th-230	4688.0	4,687.5	0.5	4403.6	4724.2	23.1	99.7	3298	0.0000	3298.00	44.360	DPM/mL
Th-229	4848.0	4,845.3	2.7	4724.2	5119.5	71.8	99.6	1668	3.0000	1665.00	23.340	DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	10.0	99.8	8	3.0000	5.00	0.067	DPM/mL

<b>Sample</b>	
Sample Name: Verification 3	Spectrum #1 Analysis #1
SampleType: Sample	Sample Volume : 0.3000mL
:	Aliquot: N/A Aliquot Fraction: N/A
<b>Batch</b>	
Sample Collection Date:	Analyst: 60040
<b>Tracer</b>	
Batch Name: Th-230_00025	Tracer Nuclide: Th-229
AnalysisID: 658658	Tracer Recovery: 94.67%
<b>Acquisition</b>	
Tracer Name: Th-229_00020	Calibration Name: IC-9885;AV117-20150603
Tracer Activity: 67.23 DPM/mL x (Vol.)0.10 mL = 6.72 DPM	Calibration Date: 6/4/2015 1:31:41AM
Tracer Ref. Date: 8/6/2014 2:35:52PM	Gain = 7.4575 keV / Ch
	Offset = 3,366.95 keV
	Energy Cal: Quadratic = 0.0000 keV / Ch <sup>2</sup>
	Efficiency: 24.89% +/- 0.37% TPU(2 sigma)
Detector: AV117	
Serial Number: 49-037X4	
Acquisition Start Date: 10/6/2015 11:28:32AM	
Live Time: 960.00 min.	
Real Time: 960.01 min.	
Background Date: 10/2/2015 2:19:03PM	
Background Info: Sample: ICB;AV117; Det: AV117; Spectrum #1;	
Oct-02-2015 14:19	



<b>General Analysis</b>	
Analysis Method: Absolute ROI Analysis, Set Name = Th2007_ROI	Nuclide Library: Thorium
Decay Correction: 10/6/2015 11:25:25AM	MDA Source: Background
MDA Constants: $K\alpha = 1.65$ , $K\beta = 1.65$	

Nuclide Summary (ROI)												
Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	44.5	100.2	2	3.0000	-1.00	-0.015	DPM/mL
Th-230	4688.0	4,687.5	0.5	4446.0	4717.0	32.7	99.7	3179	0.0310	3179.00	46.993	DPM/mL
Th-229	4848.0	4,845.3	2.7	4717.0	5119.0	81.5	99.6	1515	0.0310	1515.00	21.215	DPM/mL
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	44.5	99.8	1	2.0000	-1.00	-0.015	DPM/mL

# Sequential Thorium, Plutonium and Uranium

Batch: \_\_\_\_\_ via TEVA/UTEVA ST-RC-0242

All rinses should flow at 1 mL/minute (only 3M HNO<sub>3</sub> may be done at 3 mL/minute)

\*only necessary when analyzing for Pu

TEVA lot: TESR1517  
UTEVA lot: \_\_\_\_\_

11.5.2 Stack TEVA on top of UTEVA cartridge

11.5.3 5mL 3M HNO<sub>3</sub>

COMPLETED ☐

\*11.5.4 To samples, add 1mL ascorbic acid solution  
Place in hot water bath for 5 minutes

COMPLETED ☐

\*11.5.5 To samples, add 1mL NaNO<sub>2</sub> solution  
Place in hot water bath for 5 minutes

COMPLETED ☐

\*11.5.6 Cold water bath until samples reach room temperature

11.5.7 Load sample

11.5.8 20mL 3M HNO<sub>3</sub>

COMPLETED ☒

11.5.9 Split cartridges  
TEVA                      UTEVA

11.5.10-11.5.11 Elute Th into clean tube using 20mL 9M HCl

COMPLETED ☒

11.5.12 5mL 6M HCl into Th tube

COMPLETED ☐

11.5.16 Elute Pu into clean tube with 20mL 1M HCl + 0.250 mL TiCl<sub>3</sub>

COMPLETED ☐

COMPLETED ☐

11.5.19 5mL 3M HNO<sub>3</sub>

COMPLETED ☐

11.5.20 5mL 9M HCl

COMPLETED ☐

11.5.21 20mL 5M HCl / 0.05M oxalic

COMPLETED ☐

11.5.22-11.5.23 Elute U into clean tube with 15mL 1M HCl

COMPLETED ☐

Th  
Ver

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Form: RAD-0063, Revised 09/18/13



**Reagent ID: Th-230\_00025**

Description: Th-230 Spike- Actinides  
No. of Bottles: 1  
Storage Location: RAD Actinide STDs  
Reagent Volume: 200.000 mL  
Creation Date: 09/22/2014  
Open Date:  
Container(s): 455603  
Comment:

Expiration Date: 10/14/2015  
Laboratory: TestAmerica St. Louis  
Prepared By: Bernsen, Sarah C  
Solvent: 1M HNO3  
Solvent Lot: 0

### Reagent Analyte Information

Analyte	Source ID	Source Exp. Date	Source Conc.	Source Conc. Units	Final Conc.	Final Conc. Units
Gross Alpha	Th-230_00019	08/08/2063	2228.23100	dpm/mL	44.56461	dpm/mL
Th-230	Th-230_00019	08/08/2063	2228.23100	dpm/mL	44.56461	dpm/mL

### Source Reagents

Reagent	Description	Type	Expiration	Vendor	Vendor Lot #	Vendor Cat Lot #	Volume Used	Volume Units
Th-230_00019	Th-230 Parent		08/08/63				4.00000	mL

# **ALPHA SPECTROSCOPY**



# Method A-01-R Th

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Isotopic Thorium (Alpha  
Spectrometry) by Method A-01-R

# Prep Batch: 266788

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Preparation, Extraction  
Chromatography Resin Actinide  
Separation

# Alpha Spectroscopy Analysis Detail Report

## Prep Batch: 266788

Lab ID: MB 160-266788/1-A  
 Client ID:  
 Sigma: 2

Analyzed: 09/07/16 14:44  
 Detector: AV165  
 Dil Fac: 1

Decay Corrected: No  
 Yield Truncated: No  
 Ts: 240

Analyte	MB Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	0.2572	0.133	0.135		pCi/Sample	1.00	0.107	268472	
Thorium-232	0.01193	0.0328	0.0328	U	pCi/Sample	1.00	0.0770	268472	
Tracer	MB Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	11.02	0.801	1.22		pCi/Sample	0.0900	12.1	91.0	30 - 110

Lab ID: LCS 160-266788/2-A  
 Client ID:  
 Sigma: 2

Analyzed: 09/08/16 16:01  
 Detector: AV154  
 Dil Fac: 1

Decay Corrected: No  
 Yield Truncated: No  
 Ts: 240

Analyte	LCS Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	8.995	0.765	1.08		pCi/Sample	1.00	0.0881	268654	
Tracer	LCS Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	10.99	0.806	1.23		pCi/Sample	0.0491	12.1	90.8	30 - 110

Lab ID: LCSD 160-266788/3-A  
 Client ID:  
 Sigma: 2

Analyzed: 09/08/16 16:01  
 Detector: AV158  
 Dil Fac: 1

Decay Corrected: No  
 Yield Truncated: No  
 Ts: 240

Analyte	LCSD Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	8.750	0.762	1.06		pCi/Sample	1.00	0.0929	268655	
Tracer	LCSD Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	11.54	0.855	1.29		pCi/Sample	0.112	12.1	95.3	30 - 110

Lab ID: 160-18555-1  
 Client ID: WR111-Composite Air Sample-BZ  
 Sigma: 2

Analyzed: 09/07/16 14:44  
 Detector: AV168  
 Dil Fac: 1

Decay Corrected: No  
 Yield Truncated: No  
 Ts: 240

Analyte	Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	0.563	0.192	0.198		pCi/Sample	1.00	0.0784	268475	
Thorium-232	0.155	0.102	0.103		pCi/Sample	1.00	0.0842	268475	
Tracer	Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	11.1	0.813	1.24		pCi/Sample	0.0920	12.1	91.7	30 - 110

# Alpha Spectroscopy Analysis Detail Report

## Prep Batch: 266788

Lab ID: 160-18555-2  
 Client ID: WR111-Composite Air Sample-Low Vol  
 Sigma: 2

Analyzed: 09/07/16 14:44  
 Detector: AV169  
 Dil Fac: 1

Decay Corrected: No  
 Yield Truncated: No  
 Ts: 240

Analyte	Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	1.73	0.338	0.367		pCi/Sample	1.00	0.109	268476	
Thorium-232	0.683	0.213	0.221		pCi/Sample	1.00	0.105	268476	
Tracer	Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	11.4	0.838	1.27		pCi/Sample	0.0744	12.1	94.3	30 - 110

Lab ID: 160-18555-3  
 Client ID: WR111-Composite Air Sample-High Vol  
 Sigma: 2

Analyzed: 09/09/16 10:34  
 Detector: AV147  
 Dil Fac: 1

Decay Corrected: No  
 Yield Truncated: No  
 Ts: 240

Analyte	Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	11.5	0.895	1.32		pCi/Sample	1.00	0.0977	268746	
Thorium-232	4.25	0.543	0.650		pCi/Sample	1.00	0.0840	268746	
Tracer	Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	9.98	0.760	1.13		pCi/Sample	0.146	12.1	82.4	30 - 110

### Quality Control Summary

Method Blank ID:	Analyte	Parent Result	Spike Added	MB Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
MB 160-266788/1-A	Thorium-230			0.2572		pCi/Sample							3.814408
MB 160-266788/1-A	Thorium-232			0.01193	U	pCi/Sample							65 .7272673 6
Lab Control Sample ID:	Analyte	Parent Result	Spike Added	LCS Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
LCS 160-266788/2-A	Thorium-230		8.03	8.995		pCi/Sample	112	81 - 118	3				1.339756 3475
Lab Control Sample Duplicate	Analyte	Parent Result	Spike Added	LCSD Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
LCSD 160-266788/3-A	Thorium-230		8.03	8.750		pCi/Sample	109	81 - 118	3	0.11	0.33	1	1.002475 0877

Glossary:

Ts = Count Duration, Sample

## ALPHA SPECTROSCOPY BATCH WORKSHEET

Lab Name: TestAmerica St. Louis Job No.: 160-18555-1

SDG No.: \_\_\_\_\_

Batch Number: 266788 Batch Start Date: 08/26/16 13:26 Batch Analyst: Bernsen, Sarah CBatch Method: ExtChrom Batch End Date: 08/31/16 11:16

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	Th-229 00021	Th-230 00029			
MB 160-266788/1		ExtChrom, A-01-R		0.5 Sample	0.2 mL				
LCS 160-266788/2		ExtChrom, A-01-R		0.5 Sample	0.2 mL	0.2 mL			
LCSD 160-266788/3		ExtChrom, A-01-R		0.5 Sample	0.2 mL	0.2 mL			
160-18555-A-1	WR111-Composite Air Sample-BZ	ExtChrom, A-01-R	T	0.5 Sample	0.2 mL				
160-18555-A-2	WR111-Composite Air Sample-Low Vol	ExtChrom, A-01-R	T	0.5 Sample	0.2 mL				
160-18555-A-3	WR111-Composite Air Sample-High Vol	ExtChrom, A-01-R	T	0.5 Sample	0.2 mL				

Batch Notes	
Analyst ID - Column	nmn per scb
Column Date	8/30/16
Analyst ID - CoPrecipitation	scb
CoPrecipitation Date	8/31/16
Pipette ID	rad104
Analyst ID - Reagent Drop Witness	scb
Analyst ID - Reagent Drop	ats per scb
SOP Number	ST-RC-0004, ST-RC-0100, ST-RC-0242

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

Sample Name: MB 160-266788/1-A Type: Blank  
Spectrum #1 Analysis #1  
: MB 160-266788/1-A  
Sample Collection Date: 8/31/2016 11:21:00AM  
Comment:

## Sample

Sample Weight : 0.50 Sample Units: g  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Batch Name: 266788  
AnalysisResultsID: 176211  
Description:

## Batch

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Name: Th-229\_00021  
Tracer Activity: 67.23 DPM / mL x (Vol.) 0.20 mL = 13.45 DPM  
Tracer Ref. Date: 8/16/2014 2:33:14PM

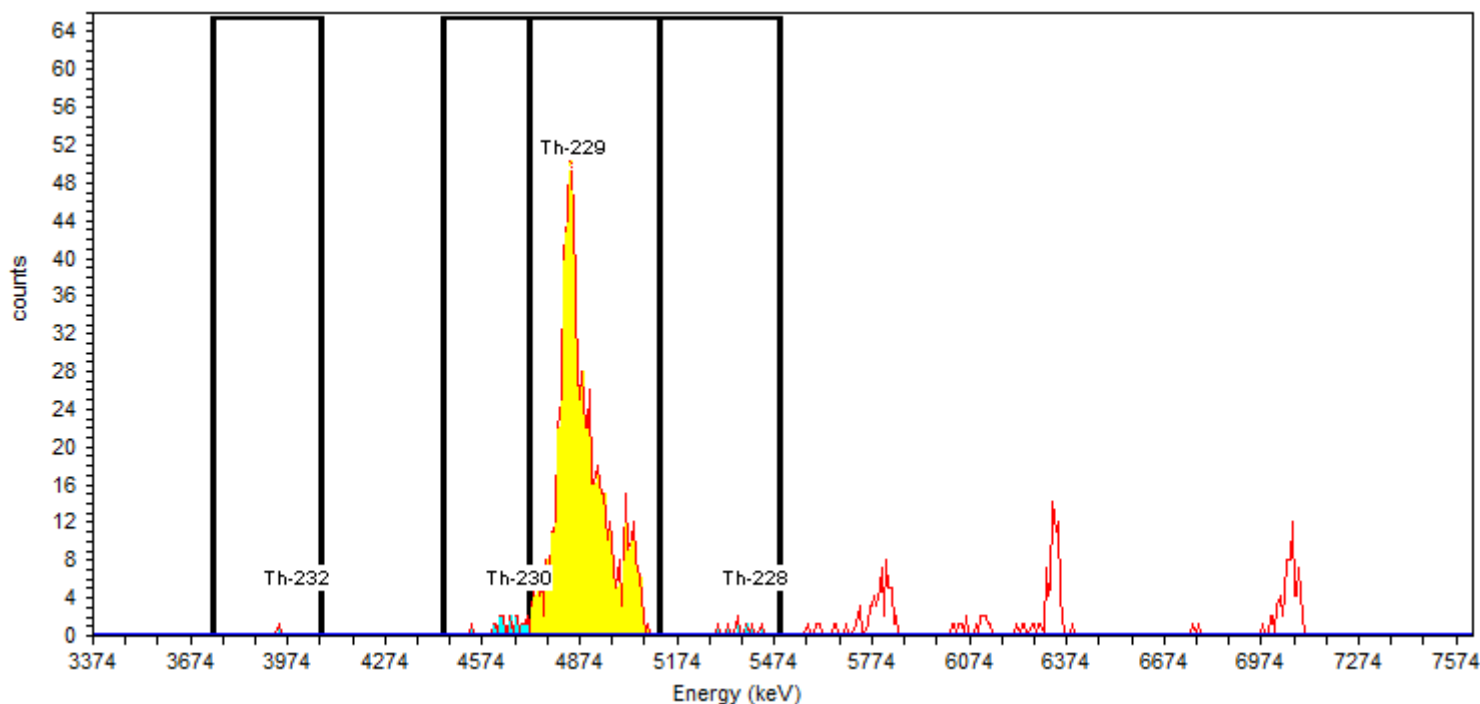
## Tracer

Tracer Nuclide: Th-229  
Tracer Recovery: 90.98%

Detector: AV165 SN: 50-112F7  
Acquisition Start Date: 9/7/2016 2:44:13PM  
Live Time: 240.00 min.  
Real Time: 240.00 min.  
Background Date: 9/1/2016 3:17:12PM  
Bkgd Info: Sample: ICB;AV165; Det: AV165; Spectrum #1; 9/1/2016 3:17:12 PM

## Acquisition

Energy Calibration: IC-8877;AV165-20151016  
Efficiency Calibration:IC-8877;AV165-20151016  
Calibration Date: 10/17/2015 2:36:40PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 25.89% +/- 0.31% TPU(2 sigma)



## General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Th2007\_ROI  
Decay Correction:9/7/2016 2:39:45PM  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

## Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	44.5	100.2	1	0.2500	0.75	1.193E-002	pCi/g
Th-230	4688.0	4,687.5	0.5	4446.0	4717.0	15.5	99.7	17	1.0000	16.09	2.572E-001	pCi/g
Th-229	4848.0	4,845.3	2.7	4717.0	5119.0	80.0	99.6	758	0.7500	757.34	1.102E+001	pCi/g
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	89.7	99.8	7	3.5000	3.50	5.591E-002	pCi/g

Sample Name: LCS 160-266788/2-A Type: Control  
Spectrum #1 Analysis #1  
: LCS 160-266788/2-A  
Sample Collection Date: 8/31/2016 11:21:00AM  
Comment:

## Sample

Sample Weight : 0.50 Sample Units: g  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Batch Name: 266788  
AnalysisResultsID: 176417  
Description:

## Batch

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Name: Th-229\_00021  
Tracer Activity: 67.23 DPM / mL x (Vol.) 0.20 mL = 13.45 DPM  
Tracer Ref. Date: 8/16/2014 2:33:14PM

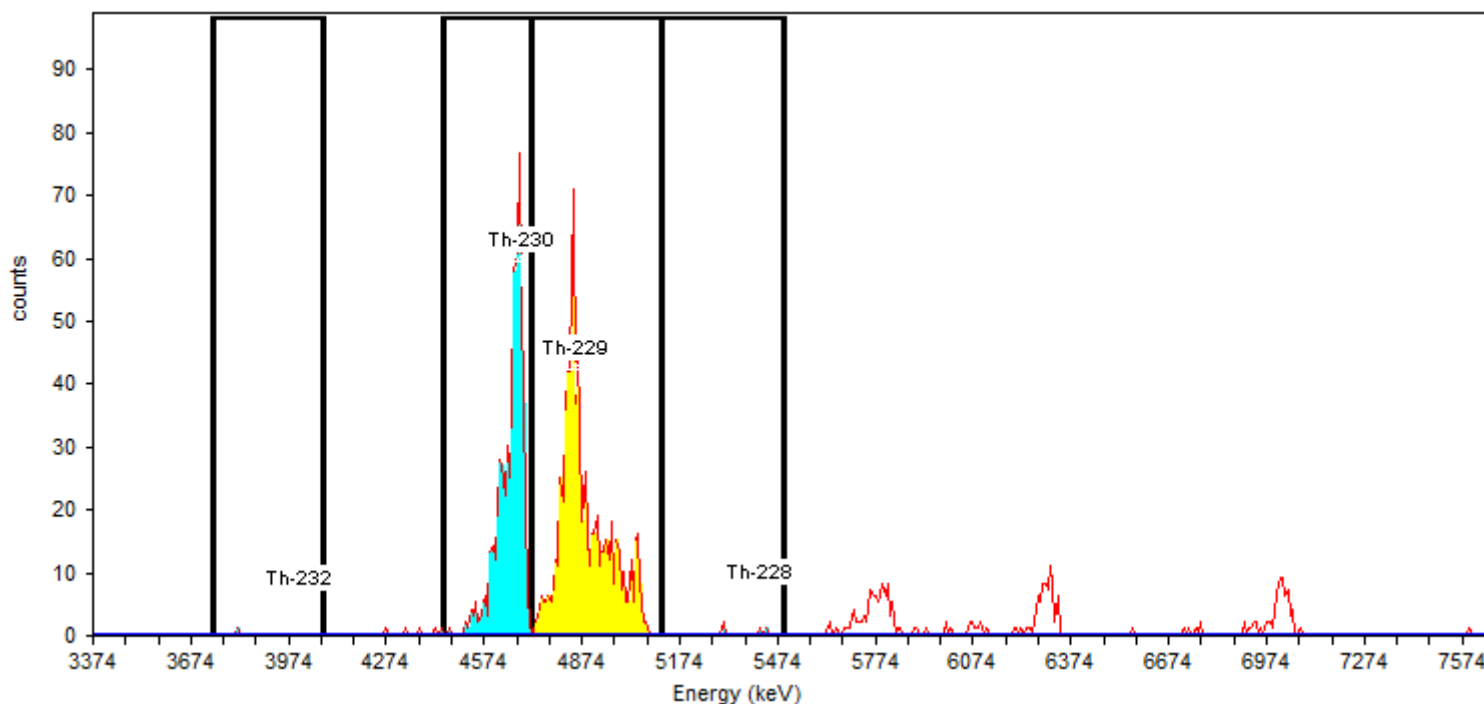
## Tracer

Tracer Nuclide: Th-229  
Tracer Recovery: 90.76%

Detector: AV154 SN: 50-05/JJ7  
Acquisition Start Date: 9/8/2016 4:01:04PM  
Live Time: 240.00 min.  
Real Time: 240.00 min.  
Background Date: 9/1/2016 3:17:08PM  
Bkgd Info: Sample: ICB;AV154; Det: AV154; Spectrum #1; 9/1/2016  
3:17:08 PM

## Acquisition

Energy Calibration: IC-9793;AV154-20151016  
Efficiency Calibration:IC-9793;AV154-20151016  
Calibration Date: 10/16/2015 6:47:00PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 25.50% +/- 0.32% TPU(2 sigma)



## General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Th2007\_ROI  
Decay Correction:9/8/2016 3:59:21PM  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

## Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	44.5	100.2	1	0.5000	0.50	8.094E-003	pCi/g
Th-230	4688.0	4,687.5	0.5	4446.0	4717.0	28.1	99.7	553	0.4307	552.88	8.995E+000	pCi/g
Th-229	4848.0	4,845.3	2.7	4717.0	5119.0	65.0	99.6	744	0.0077	743.99	1.099E+001	pCi/g
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	44.5	99.8	4	4.0000	0.00	0.000E+000	pCi/g

Sample Name: **LCSD 160-266788/3-A** Type: **Control**  
 Spectrum #1 Analysis #1  
 : **LCSD 160-266788/3-A**  
 Sample Collection Date: **8/31/2016 11:21:00AM**  
 Comment:

**Sample**

Sample Weight : **0.50** Sample Units: **g**  
 First Stage Dilution: **N/A**  
 Aliquot: **N/A** Aliquot Fraction: **N/A**  
 Dilution 2: **N/A**  
 Lab Preparation:

Batch Name: **266788**  
 AnalysisResultsID: **176416**  
 Description:

**Batch**

Client Name: **Undefined**  
 Client Contact:  
 Analyst: **60040**

Tracer Name: **Th-229\_00021**  
 Tracer Activity: **67.23 DPM / mL x (Vol.) 0.20 mL = 13.45 DPM**  
 Tracer Ref. Date: **8/16/2014 2:33:14PM**

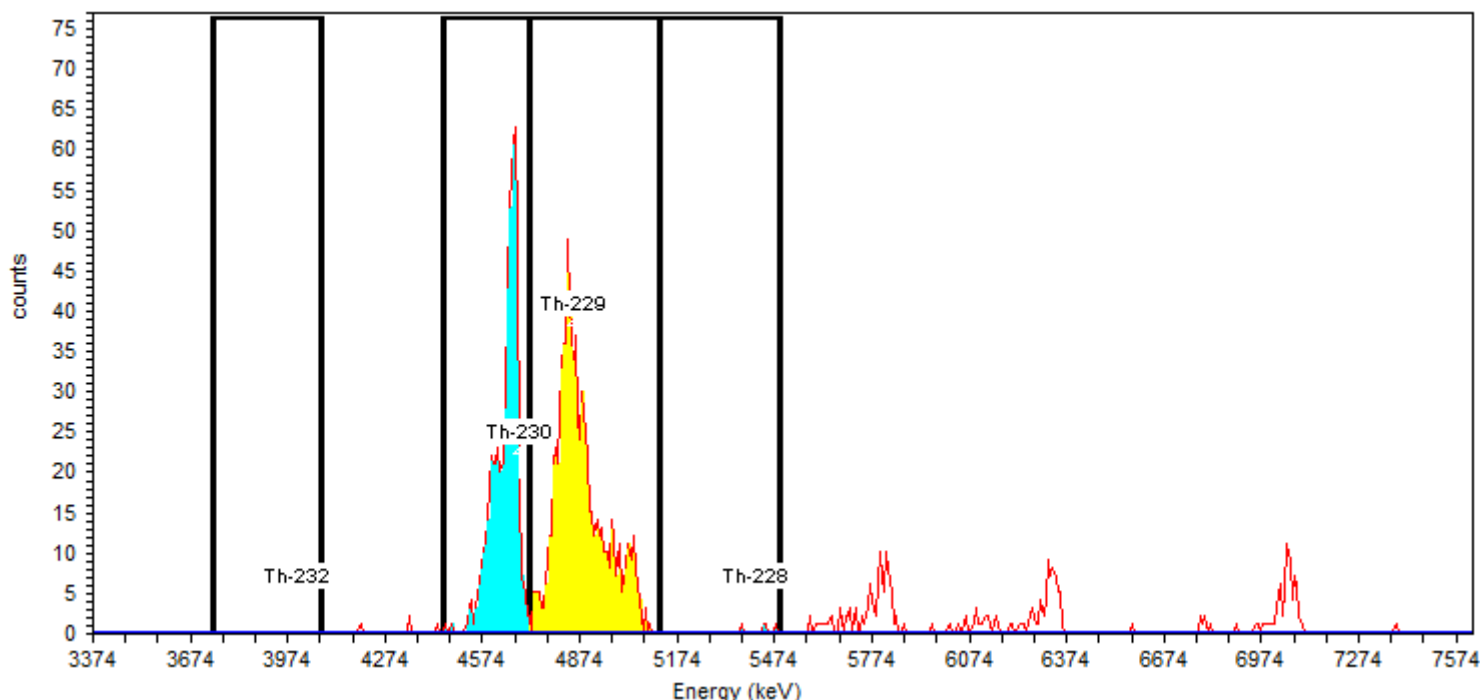
**Tracer**

Tracer Nuclide: **Th-229**  
 Tracer Recovery: **96.24%**

Detector: **AV158** SN: **50-05/II4**  
 Acquisition Start Date: **9/8/2016 4:01:04PM**  
 Live Time: **240.00 min.**  
 Real Time: **240.00 min.**  
 Background Date: **9/2/2016 10:55:25AM**  
 Bkgd Info: **Sample: ICB;AV158; Det: AV158; Spectrum #1; 9/2/2016 10:55:25 AM**

**Acquisition**

Energy Calibration: **IC-9884;AV158-20151016**  
 Efficiency Calibration: **IC-9884;AV158-20151016**  
 Calibration Date: **10/16/2015 6:47:11PM**  
 Energy Cal: Gain = **7.4575 keV / Ch**  
 Offset = **3,366.95 keV**  
 Quadratic = **0.0000 keV / Ch<sup>2</sup>**  
 Efficiency: **23.82% +/- 0.35% TPU(2 sigma)**

**General Analysis**

Analysis Method: **Absolute ROI Analysis, Set Name = Th2007\_ROI**  
 Decay Correction: **9/8/2016 3:59:22PM**  
 MDA Constants: **K $\alpha$  = 1.64 , K $\beta$  = 1.64**

Nuclide Library: **Thorium**  
 MDA Source: **Background**

**Nuclide Summary (ROI)**

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	.0	100.2	0	0.5000	-0.50	-8.172E-003	pCi/g
Th-230	4688.0	4,687.5	0.5	4446.0	4717.0	19.3	99.7	523	0.5000	522.44	8.582E+000	pCi/g
Th-229	4848.0	4,845.3	2.7	4717.0	5119.0	98.6	99.6	738	1.0160	736.92	1.166E+001	pCi/g
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	10.5	99.8	4	2.2660	1.73	2.847E-002	pCi/g



Sample Name: LCSD 160-266788/3-A Type: Control  
Spectrum #1 Analysis #1  
: LCSD 160-266788/3-A  
Sample Collection Date: 8/31/2016 11:21:00AM  
Comment:

## Sample

Sample Weight : 0.50 Sample Units: g  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Batch Name: 266788  
AnalysisResultsID: 176495  
Description:

## Batch

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Name: Th-229\_00021  
Tracer Activity: 67.23 DPM / mL x (Vol.) 0.20 mL = 13.45 DPM  
Tracer Ref. Date: 8/16/2014 2:33:14PM

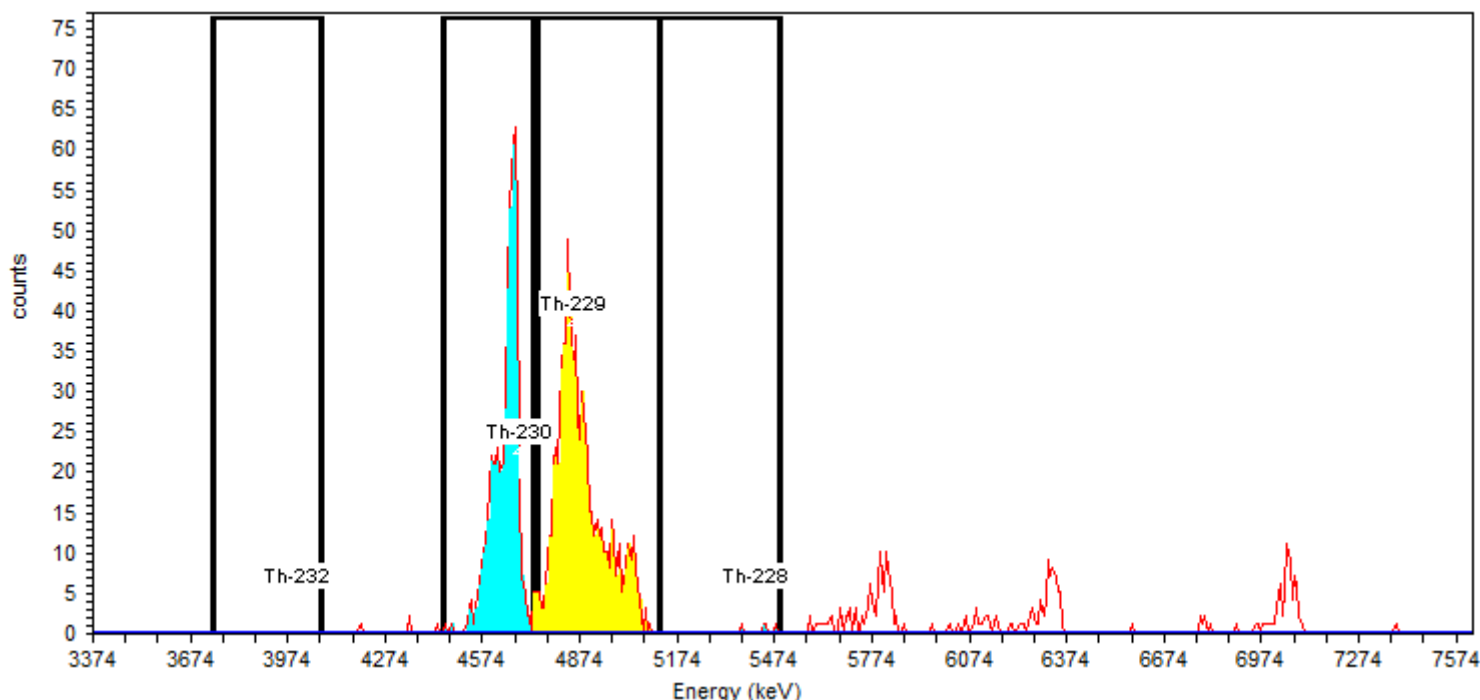
## Tracer

Tracer Nuclide: Th-229  
Tracer Recovery: 95.30%

Detector: AV158 SN: 50-05/II4  
Acquisition Start Date: 9/8/2016 4:01:04PM  
Live Time: 240.00 min.  
Real Time: 240.00 min.  
Background Date: 9/2/2016 10:55:25AM  
Bkgd Info: Sample: ICB;AV158; Det: AV158; Spectrum #1; 9/2/2016 10:55:25 AM

## Acquisition

Energy Calibration: IC-9884;AV158-20151016  
Efficiency Calibration:IC-9884;AV158-20151016  
Calibration Date: 10/16/2015 6:47:11PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 23.82% +/- 0.35% TPU(2 sigma)



## General Analysis

Analysis Method: Absolute Interactive ROI Analysis  
Decay Correction:9/8/2016 3:59:22PM  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

Manual Integration for  
tailing. 09/09/2016 ALD

## Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	.0	100.2	0	0.5000	-0.50	-8.252E-003	pCi/g
Th-230	4688.0	4,687.5	0.5	4448.3	4731.7	56.5	99.7	528	0.5000	527.50	8.750E+000	pCi/g
Th-229	4848.0	4,845.3	2.7	4739.1	5119.5	98.6	99.6	731	1.2500	729.75	1.154E+001	pCi/g
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	10.5	99.8	4	2.2660	1.73	2.875E-002	pCi/g

Sample Name: 160-18555-A-1-A Type: Sample  
Spectrum #1 Analysis #1  
: 160-18555-A-1-A  
Sample Collection Date: 8/8/2016 3:00:00PM  
Comment:

## Sample

Sample Weight : 0.50 Sample Units: g  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Batch Name: 266788  
AnalysisResultsID: 176212  
Description:

## Batch

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Name: Th-229\_00021  
Tracer Activity: 67.23 DPM / mL x (Vol.) 0.20 mL = 13.45 DPM  
Tracer Ref. Date: 8/16/2014 2:33:14PM

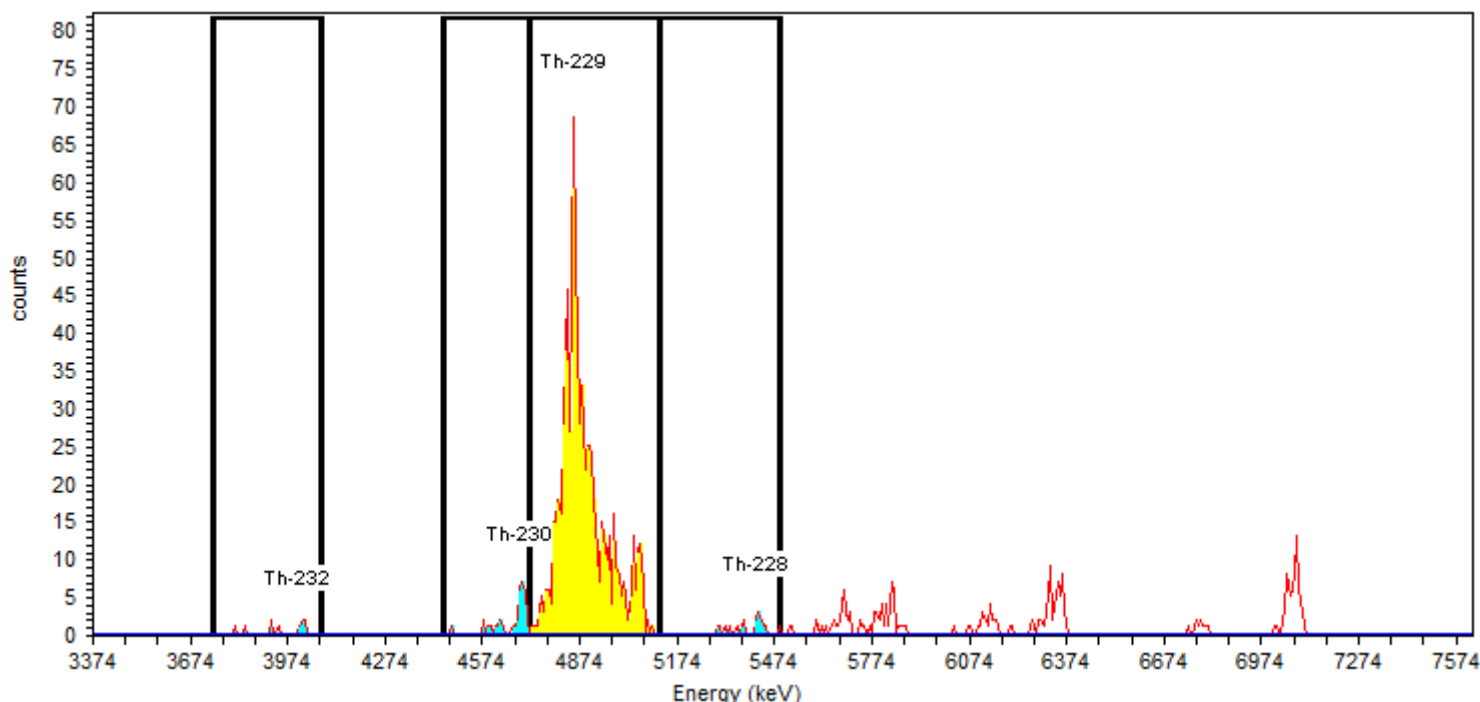
## Tracer

Tracer Nuclide: Th-229  
Tracer Recovery: 91.75%

Detector: AV168 SN: 50-113 G4  
Acquisition Start Date: 9/7/2016 2:44:14PM  
Live Time: 240.00 min.  
Real Time: 240.00 min.  
Background Date: 9/2/2016 10:55:26AM  
Bkgd Info: Sample: ICB;AV168; Det: AV168; Spectrum #1; 9/2/2016 10:55:26 AM

## Acquisition

Energy Calibration: IC-9793;AV168-20151016  
Efficiency Calibration:IC-9793;AV168-20151016  
Calibration Date: 10/17/2015 2:36:43PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 25.33% +/- 0.31% TPU(2 sigma)



## General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Th2007\_ROI  
Decay Correction:  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

## Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	119.7	100.2	10	0.3646	9.64	1.553E-001	pCi/g
Th-230	4688.0	4,687.5	0.5	4446.0	4717.0	26.1	99.7	35	0.2500	34.78	5.636E-001	pCi/g
Th-229	4848.0	4,845.3	2.7	4717.0	5119.0	80.8	99.6	748	0.7500	747.28	1.111E+001	pCi/g
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	39.6	99.8	18	2.7500	15.16	5.450E+006	pCi/g

Sample Name: 160-18555-A-2-A Type: Sample  
Spectrum #1 Analysis #1  
: 160-18555-A-2-A  
Sample Collection Date: 8/8/2016 3:00:00PM  
Comment:

## Sample

Sample Weight : 0.50 Sample Units: g  
First Stage Dilution: N/A  
Aliquot: N/A Aliquot Fraction: N/A  
Dilution 2: N/A  
Lab Preparation:

Batch Name: 266788  
AnalysisResultsID: 176213  
Description:

## Batch

Client Name: Undefined  
Client Contact:  
Analyst: 60040

Tracer Name: Th-229\_00021  
Tracer Activity: 67.23 DPM / mL x (Vol.) 0.20 mL = 13.45 DPM  
Tracer Ref. Date: 8/16/2014 2:33:14PM

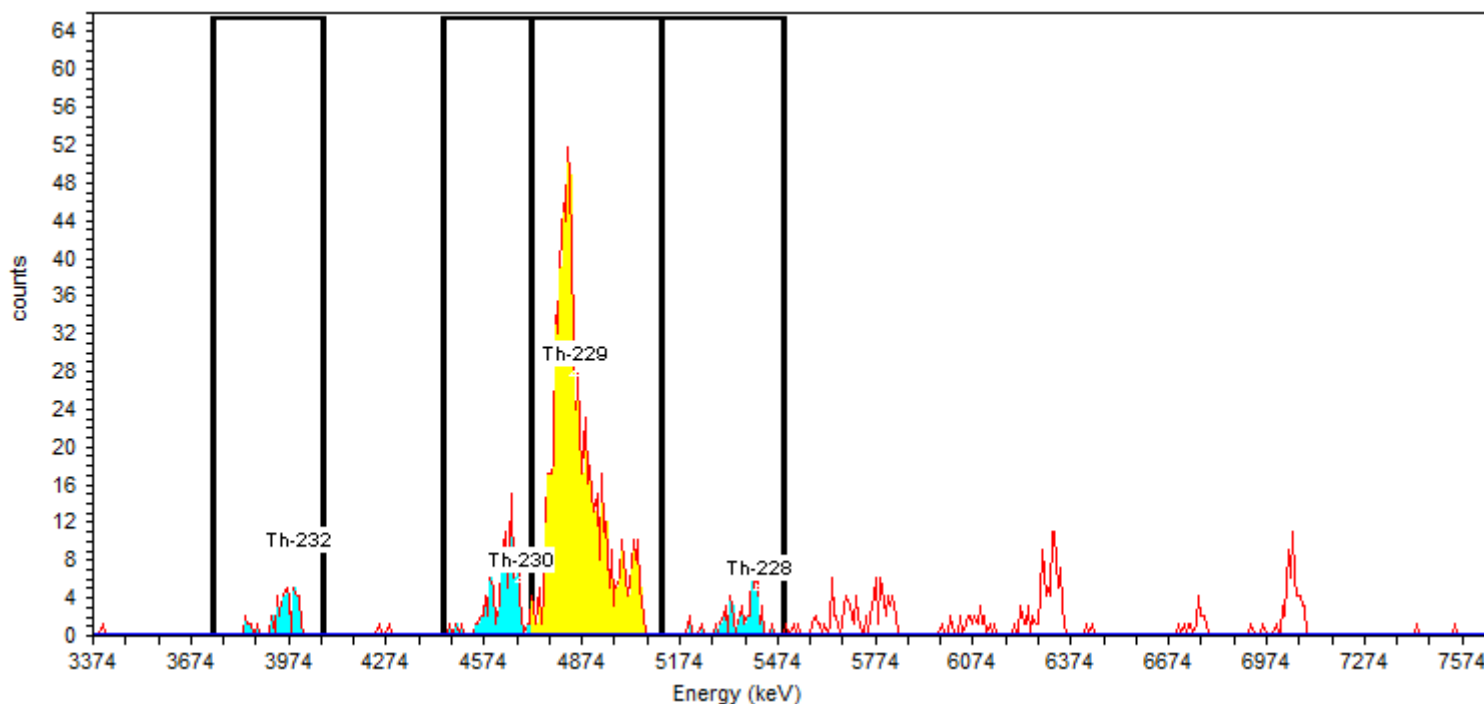
## Tracer

Tracer Nuclide: Th-229  
Tracer Recovery: 94.29%

Detector: AV169 SN: 50-112 G5  
Acquisition Start Date: 9/7/2016 2:44:14PM  
Live Time: 240.00 min.  
Real Time: 240.00 min.  
Background Date: 9/1/2016 3:17:12PM  
Bkgd Info: Sample: ICB;AV169; Det: AV169; Spectrum #1; 9/1/2016 3:17:12 PM

## Acquisition

Energy Calibration: IC-9794;AV169-20151016  
Efficiency Calibration:IC-9794;AV169-20151016  
Calibration Date: 10/17/2015 2:36:47PM  
Energy Cal: Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 24.50% +/- 0.31% TPU(2 sigma)



## General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = Th2007\_ROI  
Decay Correction:  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: Thorium  
MDA Source: Background

## Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity	Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	73.3	100.2	43	0.8854	42.11	6.829E-001	pCi/g
Th-230	4688.0	4,687.5	0.5	4446.0	4717.0	44.6	99.7	107	1.0000	105.97	1.728E+000	pCi/g
Th-229	4848.0	4,845.3	2.7	4717.0	5119.0	80.1	99.6	743	0.2500	742.72	1.142E+001	pCi/g
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	51.3	99.8	52	2.9783	49.11	1.776E+007	pCi/g

Sample Name: **160-18555-A-3-A** Type: **Sample**  
Spectrum #2 Analysis #1  
: **160-18555-A-3-A**  
Sample Collection Date: **8/8/2016 3:00:00PM**  
Comment:

### Sample

Sample Weight : **0.50** Sample Units: **g**  
First Stage Dilution: **N/A**  
Aliquot: **N/A** Aliquot Fraction: **N/A**  
Dilution 2: **N/A**  
Lab Preparation:

Batch Name: **266788**  
AnalysisResultsID: **176581**  
Description:

### Batch

Client Name: **Undefined**  
Client Contact:  
Analyst: **60040**

Tracer Name: **Th-229\_00021**  
Tracer Activity: **67.23 DPM / mL x (Vol.) 0.20 mL = 13.45 DPM**  
Tracer Ref. Date: **8/16/2014 2:33:14PM**

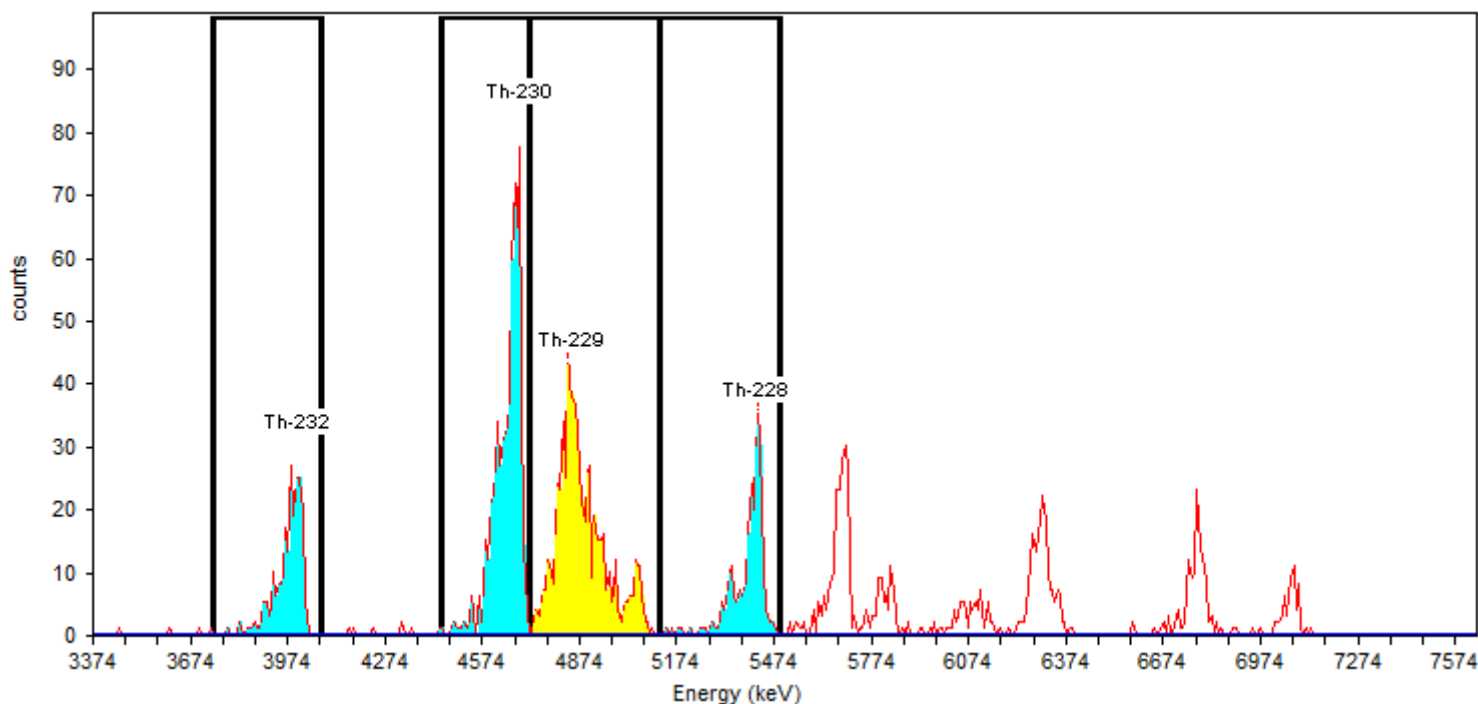
### Tracer

Tracer Nuclide: **Th-229**  
Tracer Recovery: **82.43%**

Detector: **AV147** SN: **50-05/R1**  
Acquisition Start Date: **9/9/2016 10:34:40AM**  
Live Time: **240.00 min.**  
Real Time: **240.00 min.**  
Background Date: **9/1/2016 3:17:26PM**  
Bkgd Info: **Sample: ICB;AV147; Det: AV147; Spectrum #1; 9/1/2016 3:17:26 PM**

### Acquisition

Energy Calibration: **IC-7107;AV147-20151016**  
Efficiency Calibration: **IC-7107;AV147-20151016**  
Calibration Date: **10/16/2015 6:46:39PM**  
Energy Cal: Gain = **7.4575 keV / Ch**  
Offset = **3,366.95 keV**  
Quadratic = **0.0000 keV / Ch<sup>2</sup>**  
Efficiency: **26.20% +/- 0.30% TPU(2 sigma)**



### General Analysis

Analysis Method: **Absolute ROI Analysis**, Set Name = **Th2007\_ROI**  
Decay Correction: **9/8/2016 3:59:21PM**  
MDA Constants:  $K\alpha = 1.64$ ,  $K\beta = 1.64$

Nuclide Library: **Thorium**  
MDA Source: **Background**

### Nuclide Summary (ROI)

Nuclide	Peak Energy keV	Peak Expected keV	Peak Diff keV	ROI Start keV	ROI End keV	FWHM keV	B.R. %	Gross Counts	Bkgd Counts	Net Counts	Activity Units
Th-232	3999.0	4,010.0	-11.0	3743.0	4072.0	63.7	100.2	245	0.2500	244.75	4.246E+000 pCi/g
Th-230	4688.0	4,687.5	0.5	4446.0	4717.0	30.3	99.7	659	0.5000	658.50	1.148E+001 pCi/g
Th-229	4848.0	4,845.3	2.7	4717.0	5119.0	95.1	99.6	698	3.7500	694.25	9.985E+000 pCi/g
Th-228	5420.0	5,423.3	-3.3	5119.0	5493.0	56.1	99.8	271	1.7500	269.25	4.695E+000 pCi/g

# Daily Checks

## Alpha Spectroscopy Daily Pulser Check

**Analysis Date: 09/07/16**

			Gross Counts			FWHM (keV)			Pulser Center			Energy (keV)		
Detector	Analysis	Date	Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F
AV165	09/07/16	12:23	6028	5605.6-6195.6	Pass	14.0	10-20	Pass	223.0	218.1-228.1	Pass	5030	4991.0-5071.0	Pass
AV168	09/07/16	12:23	6036	5537.1-6120.0	Pass	13.8	10-20	Pass	223.1	218.1-228.1	Pass	5031	4990.4-5070.4	Pass
AV169	09/07/16	12:23	5964	5719.2-6321.2	Pass	17.0	10-20	Pass	222.0	217.5-227.5	Pass	5023	4986.3-5066.3	Pass

**Analysis Date: 09/08/16**

			Gross Counts			FWHM (keV)			Pulser Center			Energy (keV)		
Detector	Analysis Date		Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F
AV154	09/08/16	10:49	5805	5712.1-6313.4	Pass	12.8	10-20	Pass	220.9	216.0-226.0	Pass	5015	4974.8-5054.8	Pass
AV158	09/08/16	10:49	5884	5603.2-6193.1	Pass	12.8	10-20	Pass	226.0	222.0-232.0	Pass	5052	5020.0-5100.0	Pass

**Analysis Date: 09/09/16**

		Gross Counts			FWHM (keV)			Pulser Center			Energy (keV)		
Detector	Analysis Date	Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F	Result	Criteria	P/F
AV147	09/09/16 09:10	6023	5615.2-6206.3	Pass	13.5	10-20	Pass	217.1	213.0-223.0	Pass	4986	4952.9-5032.9	Pass

Sample Name: Pulser;AV147

Comment:

Sample

Spectrum #3 Analysis #1

Batch

Batch Name: August2016a

Description:

Acquisition

Detector: AV147 , SN: 50-05/R1

Acquisition Start Date: 9/9/2016 9:10:33AM

Live Time: 1.00 min.

Real Time: 1.00 min.

Calibration Name: IC-7107;AV147-20151016

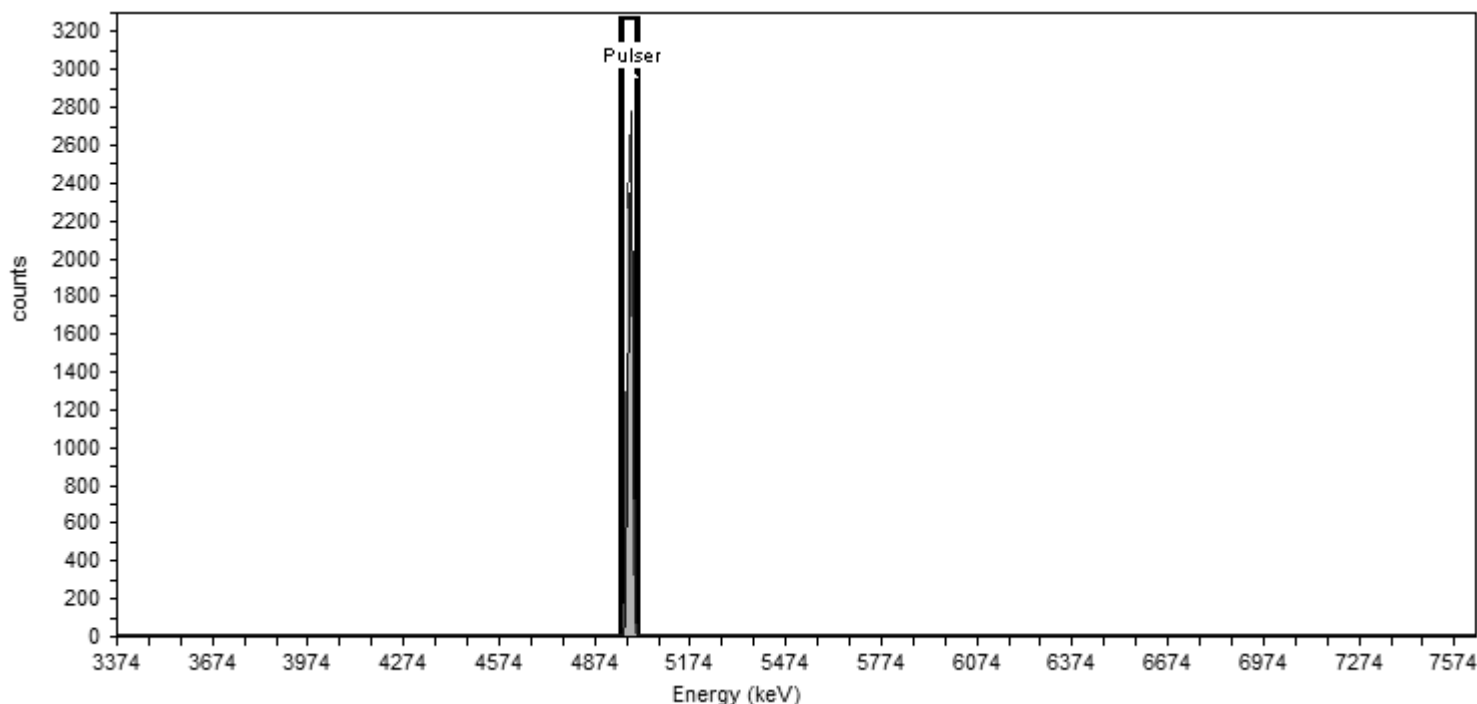
Calibration Date: 10/16/2015 6:46:39PM

Energy Calibration Equation:

Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>



### General Analysis

Analysis Method: Peak Fit Analysis

### Nuclide Summary (Peak Search)

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	4985.720	4962.798	5008.641	13.47	5,367.14	6,022.89

Sample Name: Pulser;AV154

Comment:

**Sample**

Spectrum #2 Analysis #1

**Batch**

Batch Name: August2016a

Description:

**Acquisition**

Detector: AV154 , SN: 50-05/JJ7

Acquisition Start Date: 9/8/2016 10:49:41AM

Live Time: 1.00 min.

Real Time: 1.00 min.

Calibration Name: IC-9793;AV154-20151016

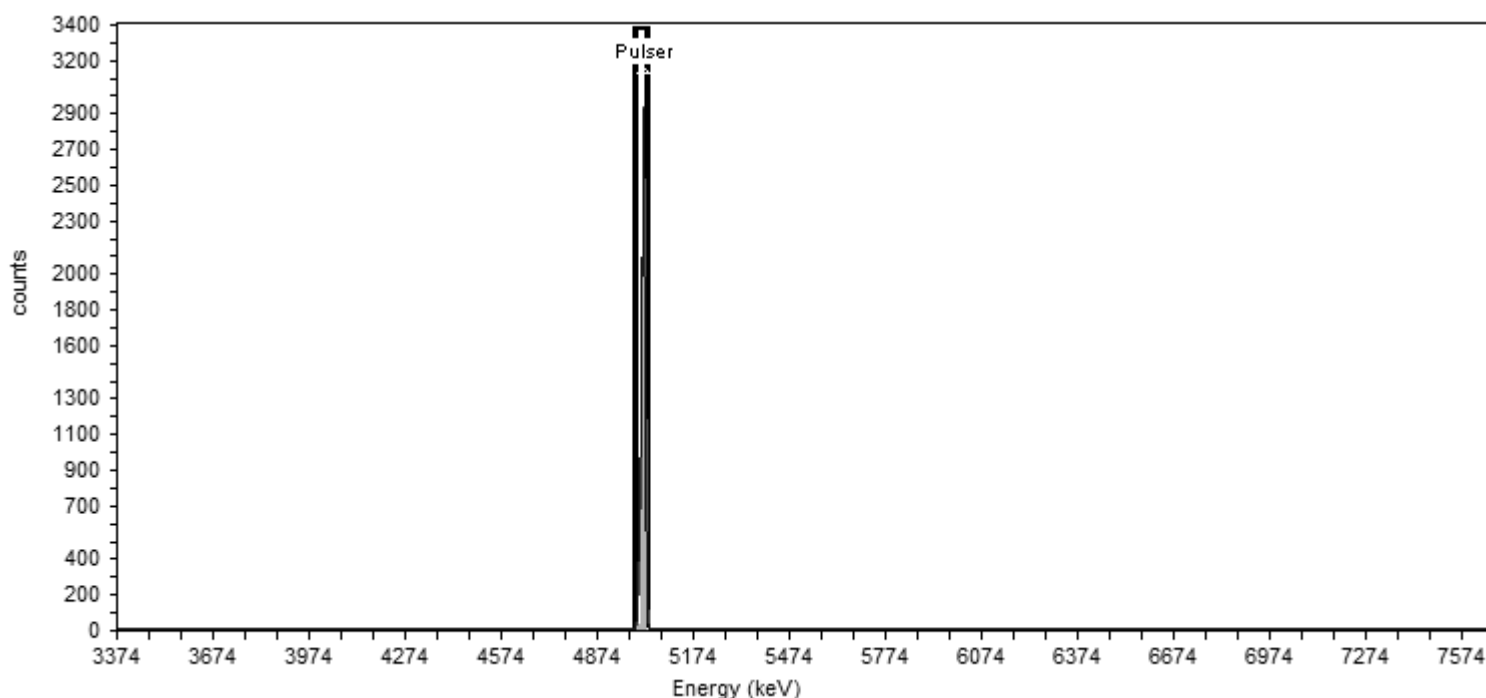
Calibration Date: 10/16/2015 6:47:00PM

Energy Calibration Equation:

Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>



### General Analysis

Analysis Method: Peak Fit Analysis

### Nuclide Summary (Peak Search)

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5014.697	4992.873	5036.521	12.82	5,401.83	5,805.35



Sample Name: Pulser;AV158

Comment:

**Sample**

Spectrum #2 Analysis #1

**Batch**

Batch Name: August2016a

Description:

**Acquisition**

Detector: AV158 , SN: 50-05/II4

Acquisition Start Date: 9/8/2016 10:49:42AM

Live Time: 1.00 min.

Real Time: 1.00 min.

Calibration Name: IC-9884;AV158-20151016

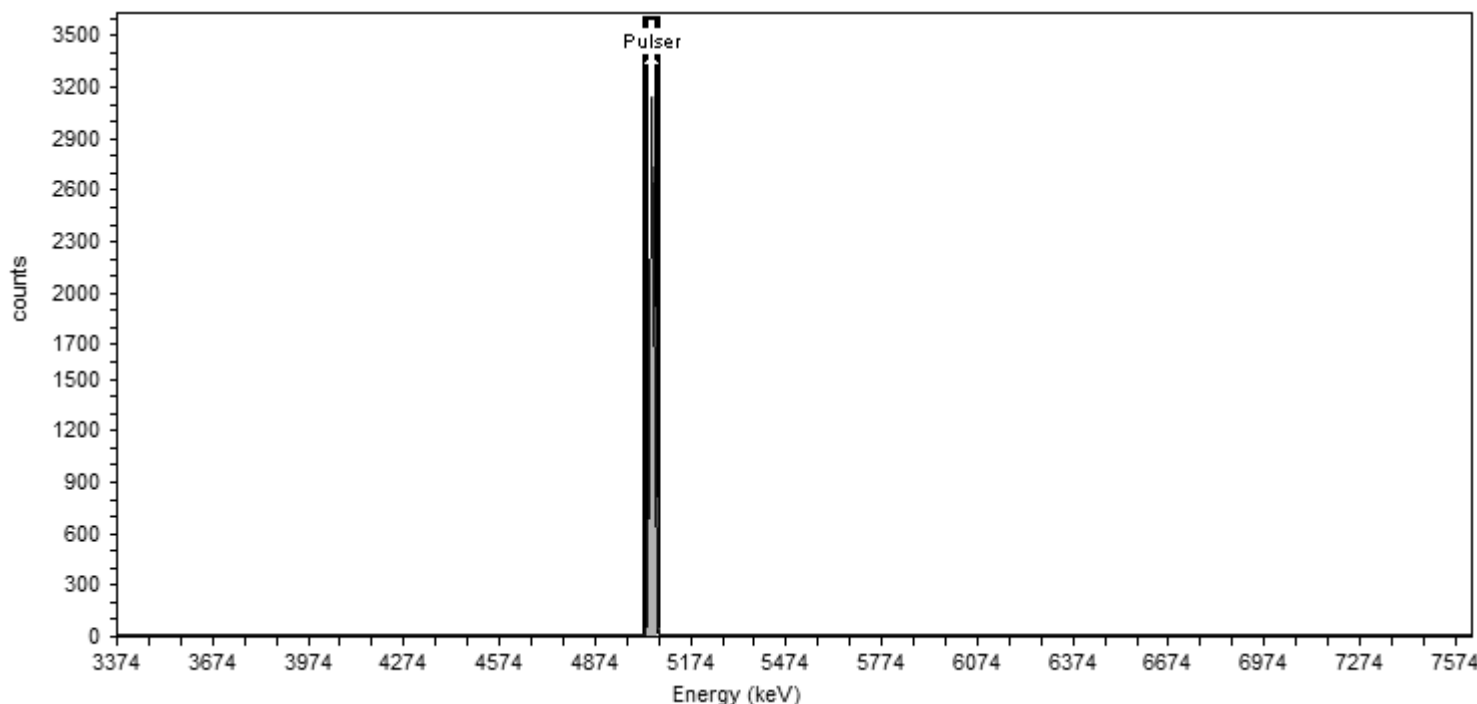
Calibration Date: 10/16/2015 6:47:11PM

Energy Calibration Equation:

Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>



### General Analysis

Analysis Method: Peak Fit Analysis

### Nuclide Summary (Peak Search)

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5052.260	5030.484	5074.036	12.79	5,753.83	5,883.81

Sample Name: Pulser;AV165

Comment:

**Sample**

Spectrum #1 Analysis #1

**Batch**

Batch Name: August2016a

Description:

**Acquisition**

Detector: AV165 , SN: 50-112F7

Acquisition Start Date: 9/7/2016 12:23:10PM

Live Time: 1.00 min.

Real Time: 1.00 min.

Calibration Name: IC-8877;AV165-20151016

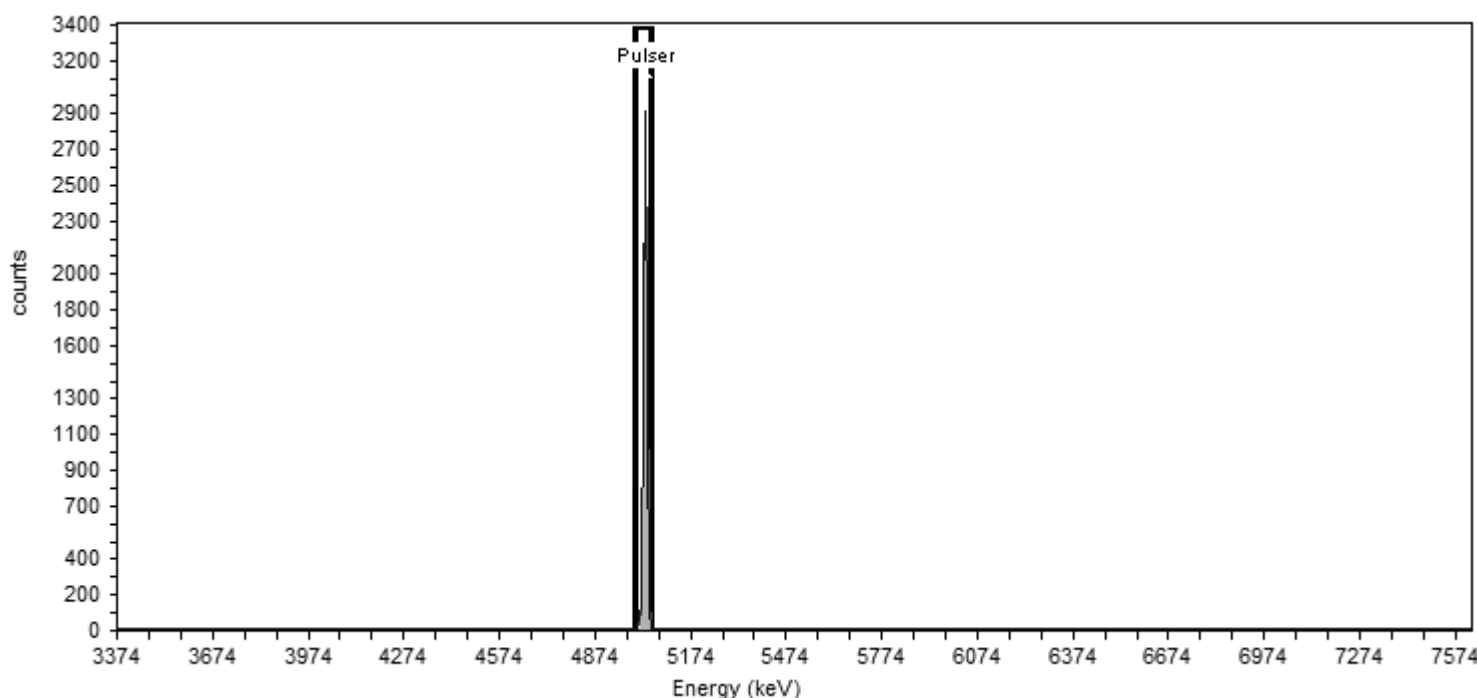
Calibration Date: 10/17/2015 2:36:40PM

Energy Calibration Equation:

Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>



### General Analysis

Analysis Method: Peak Fit Analysis

### Nuclide Summary (Peak Search)

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5029.654	5005.772	5053.536	14.03	5,862.93	6,028.37

Sample Name: Pulser;AV168

Comment:

**Sample**

Spectrum #1 Analysis #1

**Batch**

Batch Name: August2016a

Description:

**Acquisition**

Detector: AV168 , SN: 50-113 G4

Acquisition Start Date: 9/7/2016 12:23:10PM

Live Time: 1.00 min.

Real Time: 1.01 min.

Calibration Name: IC-9793;AV168-20151016

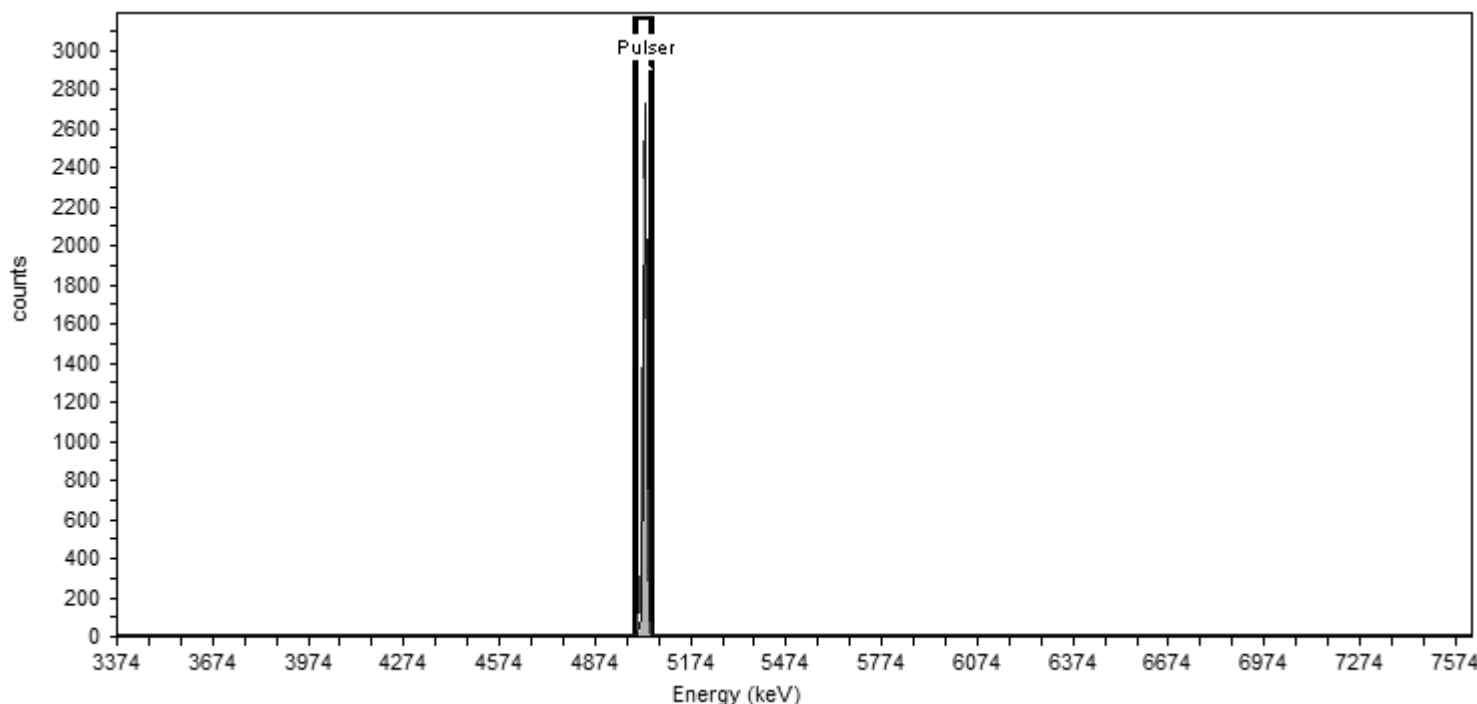
Calibration Date: 10/17/2015 2:36:43PM

Energy Calibration Equation:

Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>



### General Analysis

Analysis Method: Peak Fit Analysis

### Nuclide Summary (Peak Search)

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5030.531	5007.118	5053.945	13.76	5,382.09	6,036.47

Sample Name: Pulser;AV169

Comment:

### Sample

Spectrum #1 Analysis #1

### Batch

Batch Name: August2016a

Description:

### Acquisition

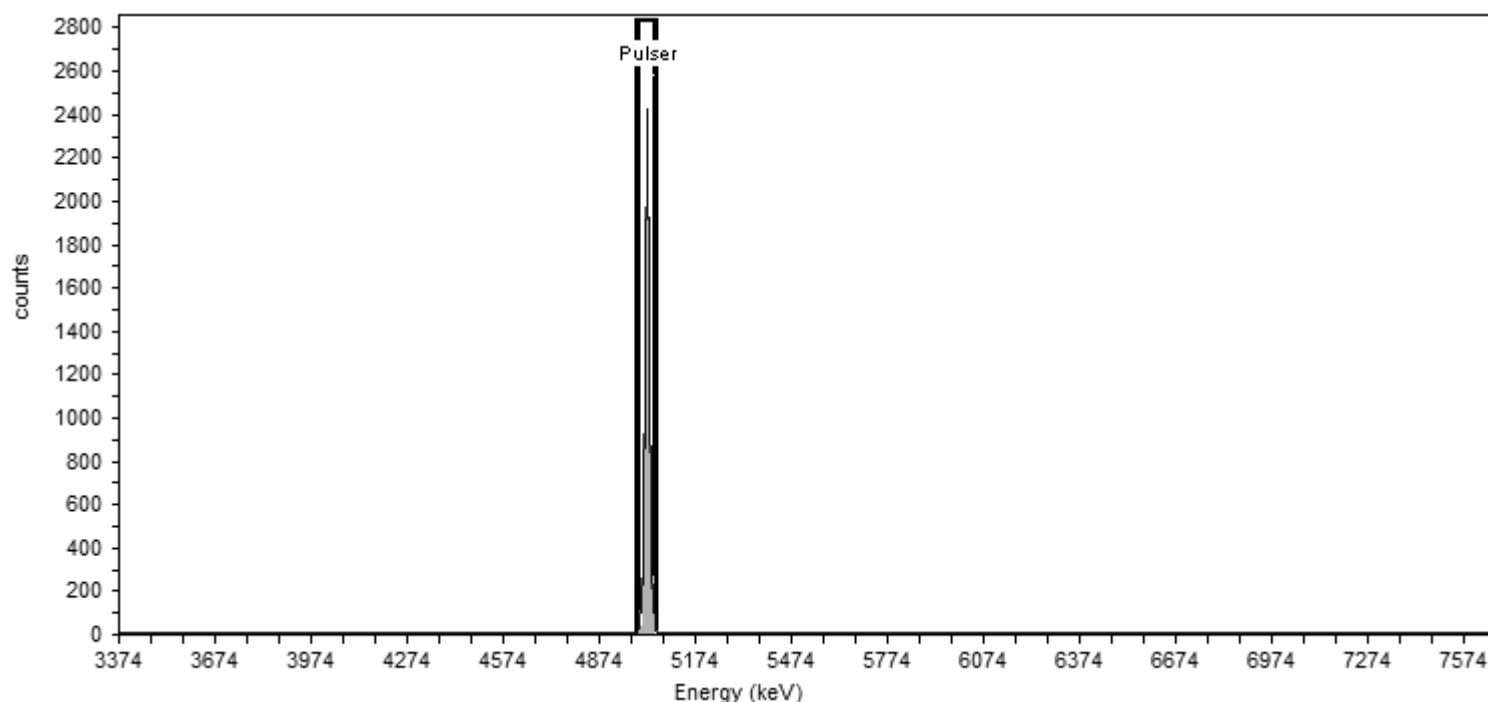
Detector: AV169 , SN: 50-112 G5  
Acquisition Start Date: 9/7/2016 12:23:10PM  
Live Time: 1.00 min.  
Real Time: 1.00 min.  
Calibration Name: IC-9794;AV169-20151016  
Calibration Date: 10/17/2015 2:36:47PM

Energy Calibration Equation:

Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>



### General Analysis

Analysis Method: Peak Fit Analysis

### Nuclide Summary (Peak Search)

Nuclide	Peak Energy keV	Start Energy keV	End Energy keV	FWHM keV	Fit Area	Gross Counts
Pulser	5022.582	4993.605	5051.559	17.02	5,913.50	5,964.49

# Initial Calibrations

Sample Name: IC-7107;AV147-20151016

Description:

Detector: AV147

### Calibration

Analyst: 60040

Analysis Date: 10/16/2015 6:46:39PM

Calibration Type: Energy And Efficiency

Certificate ID: 82232-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/3/2010 12:00:00PM

### Acquisition

Detector: AV147 , SN: 50-05/R1

Acquisition Start Date: 10/16/2015 3:47:38PM

Live Time: 140.00 min.

Real Time: 140.01 min.

Energy Calibration Equation:

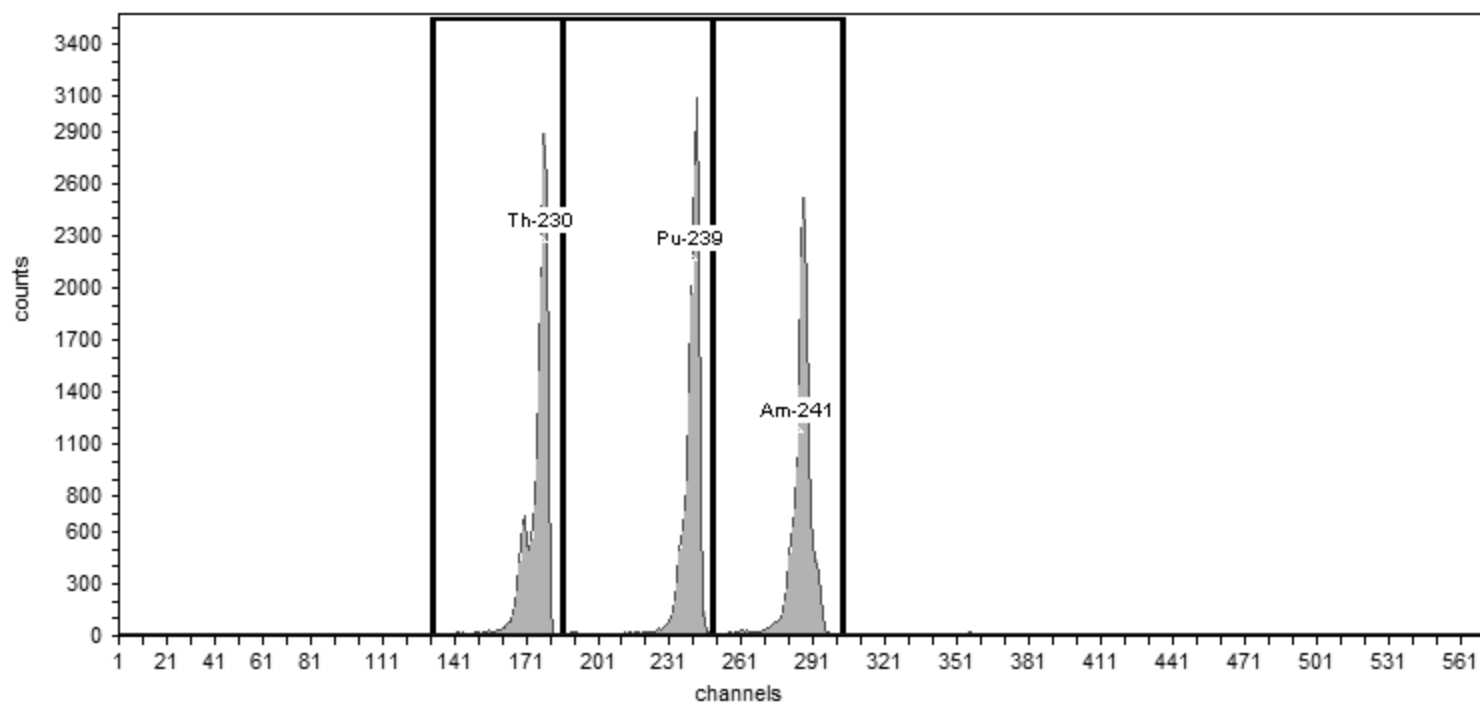
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-7107;AV147-20151016

Efficiency: 26.20% +/- 0.30% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: Yes

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	29.37	16,447.00	117.48
Pu-239	240	5,155.40	186	249	31.93	16,371.00	116.94
Am-241	284	5,485.70	249	303	31.66	15,642.00	111.73

Sample Name: IC-9793;AV154-20151016  
Description:  
Detector: AV154

### Calibration

Analyst: 60040  
Analysis Date: 10/16/2015 6:47:00PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82241-334  
Prepared by: Analytics  
Description:

### Source Info

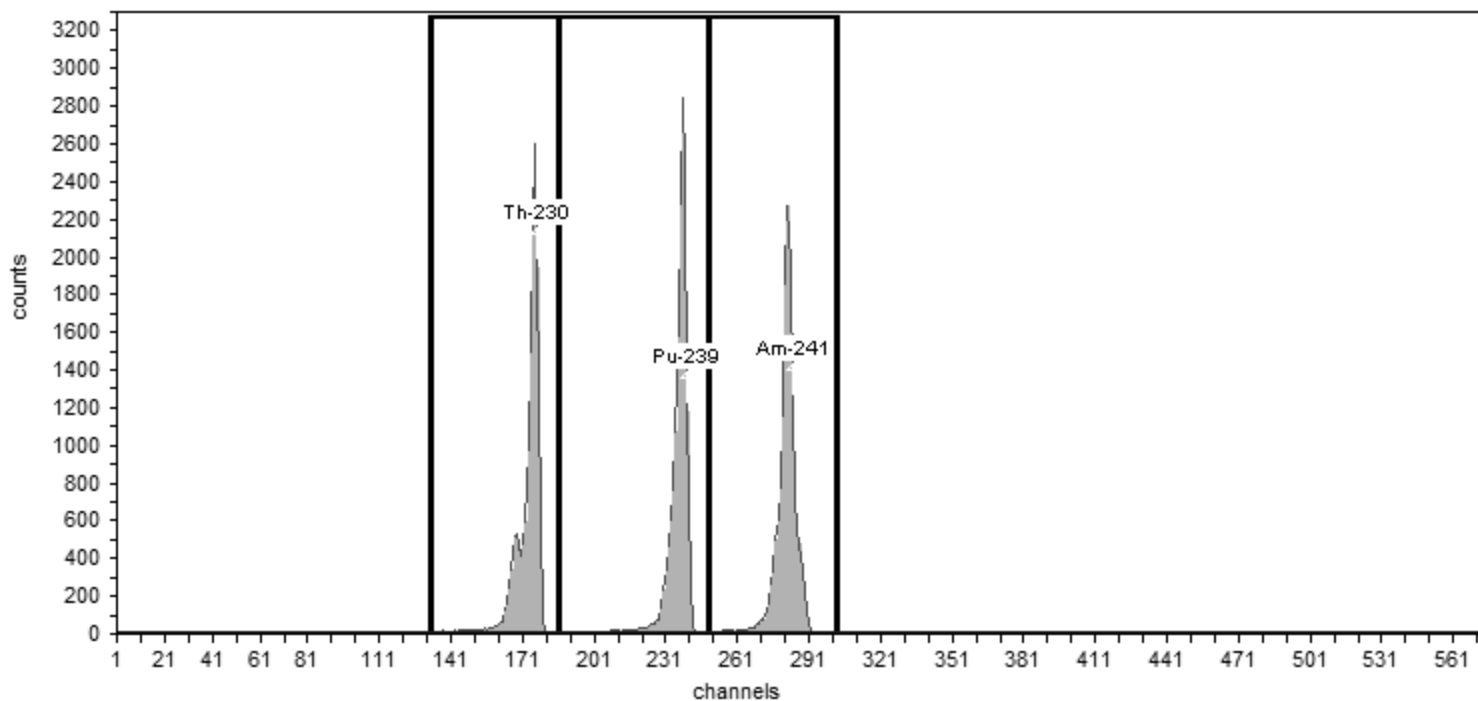
Certification Date: 6/8/2010 12:00:00PM

Detector: AV154 , SN: 50-05/JJ7  
Acquisition Start Date: 10/16/2015 3:52:39PM

Live Time: 140.00 min.  
Real Time: 140.01 min.

### Acquisition

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency Calibration Name: IC-9793;AV154-20151016  
Efficiency: 25.50% +/- 0.32% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: Yes  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	28.72	14,071.00	100.51
Pu-239	240	5,155.40	186	249	30.68	14,748.00	105.34
Am-241	284	5,485.70	249	303	31.45	14,051.00	100.36

Sample Name: IC-9884;AV158-20151016

Description:

Detector: AV158

### Calibration

Analyst: 60040

Analysis Date: 10/16/2015 6:47:11PM

Calibration Type: Energy And Efficiency

Certificate ID: 82245-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/9/2010 12:00:00PM

### Acquisition

Detector: AV158 , SN: 50-05/II4

Acquisition Start Date: 10/16/2015 3:53:27PM

Live Time: 140.00 min.

Real Time: 140.01 min.

Energy Calibration Equation:

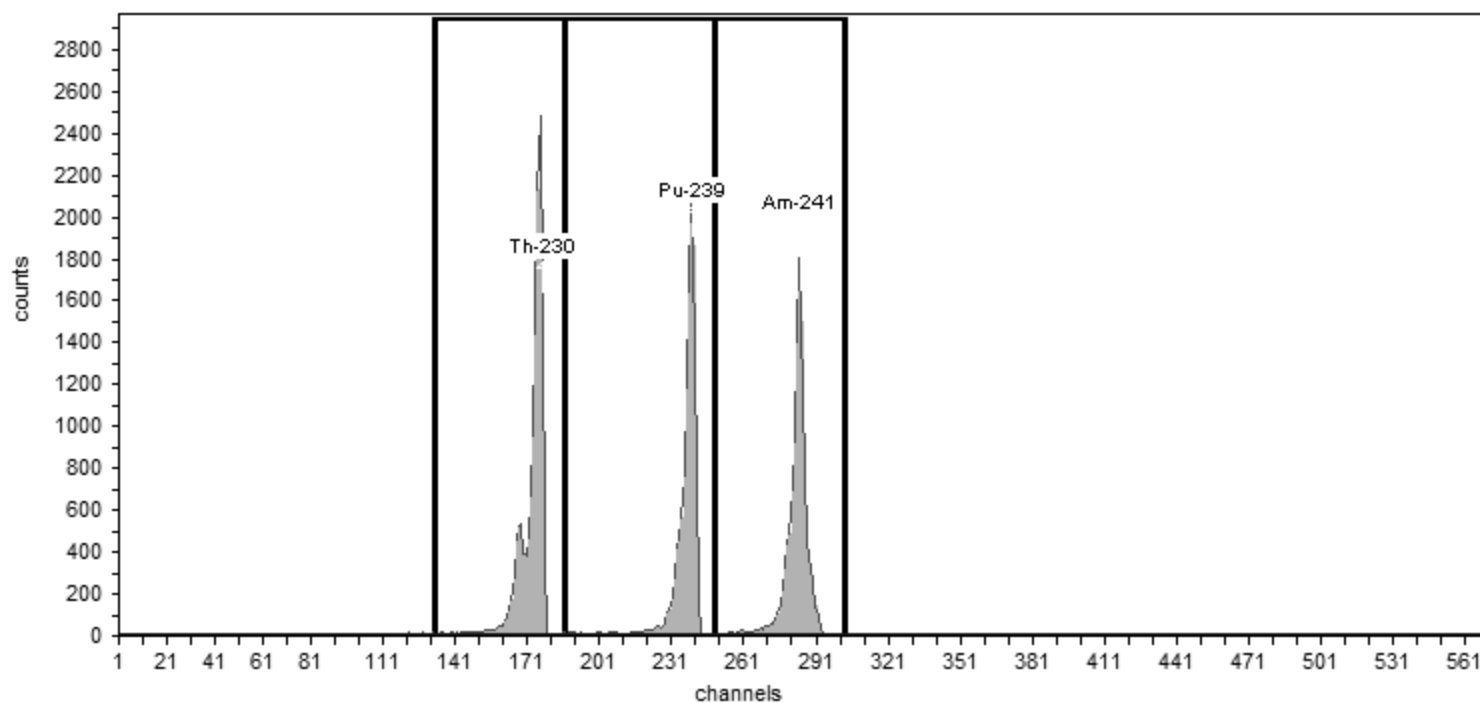
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-9884;AV158-20151016

Efficiency: 23.82% +/- 0.35% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: Yes

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	27.57	13,439.00	95.99
Pu-239	240	5,155.40	186	249	30.43	11,009.00	78.64
Am-241	284	5,485.70	249	303	29.29	10,876.00	77.69



Sample Name: IC-8877;AV165-20151016  
Description:  
Detector: AV165

### Calibration

Analyst: 60040  
Analysis Date: 10/17/2015 2:36:40PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82236-334  
Prepared by: Analytics  
Description:

### Source Info

Certification Date: 6/2/2010 12:00:00PM

### Acquisition

Detector: AV165 , SN: 50-112F7  
Acquisition Start Date: 10/16/2015 6:58:30PM

Live Time: 140.00 min.  
Real Time: 140.01 min.

Energy Calibration Equation:

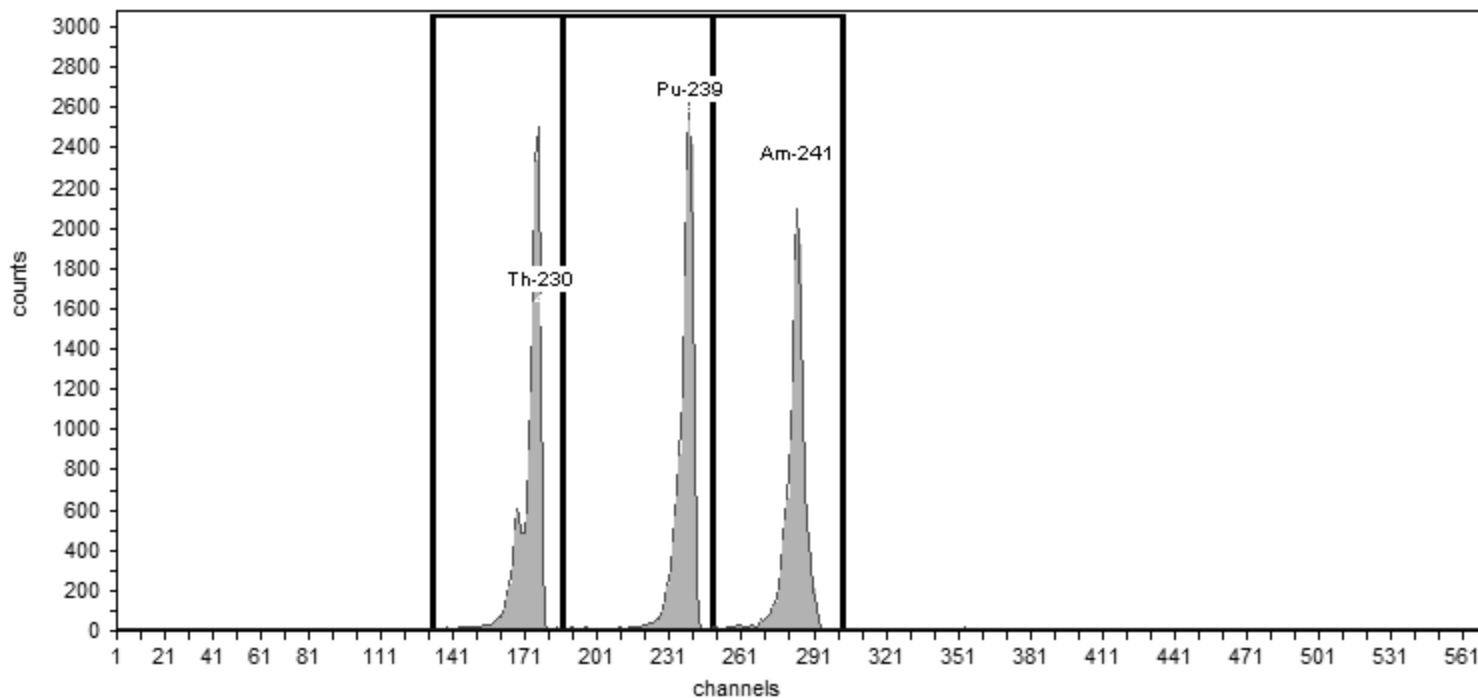
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-8877;AV165-20151016

Efficiency: 25.89% +/- 0.31% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: Yes  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.38	15,008.00	107.20
Pu-239	240	5,155.40	186	249	33.77	15,425.00	110.18
Am-241	284	5,485.70	249	303	36.38	14,540.00	103.86

Sample Name: IC-9793;AV168-20151016

Description:

Detector: AV168

### Calibration

Analyst: 60040

Analysis Date: 10/17/2015 2:36:43PM

Calibration Type: Energy And Efficiency

Certificate ID: 82241-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/8/2010 12:00:00PM

### Acquisition

Detector: AV168 , SN: 50-113 G4

Acquisition Start Date: 10/16/2015 6:59:06PM

Live Time: 140.00 min.

Real Time: 140.01 min.

Energy Calibration Equation:

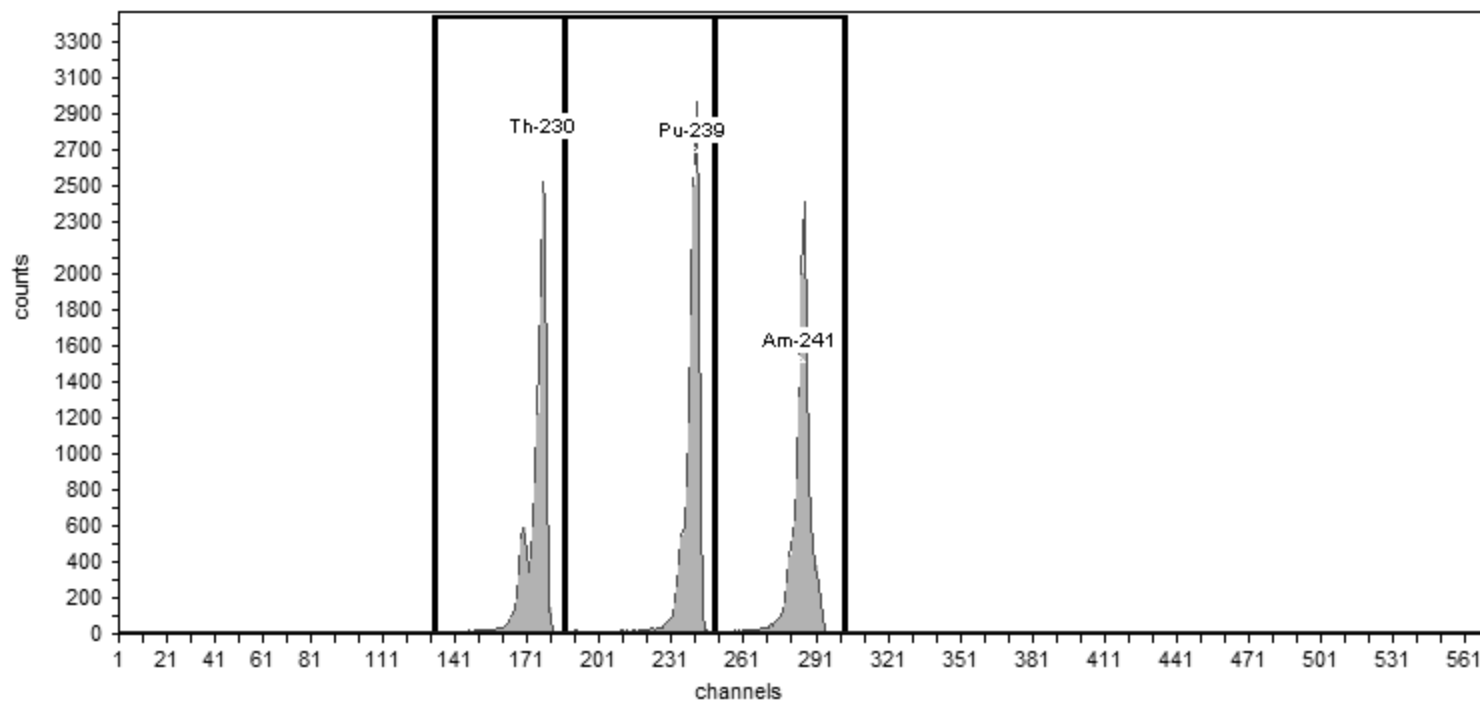
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-9793;AV168-20151016

Efficiency: 25.33% +/- 0.31% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: Yes

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	28.27	14,086.00	100.61
Pu-239	240	5,155.40	186	249	29.54	14,748.00	105.34
Am-241	284	5,485.70	249	303	28.44	13,768.00	98.34

Sample Name: IC-9794;AV169-20151016

Description:

Detector: AV169

### Calibration

Analyst: 60040

Analysis Date: 10/17/2015 2:36:47PM

Calibration Type: Energy And Efficiency

Certificate ID: 82242-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/8/2010 12:00:00PM

### Acquisition

Detector: AV169 , SN: 50-112 G5

Acquisition Start Date: 10/16/2015 6:59:16PM

Live Time: 140.00 min.

Real Time: 140.01 min.

Energy Calibration Equation:

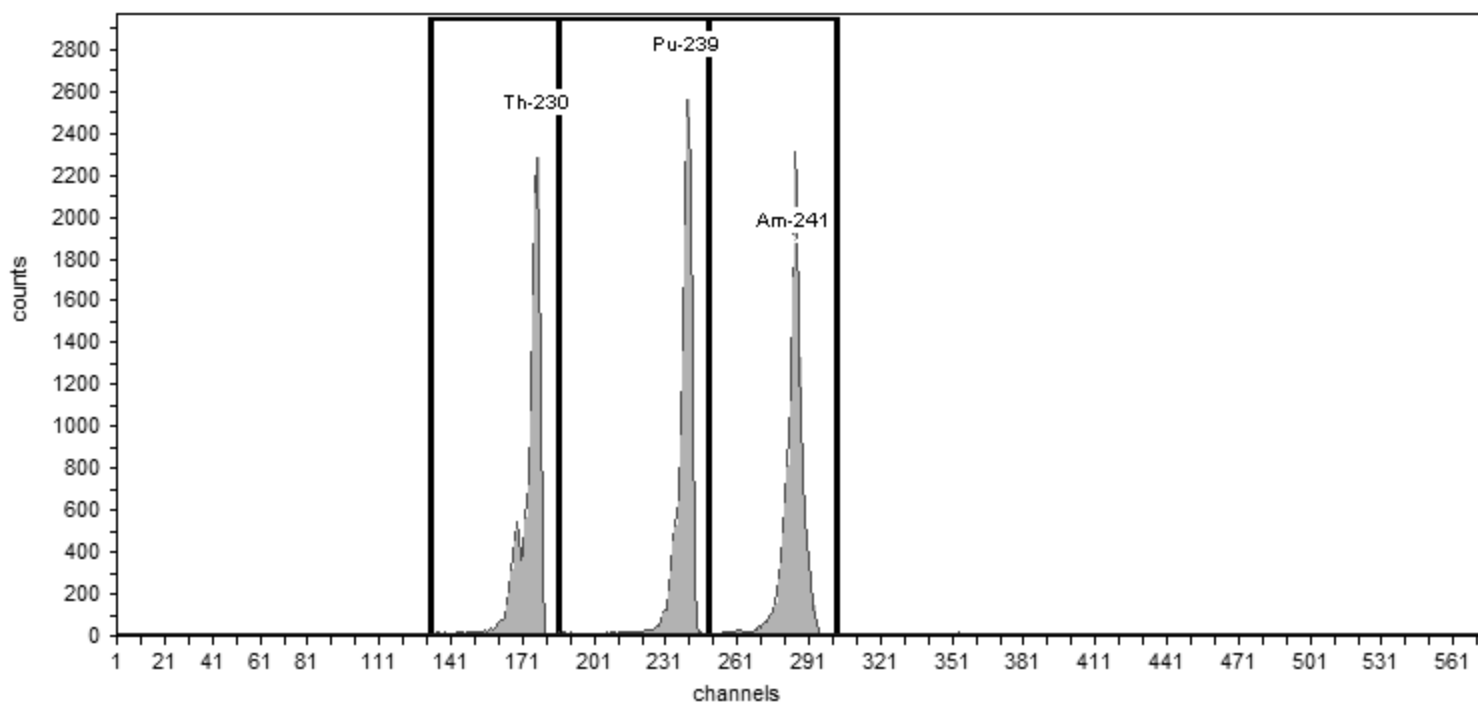
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: IC-9794;AV169-20151016

Efficiency: 24.50% +/- 0.31% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: Yes

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.08	13,354.00	95.39
Pu-239	240	5,155.40	186	249	30.67	13,390.00	95.64
Am-241	284	5,485.70	249	303	31.74	14,605.00	104.32

# **Initial Calibration Verifications**

## Alpha Spectroscopy Calibration Summary

### Detector: AV147

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223444/1	10/16/15 15:47	82232-334_00001	0.2620	0.20-0.32		
ICV 160-223562/1	10/26/15 19:10	82233-334_00001	0.2656	0.20-0.32	101.4	95-105
CCV 160-268312/1	09/06/16 15:28	82232-334_00001	0.2566	0.20-0.32	98.0	95-105

### Detector: AV154

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223451/1	10/16/15 15:52	82241-334_00001	0.2550	0.20-0.32		
ICV 160-223569/1	10/26/15 19:11	82244-334_00001	0.2459	0.20-0.32	96.4	95-105
CCV 160-268317/1	09/06/16 12:40	82241-334_00001	0.2435	0.20-0.32	95.5	95-105

### Detector: AV158

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223455/1	10/16/15 15:53	82245-334_00001	0.2382	0.20-0.32		
ICV 160-223573/1	10/26/15 19:13	82234-334_00001	0.2384	0.20-0.32	100.1	95-105
CCV 160-268318/1	09/06/16 15:24	82245-334_00001	0.2325	0.20-0.32	97.6	95-105

### Detector: AV165

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223462/1	10/16/15 18:58	82236-334_00001	0.2589	0.20-0.32		
ICV 160-223580/1	10/26/15 20:27	82246-334_00001	0.2628	0.20-0.32	101.5	95-105
CCV 160-268323/1	09/06/16 15:29	82236-334_00001	0.2554	0.20-0.32	98.6	95-105

### Detector: AV168

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223465/1	10/16/15 18:59	82241-334_00001	0.2533	0.20-0.32		
ICV 160-223583/1	10/26/15 20:32	82244-334_00001	0.2462	0.20-0.32	97.2	95-105
CCV 160-268326/1	09/06/16 13:59	82241-334_00001	0.2452	0.20-0.32	96.8	95-105

### Detector: AV169

Lab Sample ID	Analysis Date	Reagent ID	Efficiency	Efficiency Limits	Efficiency Recovery	Recovery Limits
IC 160-223466/1	10/16/15 18:59	82242-334_00001	0.2450	0.20-0.32		
ICV 160-223584/1	10/26/15 20:28	82237-334_00003	0.2461	0.20-0.32	100.4	95-105
CCV 160-268327/1	09/06/16 13:59	82242-334_00001	0.2331	0.20-0.32	95.1	95-105

Sample Name: ICV-8874;AV147-20151026

Description:

Detector: AV147

### Calibration

Analyst: 60040

Analysis Date: 10/26/2015 8:20:47PM

Calibration Type: Energy And Efficiency

Certificate ID: 82233-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/3/2010 12:00:00PM

### Acquisition

Detector: AV147 , SN: 50-05/R1

Acquisition Start Date: 10/26/2015 7:10:15PM

Live Time: 60.00 min.

Real Time: 60.00 min.

Energy Calibration Equation:

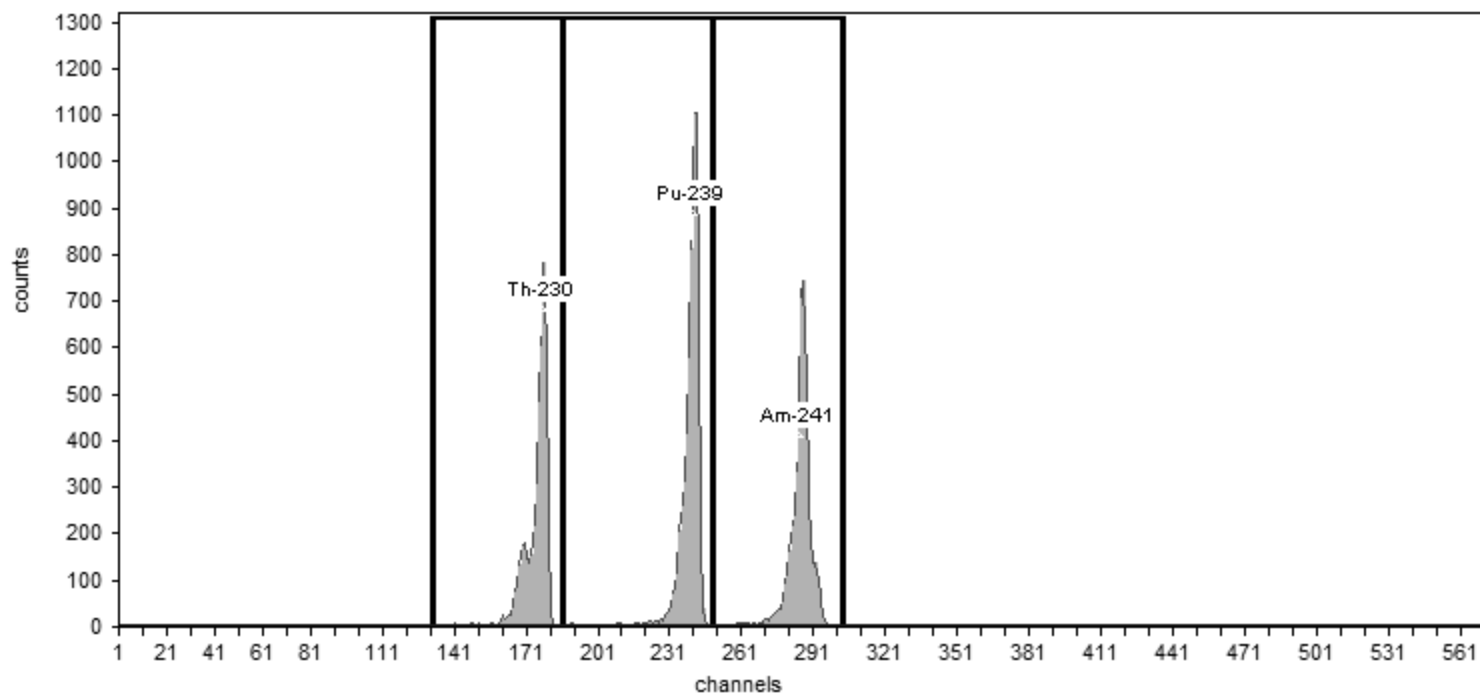
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-8874;AV147-20151026

Efficiency: 26.56% +/- 0.50% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: No

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.32	4,467.00	74.45
Pu-239	240	5,155.40	186	249	32.83	6,174.00	102.90
Am-241	284	5,485.70	249	303	32.02	4,766.00	79.43

Sample Name: ICV-9817;AV154-20151026

Description:

Detector: AV154

### Calibration

Analyst: 60040

Analysis Date: 10/26/2015 8:21:09PM

Calibration Type: Energy And Efficiency

Certificate ID: 82244-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/9/2010 12:00:00PM

### Acquisition

Detector: AV154 , SN: 50-05/JJ7

Acquisition Start Date: 10/26/2015 7:11:54PM

Live Time: 60.00 min.

Real Time: 60.00 min.

Energy Calibration Equation:

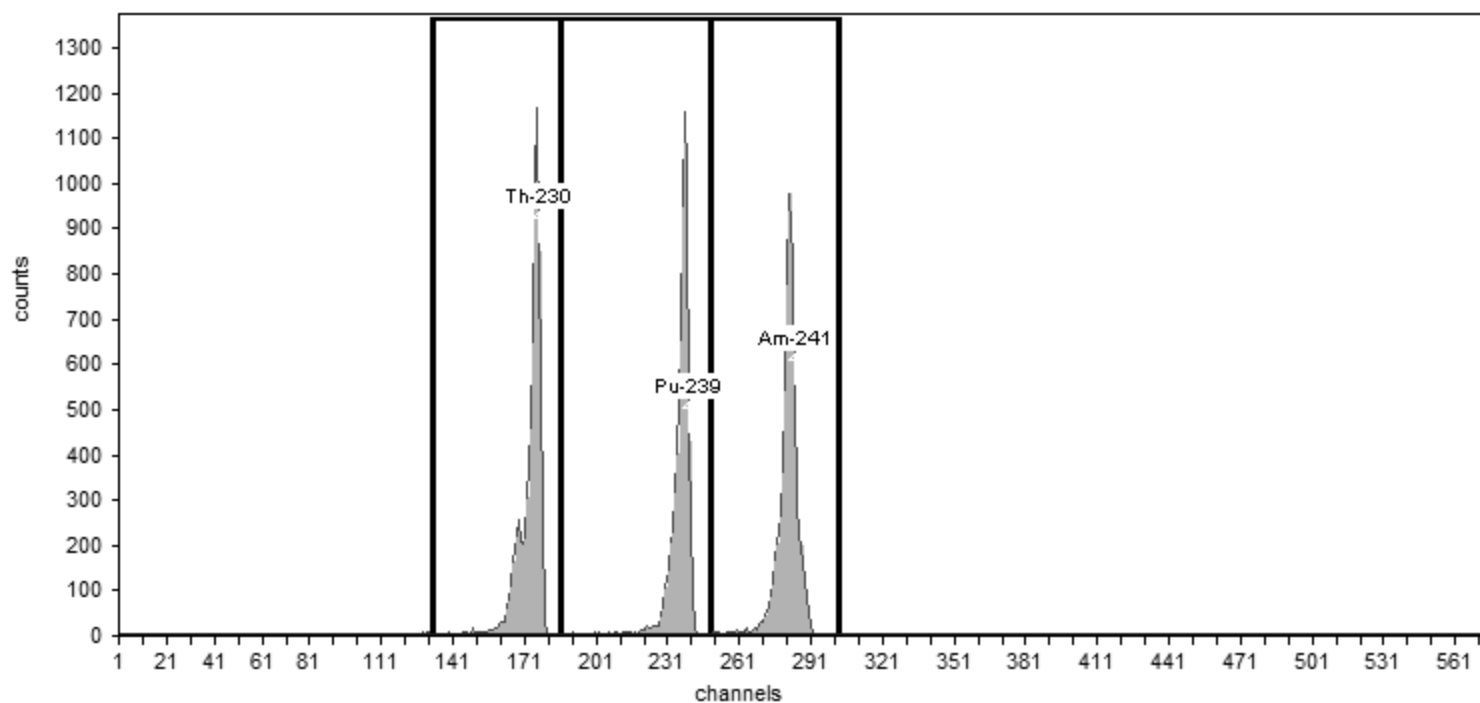
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-9817;AV154-20151026

Efficiency: 24.59% +/- 0.41% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: No

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	28.21	6,412.00	106.87
Pu-239	240	5,155.40	186	249	30.02	6,004.00	100.07
Am-241	284	5,485.70	249	303	33.36	6,101.00	101.68

Sample Name: ICV-8875;AV158-20151026

Description:

Detector: AV158

### Calibration

Analyst: 60040

Analysis Date: 10/26/2015 8:21:23PM

Calibration Type: Energy And Efficiency

Certificate ID: 82234-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/2/2010 12:00:00PM

### Acquisition

Detector: AV158 , SN: 50-05/II4

Acquisition Start Date: 10/26/2015 7:13:00PM

Live Time: 60.00 min.

Real Time: 60.00 min.

Energy Calibration Equation:

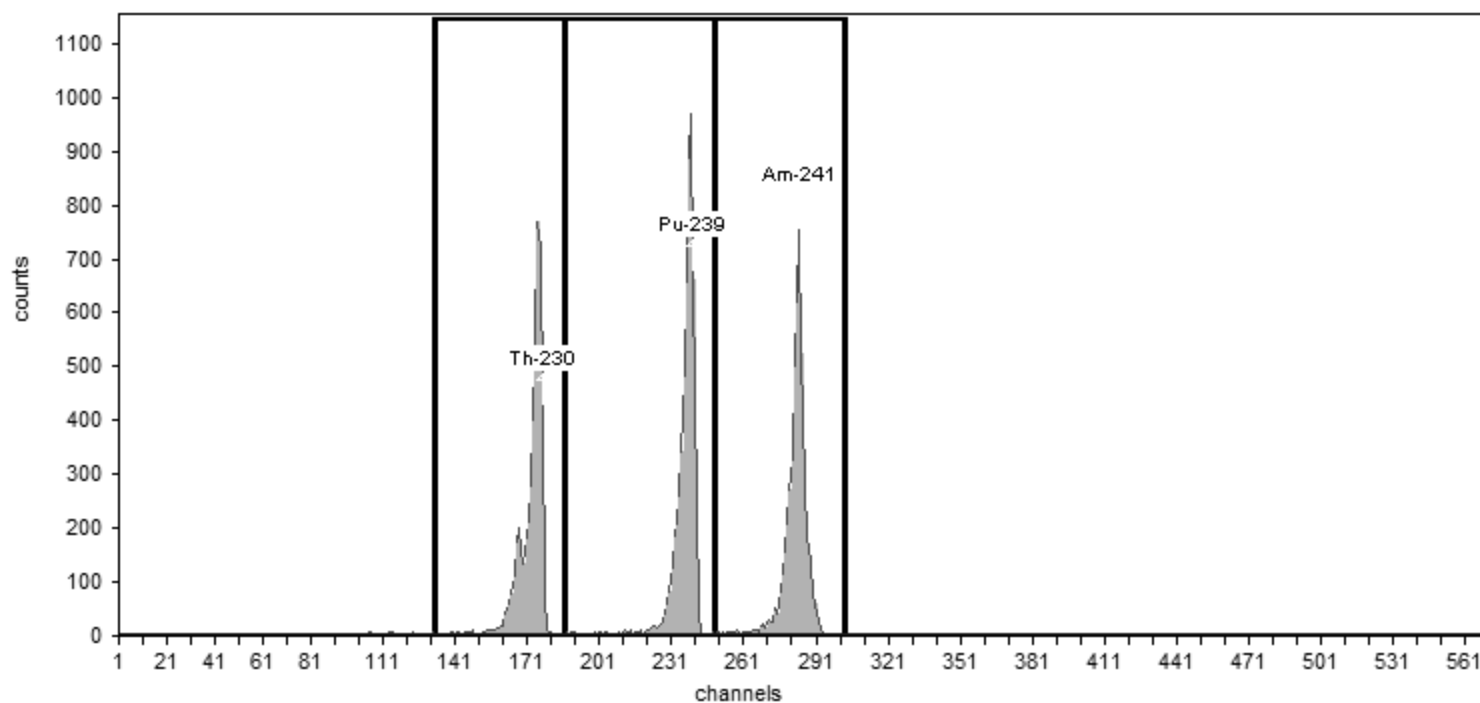
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-8875;AV158-20151026

Efficiency: 23.84% +/- 0.45% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: No

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	31.31	4,668.00	77.80
Pu-239	240	5,155.40	186	249	32.94	5,406.00	90.10
Am-241	284	5,485.70	249	303	32.15	4,748.00	79.13



Sample Name: ICV-9885;AV165-20151026  
Description:  
Detector: AV165

### Calibration

Analyst: 60040  
Analysis Date: 10/27/2015 2:14:05PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82246-334  
Prepared by: Analytics  
Description:

### Source Info

Certification Date: 6/9/2010 12:00:00PM

### Acquisition

Detector: AV165 , SN: 50-112F7  
Acquisition Start Date: 10/26/2015 8:27:21PM

Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:

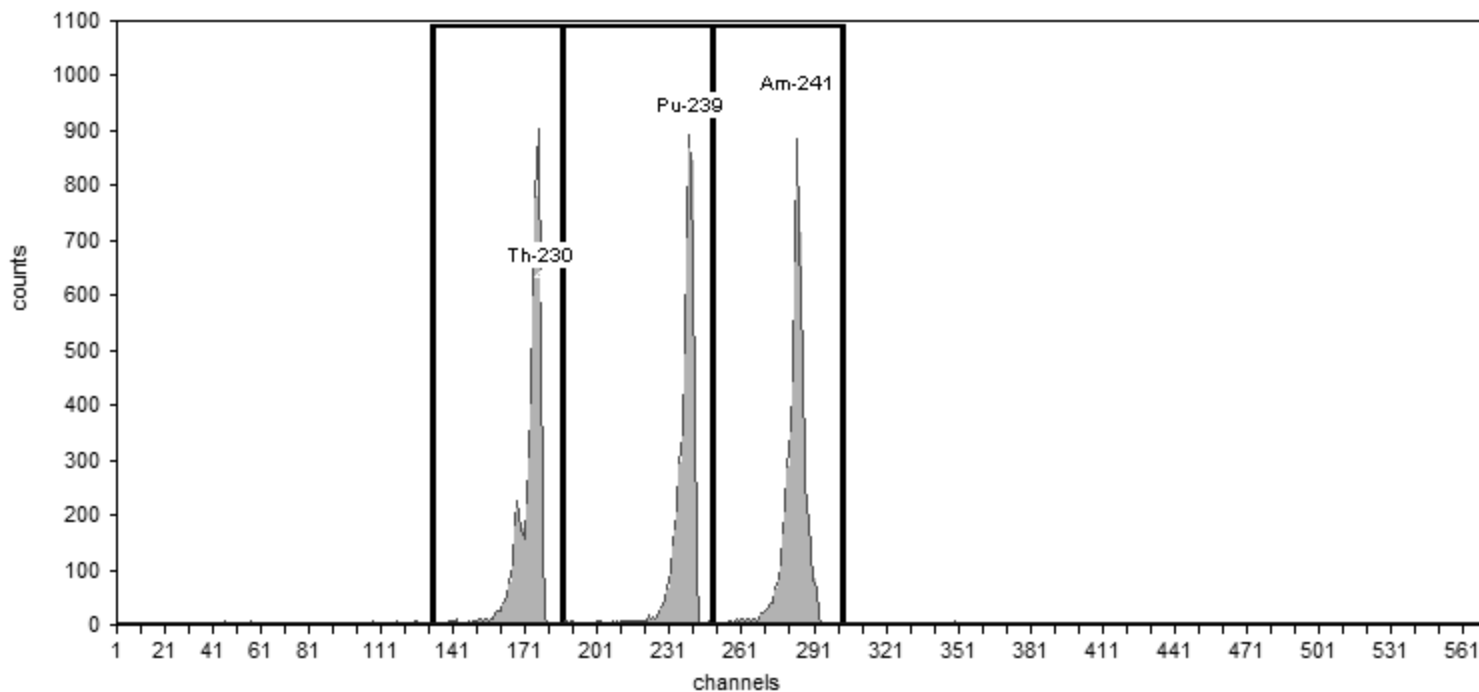
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-9885;AV165-20151026

Efficiency: 26.28% +/- 0.50% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.05	5,301.00	88.35
Pu-239	240	5,155.40	186	249	31.71	5,011.00	83.52
Am-241	284	5,485.70	249	303	31.12	5,658.00	94.30

Sample Name: ICV-9817;AV168-20151026a  
Description:  
Detector: AV168

### Calibration

Analyst: 60040  
Analysis Date: 10/27/2015 2:14:46PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82244-334  
Prepared by: Analytics  
Description:

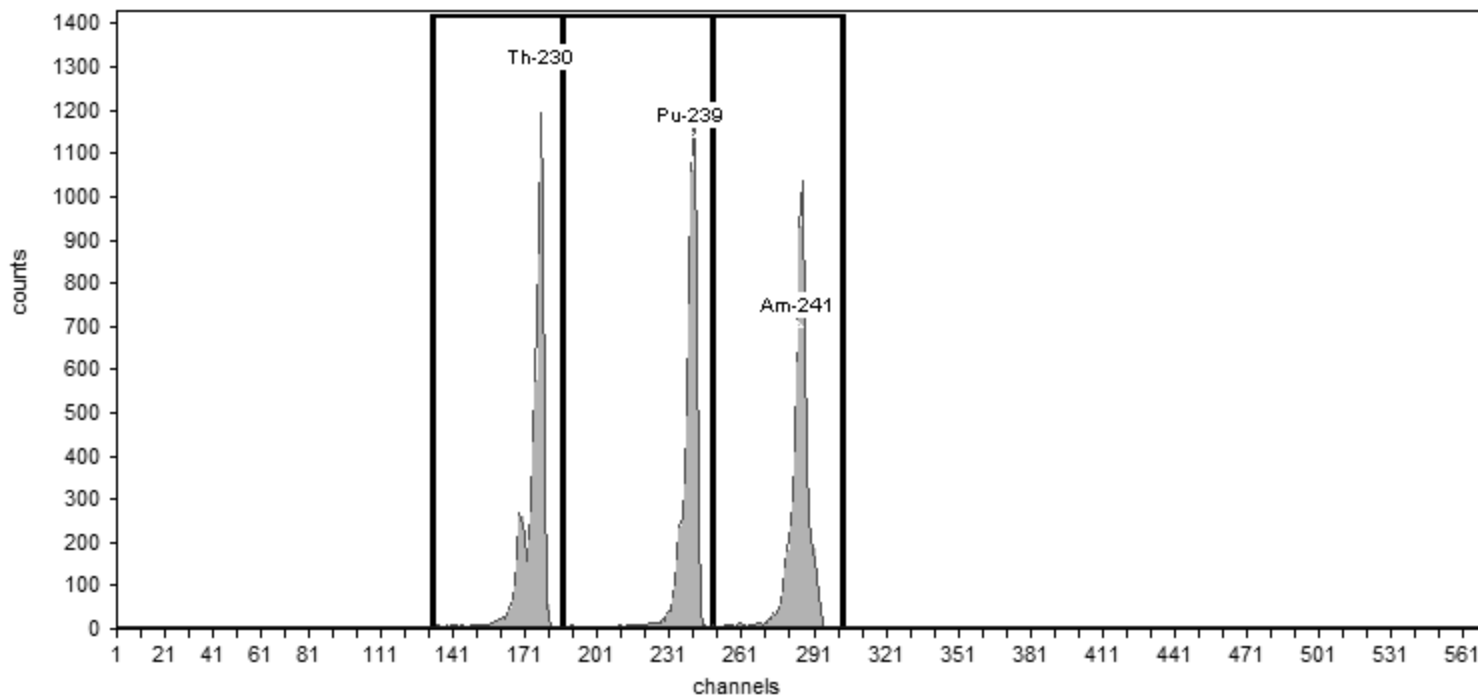
### Source Info

Certification Date: 6/9/2010 12:00:00PM

### Acquisition

Detector: AV168 , SN: 50-113 G4  
Acquisition Start Date: 10/26/2015 8:32:38PM  
Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency Calibration Name: ICV-9817;AV168-20151026a  
Efficiency: 24.62% +/- 0.41% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	26.50	6,422.00	107.03
Pu-239	240	5,155.40	186	249	29.31	5,938.00	98.97
Am-241	284	5,485.70	249	303	30.05	6,184.00	103.07

Sample Name: ICV-9520;AV169-20151026

Description:

Detector: AV169

### Calibration

Analyst: 60040

Analysis Date: 10/27/2015 2:14:18PM

Calibration Type: Energy And Efficiency

Certificate ID: 82237-334

Prepared by: Analytics

Description:

### Source Info

Certification Date: 6/1/2010 12:00:00PM

### Acquisition

Detector: AV169 , SN: 50-112 G5

Acquisition Start Date: 10/26/2015 8:28:24PM

Live Time: 60.00 min.

Real Time: 60.00 min.

Energy Calibration Equation:

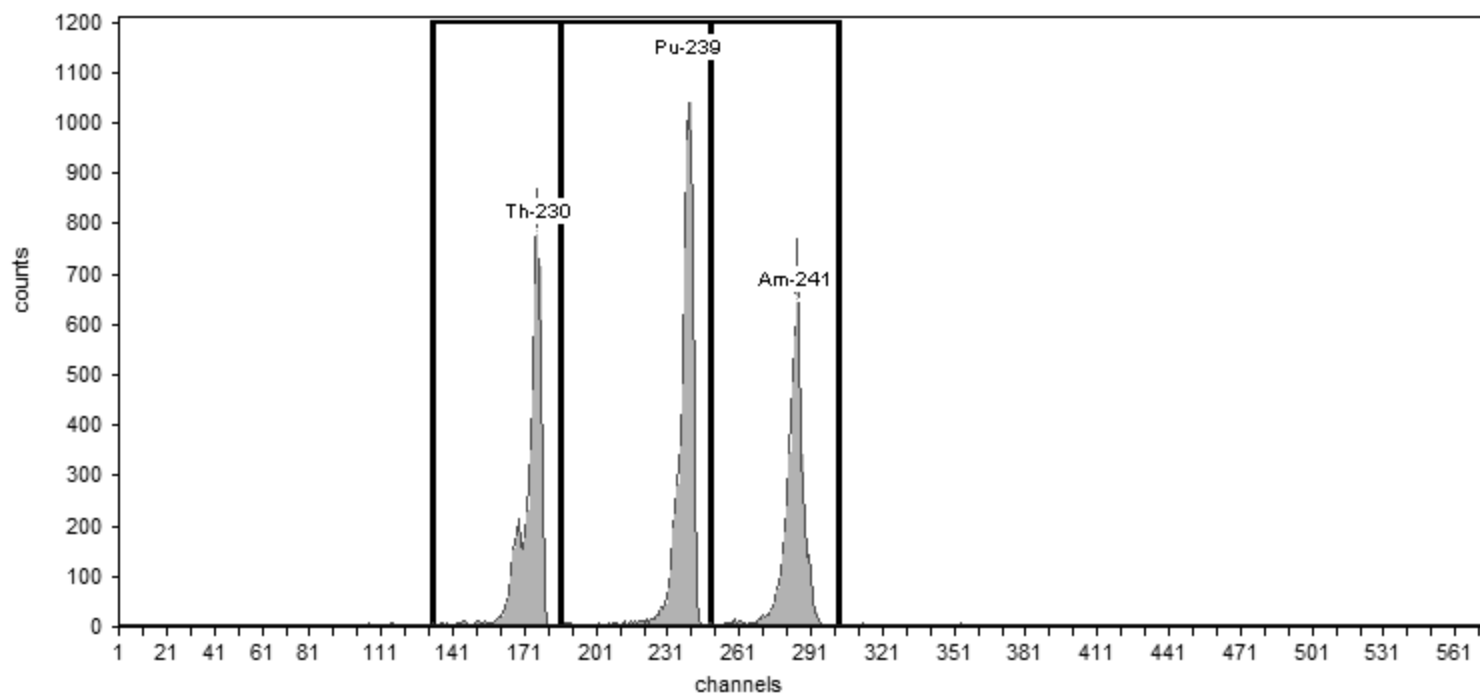
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: ICV-9520;AV169-20151026

Efficiency: 24.61% +/- 0.46% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)

Algorithm: Linear

Initial Calibration: No

Shelf: 0

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	29.53	5,052.00	84.20
Pu-239	240	5,155.40	186	249	33.21	5,973.00	99.55
Am-241	284	5,485.70	249	303	33.98	4,794.00	79.90

# Monthly Calibration Verifications

Sample Name: CCV-7107;AV147-20160906a  
Description:  
Detector: AV147

### Calibration

Analyst: 60040  
Analysis Date: 9/6/2016 4:33:24PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82232-334  
Prepared by: Analytics  
Description:

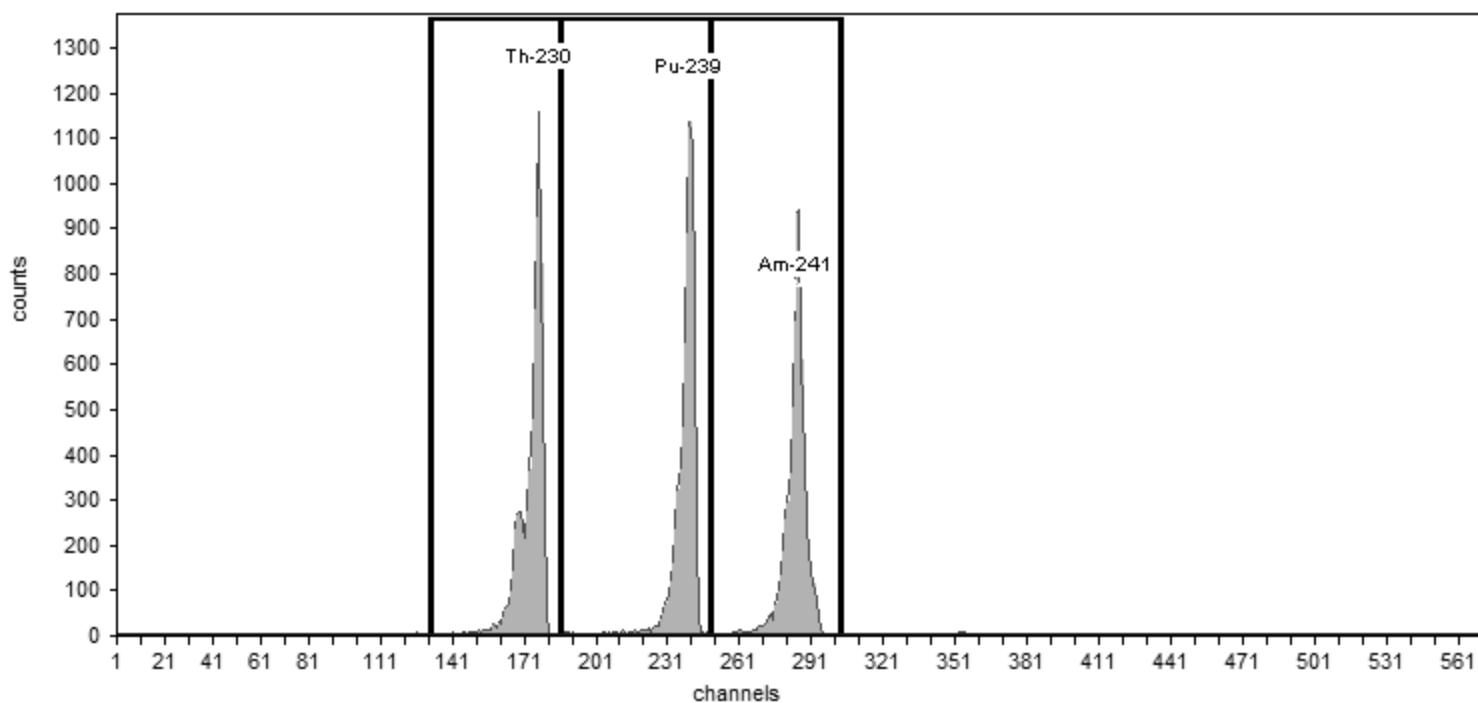
### Source Info

Certification Date: 6/3/2010 12:00:00PM

### Acquisition

Detector: AV147 , SN: 50-05/R1  
Acquisition Start Date: 9/6/2016 3:28:58PM  
Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency Calibration Name: CCV-7107;AV147-20160906a  
Efficiency: 25.66% +/- 0.40% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.20	6,917.00	115.28
Pu-239	240	5,155.40	186	249	35.15	6,832.00	113.87
Am-241	284	5,485.70	249	303	36.47	6,575.00	109.58

Sample Name: CCV-9793;AV154-20160906  
Description:  
Detector: AV154

### Calibration

Analyst: 60040  
Analysis Date: 9/6/2016 1:43:02PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82241-334  
Prepared by: Analytics  
Description:

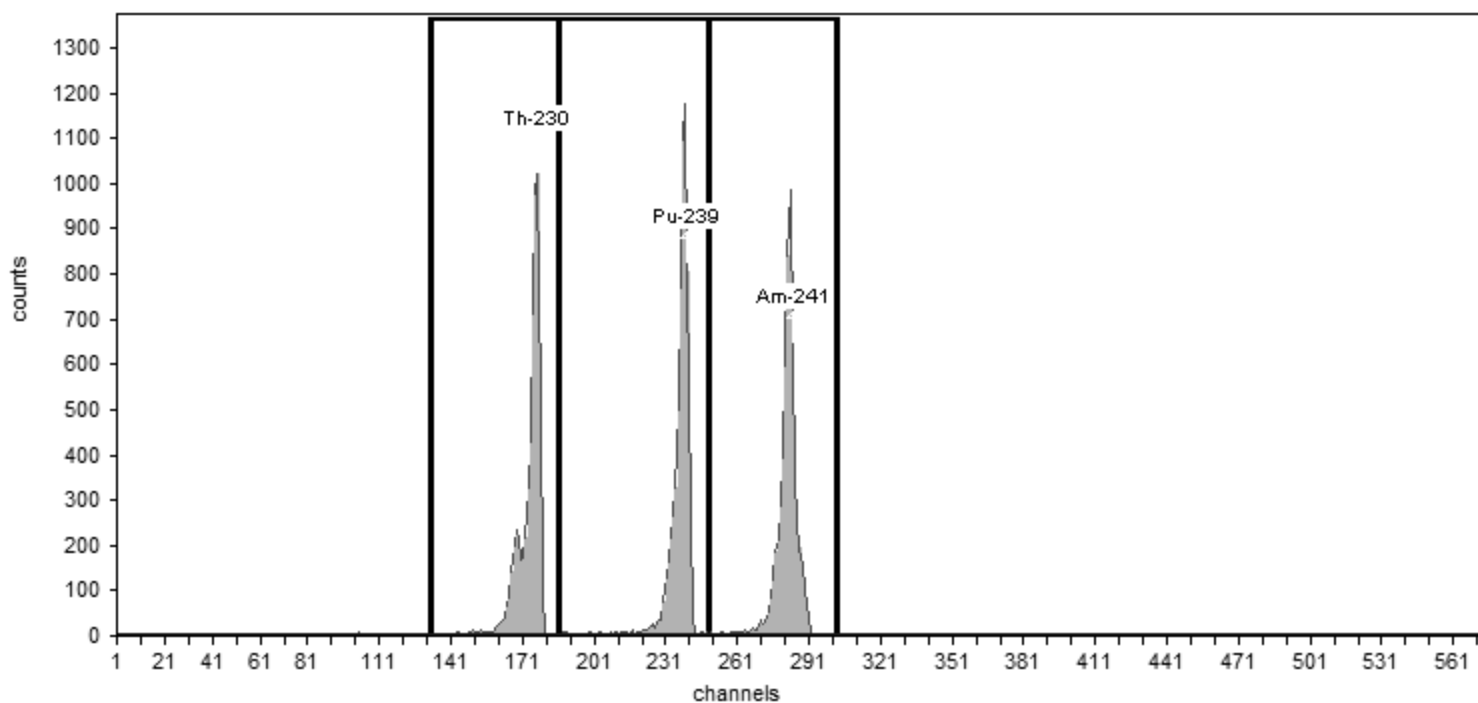
### Source Info

Certification Date: 6/8/2010 12:00:00PM

### Acquisition

Detector: AV154 , SN: 50-05/JJ7  
Acquisition Start Date: 9/6/2016 12:40:22PM  
Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency Calibration Name: CCV-9793;AV154-20160906  
Efficiency: 24.35% +/- 0.41% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	27.82	5,737.00	95.62
Pu-239	240	5,155.40	186	249	30.27	6,076.00	101.27
Am-241	284	5,485.70	249	303	29.68	5,725.00	95.42

Sample Name: CCV-9884;AV158-20160906  
Description:  
Detector: AV158

### Calibration

Analyst: 60040  
Analysis Date: 9/6/2016 4:33:06PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82245-334  
Prepared by: Analytics  
Description:

### Source Info

Certification Date: 6/9/2010 12:00:00PM

### Acquisition

Detector: AV158 , SN: 50-05/II4  
Acquisition Start Date: 9/6/2016 3:24:21PM

Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:

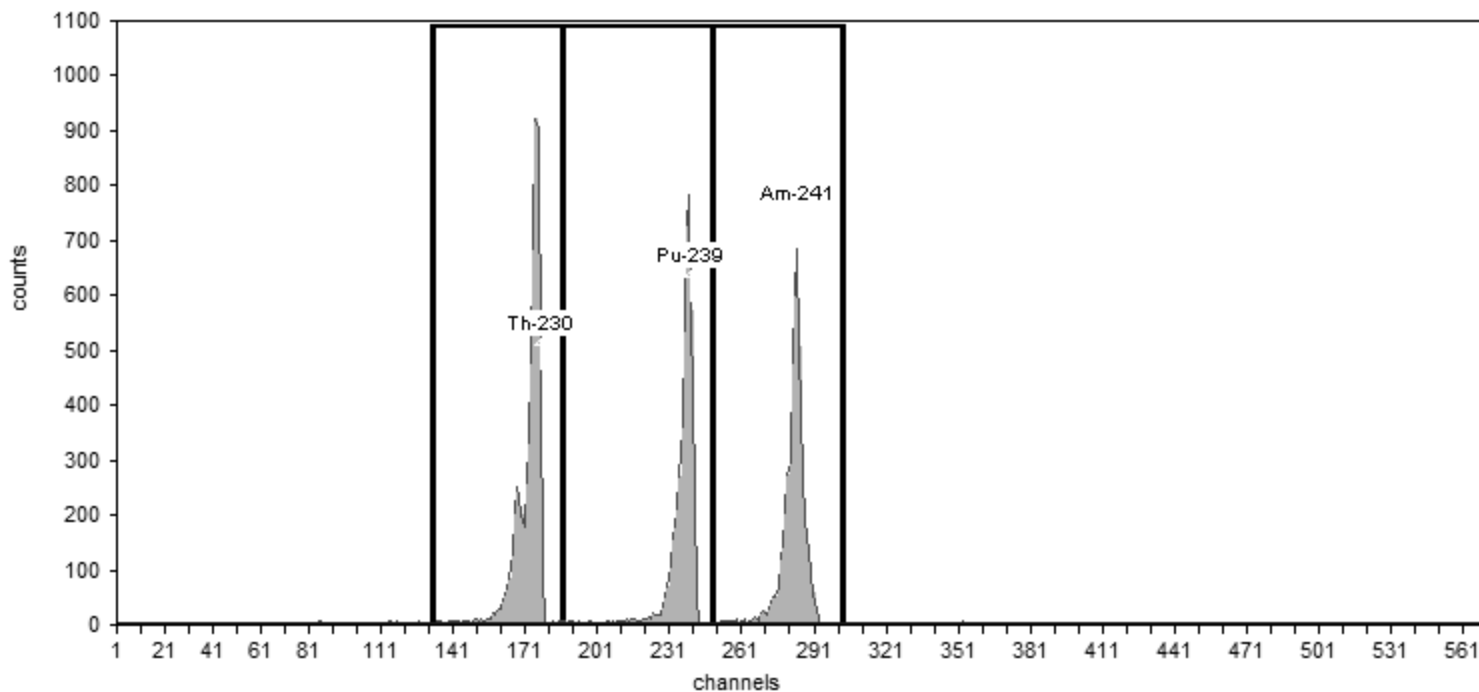
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: CCV-9884;AV158-20160906

Efficiency: 23.25% +/- 0.45% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.27	5,704.00	95.07
Pu-239	240	5,155.40	186	249	32.47	4,502.00	75.03
Am-241	284	5,485.70	249	303	33.06	4,558.00	75.97

Sample Name: CCV-8877;AV165-20160906a  
Description:  
Detector: AV165

### Calibration

Analyst: 60040  
Analysis Date: 9/6/2016 4:33:30PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82236-334  
Prepared by: Analytics  
Description:

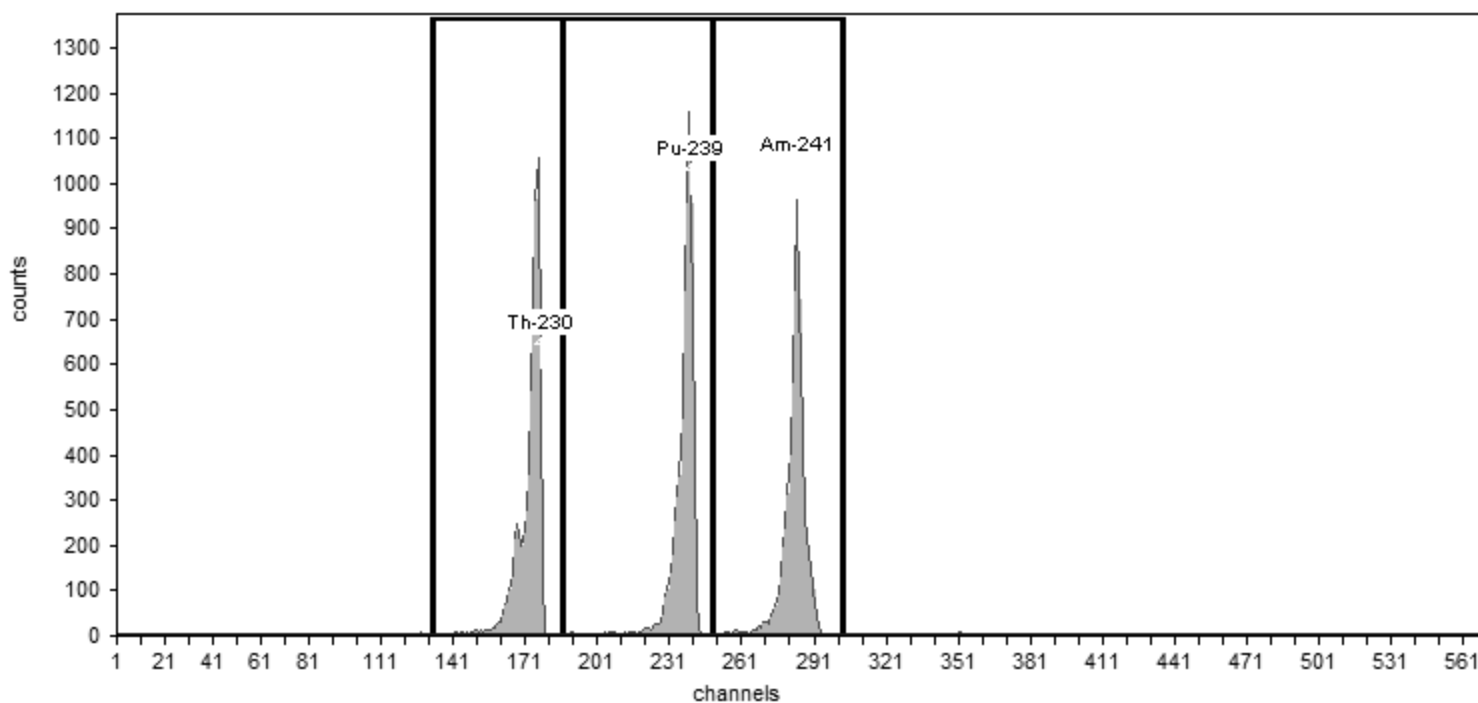
### Source Info

Certification Date: 6/2/2010 12:00:00PM

### Acquisition

Detector: AV165 , SN: 50-112F7  
Acquisition Start Date: 9/6/2016 3:29:15PM  
Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency Calibration Name: CCV-8877;AV165-20160906a  
Efficiency: 25.54% +/- 0.42% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	31.10	6,316.00	105.27
Pu-239	240	5,155.40	186	249	32.48	6,520.00	108.67
Am-241	284	5,485.70	249	303	32.73	6,154.00	102.57



Sample Name: CCV-9793;AV168-20160906  
Description:  
Detector: AV168

### Calibration

Analyst: 60040  
Analysis Date: 9/6/2016 3:08:21PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82241-334  
Prepared by: Analytics  
Description:

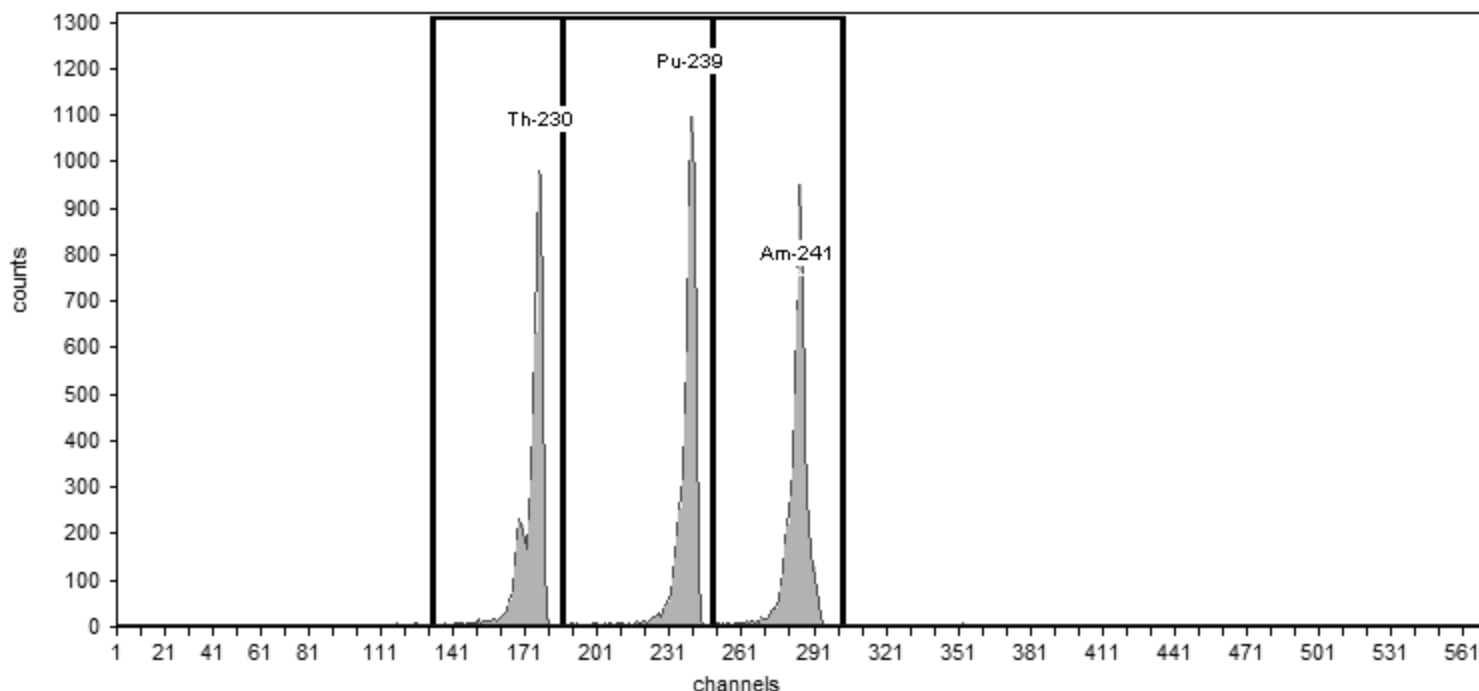
### Source Info

Certification Date: 6/8/2010 12:00:00PM

### Acquisition

Detector: AV168 , SN: 50-113 G4  
Acquisition Start Date: 9/6/2016 1:59:29PM  
Live Time: 60.00 min.  
Real Time: 60.00 min.  
Efficiency Calibration Name: CCV-9793;AV168-20160906

Energy Calibration Equation:  
Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>  
Efficiency: 24.52% +/- 0.42% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	30.53	5,844.00	97.40
Pu-239	240	5,155.40	186	249	31.48	6,042.00	100.70
Am-241	284	5,485.70	249	303	29.95	5,774.00	96.23

Sample Name: CCV-9794;AV169-20160906  
Description:  
Detector: AV169

### Calibration

Analyst: 60040  
Analysis Date: 9/6/2016 3:08:15PM  
Calibration Type: Energy And Efficiency

Certificate ID: 82242-334  
Prepared by: Analytics  
Description:

### Source Info

Certification Date: 6/8/2010 12:00:00PM

### Acquisition

Detector: AV169 , SN: 50-112 G5  
Acquisition Start Date: 9/6/2016 1:59:15PM

Live Time: 60.00 min.  
Real Time: 60.00 min.

Energy Calibration Equation:

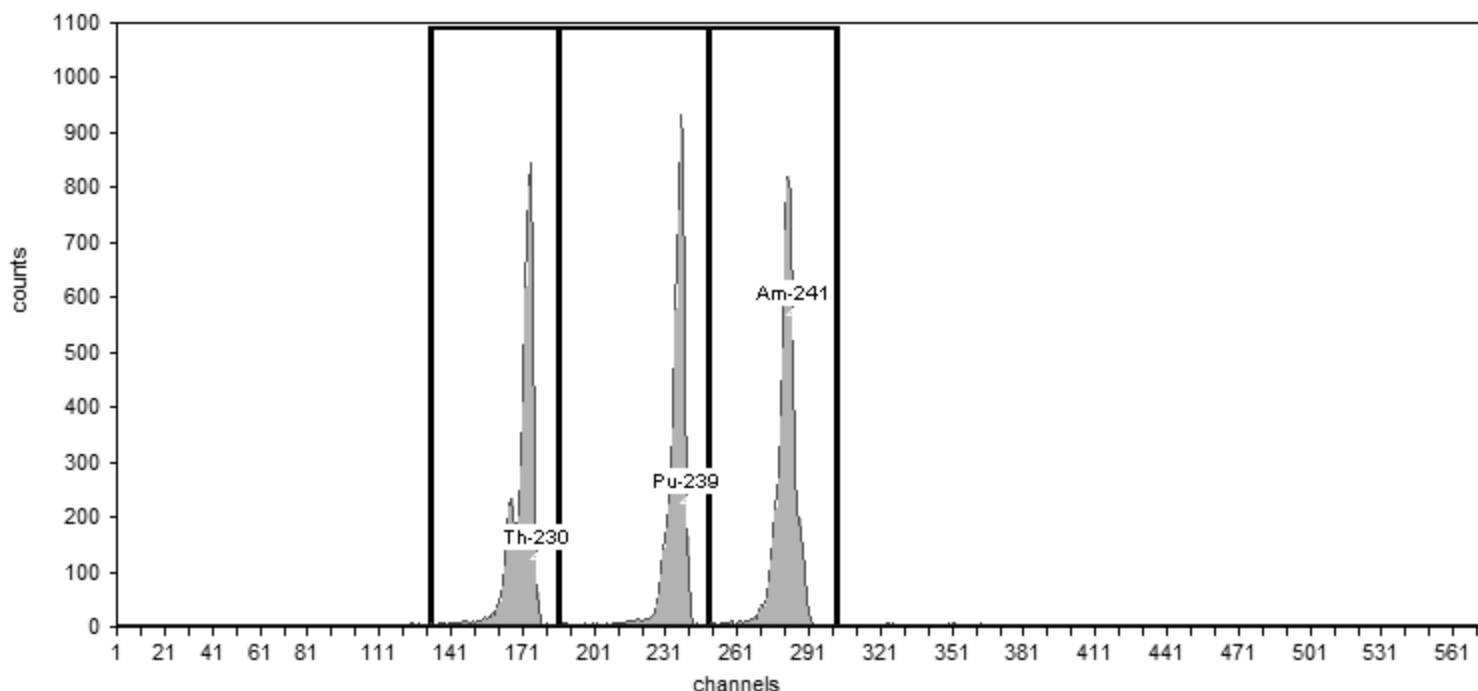
Gain = 7.4575 keV / Ch

Offset = 3,366.95 keV

Quadratic = 0.0000 keV / Ch<sup>2</sup>

Efficiency Calibration Name: CCV-9794;AV169-20160906

Efficiency: 23.31% +/- 0.40% TPU(2 sigma)



### General Analysis

Method: Manual (ROI)  
Algorithm: Linear

Initial Calibration: No  
Shelf: 1

### Nuclide Activity Summary

Nuclide	Peak Channel	Peak Energy keV	ROI Start Channel	ROI End Channel	Peak FWHM keV	Gross Counts	Net Count Rate (cpm)
Th-230	177	4,687.50	132	186	33.39	5,531.00	92.18
Pu-239	240	5,155.40	186	249	35.08	5,456.00	90.93
Am-241	284	5,485.70	249	303	38.94	5,863.00	97.72

# Monthly Backgrounds

Sample Name: **ICB;AV147**

Comment:

### Sample

Spectrum #1 Analysis #1

Analyst: **60040**

Batch Name: **August2016**

Description:

### Batch

### Acquisition

Detector: **AV147**, SN: **50-05/R1**

Acquisition Start Date: **9/1/2016 3:17:26PM**

Live Time: **960.00 min.**

Real Time: **960.00 min.**

Calibration Name: **IC-7107;AV147-20151016**

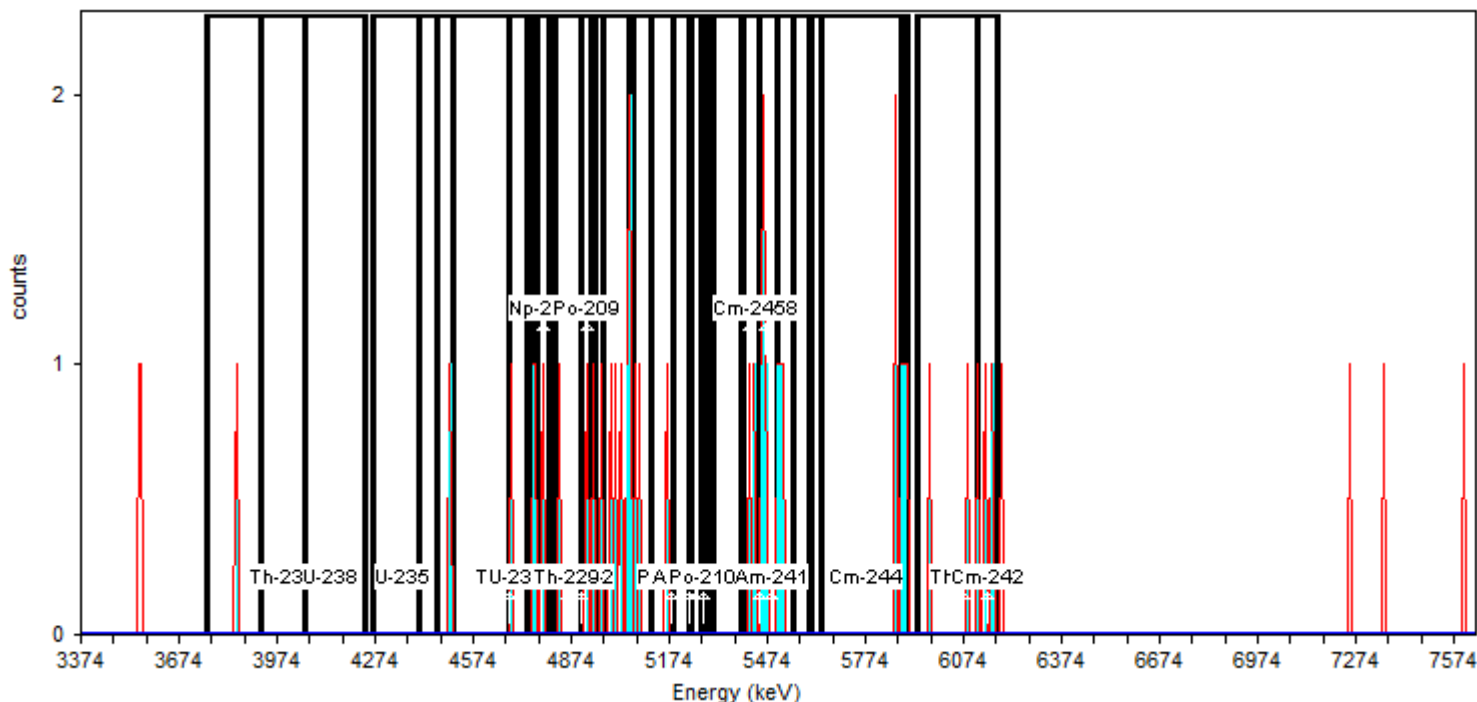
Calibration Date: **10/16/2015 6:46:39PM**

Energy Calibration Equation:

Gain = **7.4575 keV / Ch**

Offset = **3,366.95 keV**

Quadratic = **0.0000 keV / Ch<sup>2</sup>**



### General Analysis

Analysis Method: **Absolute ROI Analysis**, Set Name = **11/05\_BackgroundROI**, Nuclide Library: **Background ROI Library**

Total Background Counts: **44.00**

# **Nuclide Summary (ROI)**

<b><u>RegionName</u></b>	<b><u>Peak Energy</u></b> <b>(keV)</b>	<b><u>Start Energy</u></b> <b>(keV)</b>	<b><u>End Energy</u></b> <b>(keV)</b>	<b><u>GrossCounts</u></b>	<b><u>Count Rate</u></b> <b>(CPM)</b>	<b><u>CR Uncertainty</u></b> <b>(CPM)</b>
Th-232	3,985.93	3,754.75	4,053.05	1.00	1.042E-003	1.473E-003
U-238	4,135.08	3,918.81	4,239.49	0.00	0.000E+000	1.473E-003
U-235	4,358.81	4,261.86	4,463.21	0.00	0.000E+000	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	2.00	2.083E-003	1.804E-003
U-234	4,709.31	4,507.96	4,821.17	4.00	4.167E-003	2.329E-003
Pu-242	4,903.21	4,679.48	4,947.95	7.00	7.292E-003	2.946E-003
Th-229	4,858.46	4,739.14	5,119.48	15.00	1.563E-002	4.167E-003
Np-237	4,783.89	4,768.97	4,806.26	1.00	1.042E-003	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	1.00	1.042E-003	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	9.00	9.375E-003	3.294E-003
Am-243	5,231.34	5,052.36	5,305.92	5.00	5.208E-003	2.552E-003
U-232	5,253.71	5,059.82	5,402.86	3.00	3.125E-003	2.083E-003
Th-228	5,447.61	5,186.59	5,507.27	7.00	7.292E-003	2.946E-003
Po-210	5,276.09	5,231.34	5,291.00	0.00	0.000E+000	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	9.00	9.375E-003	3.294E-003
Am-241	5,484.90	5,298.46	5,604.22	9.00	9.375E-003	3.294E-003
Cm-245	5,417.78	5,395.41	5,447.61	2.00	2.083E-003	1.804E-003
Pu-236	5,760.83	5,611.67	5,887.60	3.00	3.125E-003	2.083E-003
Cm-244	5,775.74	5,641.51	5,902.52	5.00	5.208E-003	2.552E-003
Th-227	6,074.04	5,932.35	6,178.45	5.00	5.208E-003	2.552E-003
Cm-242	6,148.62	6,118.79	6,178.45	3.00	3.125E-003	2.083E-003

Comment:

## Sample

Analyst: 60040

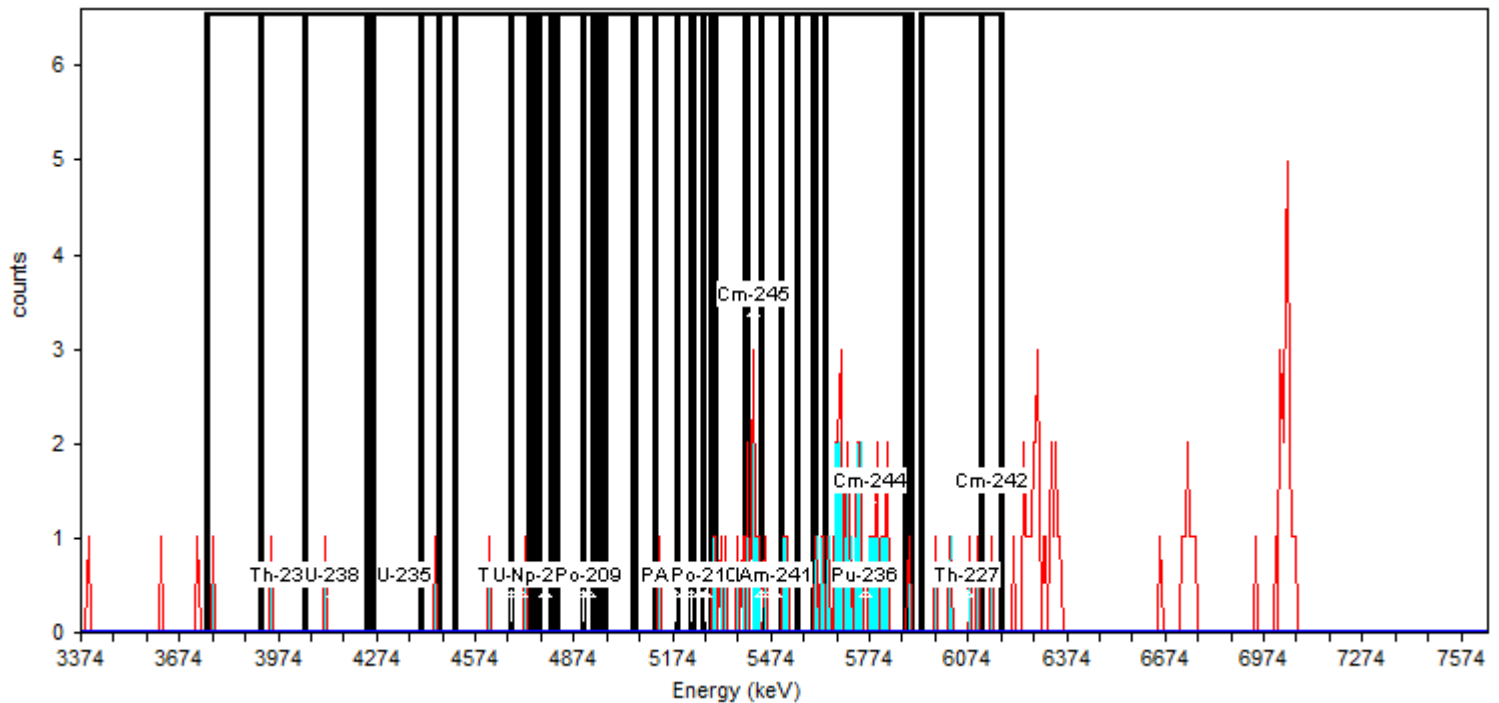
Description:

## Batch

## Acquisition

Energy Calibration Equation:

Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>



## General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = 11/05\_BackgroundROI, Nuclide Library: Background ROI Library  
Total Background Counts: 112.00

# Nuclide Summary (ROI)

<u>RegionName</u>	<u>Peak Energy</u> (keV)	<u>Start Energy</u> (keV)	<u>End Energy</u> (keV)	<u>GrossCounts</u>	<u>Count Rate</u> (CPM)	<u>CR Uncertainty</u> (CPM)
Th-232	3,985.93	3,754.75	4,053.05	2.00	2.083E-003	1.804E-003
U-238	4,135.08	3,918.81	4,239.49	2.00	2.083E-003	1.804E-003
U-235	4,358.81	4,261.86	4,463.21	1.00	1.042E-003	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	3.00	3.125E-003	2.083E-003
U-234	4,709.31	4,507.96	4,821.17	2.00	2.083E-003	1.804E-003
Pu-242	4,903.21	4,679.48	4,947.95	1.00	1.042E-003	1.473E-003
Th-229	4,858.46	4,739.14	5,119.48	0.00	0.000E+000	1.473E-003
Np-237	4,783.89	4,768.97	4,806.26	0.00	0.000E+000	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	1.00	1.042E-003	1.473E-003
Am-243	5,231.34	5,052.36	5,305.92	3.00	3.125E-003	2.083E-003
U-232	5,253.71	5,059.82	5,402.86	9.00	9.375E-003	3.294E-003
Th-228	5,447.61	5,186.59	5,507.27	15.00	1.563E-002	4.167E-003
Po-210	5,276.09	5,231.34	5,291.00	0.00	0.000E+000	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	17.00	1.771E-002	4.419E-003
Am-241	5,484.90	5,298.46	5,604.22	17.00	1.771E-002	4.419E-003
Cm-245	5,417.78	5,395.41	5,447.61	8.00	8.333E-003	3.125E-003
Pu-236	5,760.83	5,611.67	5,887.60	29.00	3.021E-002	5.705E-003
Cm-244	5,775.74	5,641.51	5,902.52	27.00	2.812E-002	5.512E-003
Th-227	6,074.04	5,932.35	6,178.45	5.00	5.208E-003	2.552E-003
Cm-242	6,148.62	6,118.79	6,178.45	1.00	1.042E-003	1.473E-003

Sample Name: **ICB;AV158**

Comment:

### Sample

Spectrum #1 Analysis #1

Analyst: **60040**

Batch Name: **August2016a**

Description:

### Batch

### Acquisition

Detector: **AV158**, SN: **50-05/II4**

Acquisition Start Date: **9/2/2016 10:55:25AM**

Live Time: **960.00 min.**

Real Time: **960.00 min.**

Calibration Name: **IC-9884;AV158-20151016**

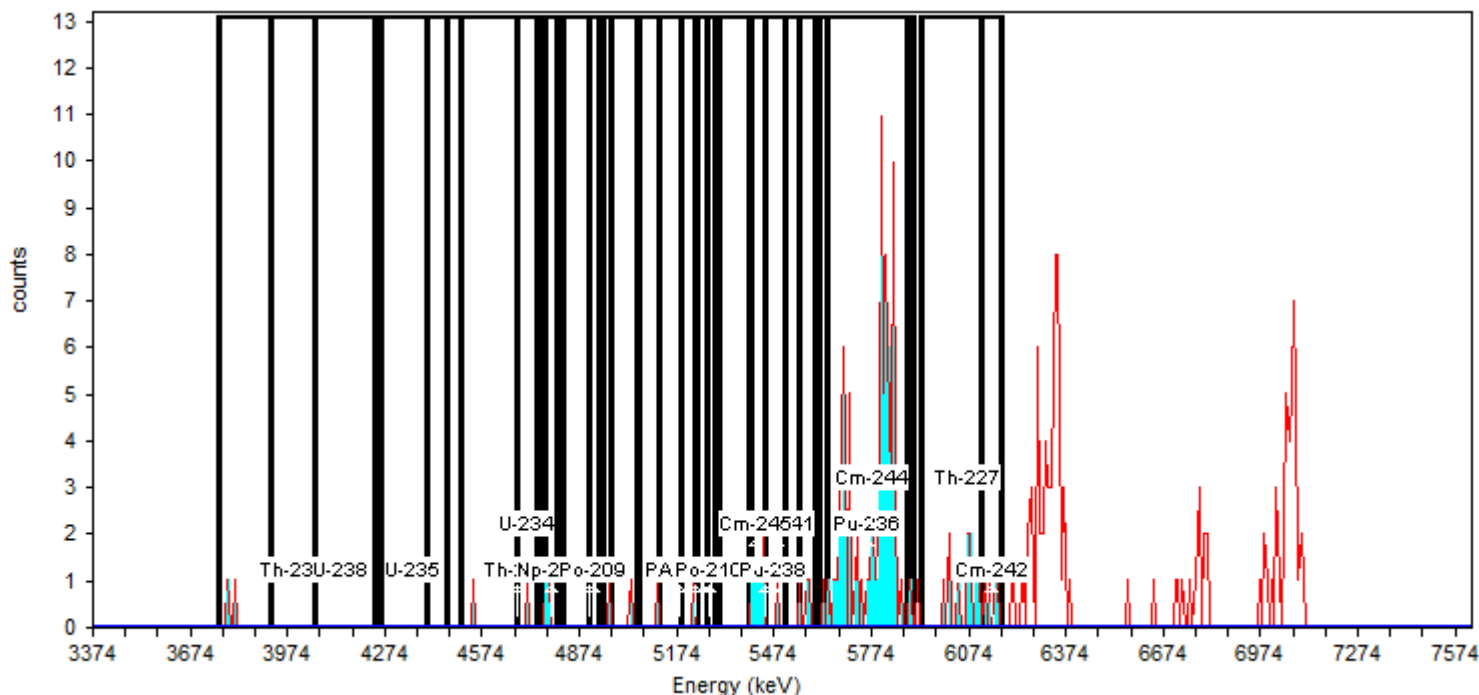
Calibration Date: **10/16/2015 6:47:11PM**

Energy Calibration Equation:

Gain = **7.4575 keV / Ch**

Offset = **3,366.95 keV**

Quadratic = **0.0000 keV / Ch<sup>2</sup>**



### General Analysis

Analysis Method: **Absolute ROI Analysis**, Set Name = **11/05\_BackgroundROI**, Nuclide Library: **Background ROI Library**

Total Background Counts: **237.00**



# Nuclide Summary (ROI)

<u>RegionName</u>	<u>Peak Energy</u> (keV)	<u>Start Energy</u> (keV)	<u>End Energy</u> (keV)	<u>GrossCounts</u>	<u>Count Rate</u> (CPM)	<u>CR Uncertainty</u> (CPM)
Th-232	3,985.93	3,754.75	4,053.05	2.00	2.083E-003	1.804E-003
U-238	4,135.08	3,918.81	4,239.49	0.00	0.000E+000	1.473E-003
U-235	4,358.81	4,261.86	4,463.21	0.00	0.000E+000	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	2.00	2.083E-003	1.804E-003
U-234	4,709.31	4,507.96	4,821.17	4.00	4.167E-003	2.329E-003
Pu-242	4,903.21	4,679.48	4,947.95	3.00	3.125E-003	2.083E-003
Th-229	4,858.46	4,739.14	5,119.48	5.00	5.208E-003	2.552E-003
Np-237	4,783.89	4,768.97	4,806.26	2.00	2.083E-003	1.804E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	3.00	3.125E-003	2.083E-003
Am-243	5,231.34	5,052.36	5,305.92	2.00	2.083E-003	1.804E-003
U-232	5,253.71	5,059.82	5,402.86	3.00	3.125E-003	2.083E-003
Th-228	5,447.61	5,186.59	5,507.27	9.00	9.375E-003	3.294E-003
Po-210	5,276.09	5,231.34	5,291.00	0.00	0.000E+000	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	9.00	9.375E-003	3.294E-003
Am-241	5,484.90	5,298.46	5,604.22	11.00	1.146E-002	3.608E-003
Cm-245	5,417.78	5,395.41	5,447.61	7.00	7.292E-003	2.946E-003
Pu-236	5,760.83	5,611.67	5,887.60	83.00	8.646E-002	9.547E-003
Cm-244	5,775.74	5,641.51	5,902.52	83.00	8.646E-002	9.547E-003
Th-227	6,074.04	5,932.35	6,178.45	15.00	1.563E-002	4.167E-003
Cm-242	6,148.62	6,118.79	6,178.45	4.00	4.167E-003	2.329E-003

Sample Name: **ICB;AV165**

Comment:

### Sample

Spectrum #1 Analysis #1

Analyst: **60040**

### Batch

Batch Name: **August2016**

Description:

### Acquisition

Detector: **AV165**, SN: **50-112F7**

Acquisition Start Date: **9/1/2016 3:17:12PM**

Live Time: **960.00 min.**

Real Time: **960.08 min.**

Calibration Name: **IC-8877;AV165-20151016**

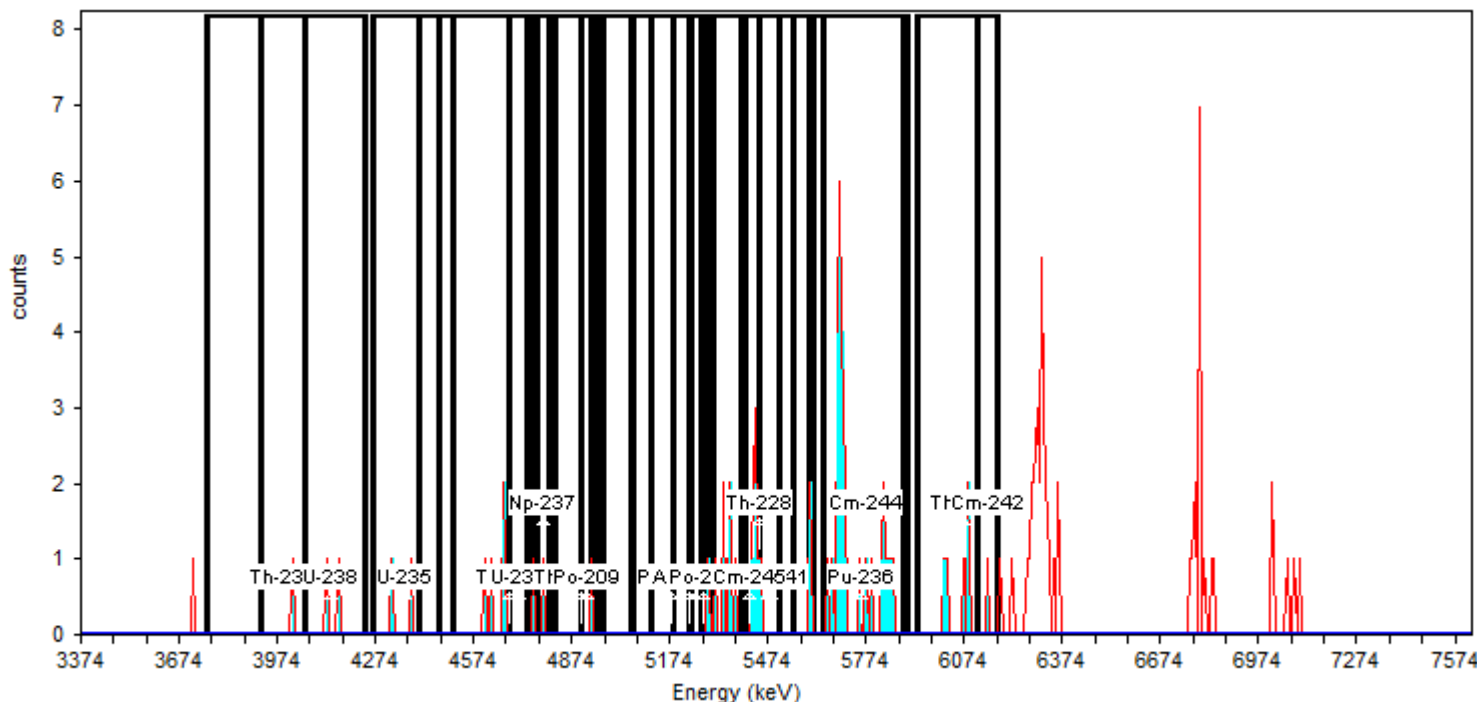
Calibration Date: **10/17/2015 2:36:40PM**

Energy Calibration Equation:

Gain = **7.4575 keV / Ch**

Offset = **3,366.95 keV**

Quadratic = **0.0000 keV / Ch<sup>2</sup>**



### General Analysis

Analysis Method: **Absolute ROI Analysis**, Set Name = **11/05\_BackgroundROI**, Nuclide Library: **Background ROI Library**

Total Background Counts: **109.00**

# Nuclide Summary (ROI)

<u>RegionName</u>	<u>Peak Energy</u> (keV)	<u>Start Energy</u> (keV)	<u>End Energy</u> (keV)	<u>GrossCounts</u>	<u>Count Rate</u> (CPM)	<u>CR Uncertainty</u> (CPM)
Th-232	3,985.93	3,754.75	4,053.05	1.00	1.042E-003	1.473E-003
U-238	4,135.08	3,918.81	4,239.49	3.00	3.125E-003	2.083E-003
U-235	4,358.81	4,261.86	4,463.21	2.00	2.083E-003	1.804E-003
Th-230	4,679.48	4,403.55	4,746.60	4.00	4.167E-003	2.329E-003
U-234	4,709.31	4,507.96	4,821.17	6.00	6.250E-003	2.756E-003
Pu-242	4,903.21	4,679.48	4,947.95	3.00	3.125E-003	2.083E-003
Th-229	4,858.46	4,739.14	5,119.48	3.00	3.125E-003	2.083E-003
Np-237	4,783.89	4,768.97	4,806.26	1.00	1.042E-003	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	1.00	1.042E-003	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	0.00	0.000E+000	1.473E-003
Am-243	5,231.34	5,052.36	5,305.92	1.00	1.042E-003	1.473E-003
U-232	5,253.71	5,059.82	5,402.86	7.00	7.292E-003	2.946E-003
Th-228	5,447.61	5,186.59	5,507.27	14.00	1.458E-002	4.034E-003
Po-210	5,276.09	5,231.34	5,291.00	1.00	1.042E-003	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	14.00	1.458E-002	4.034E-003
Am-241	5,484.90	5,298.46	5,604.22	15.00	1.563E-002	4.167E-003
Cm-245	5,417.78	5,395.41	5,447.61	6.00	6.250E-003	2.756E-003
Pu-236	5,760.83	5,611.67	5,887.60	28.00	2.917E-002	5.610E-003
Cm-244	5,775.74	5,641.51	5,902.52	28.00	2.917E-002	5.610E-003
Th-227	6,074.04	5,932.35	6,178.45	6.00	6.250E-003	2.756E-003
Cm-242	6,148.62	6,118.79	6,178.45	1.00	1.042E-003	1.473E-003



# **Nuclide Summary (ROI)**

<b><u>RegionName</u></b>	<b><u>Peak Energy</u></b>	<b><u>Start Energy</u></b>	<b><u>End Energy</u></b>	<b><u>GrossCounts</u></b>	<b><u>Count Rate</u></b>	<b><u>CR Uncertainty</u></b>
	<b>(keV)</b>	<b>(keV)</b>	<b>(keV)</b>		<b>(CPM)</b>	<b>(CPM)</b>
Th-232	3,985.93	3,754.75	4,053.05	1.00	1.042E-003	1.473E-003
U-238	4,135.08	3,918.81	4,239.49	2.00	2.083E-003	1.804E-003
U-235	4,358.81	4,261.86	4,463.21	0.00	0.000E+000	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	1.00	1.042E-003	1.473E-003
U-234	4,709.31	4,507.96	4,821.17	1.00	1.042E-003	1.473E-003
Pu-242	4,903.21	4,679.48	4,947.95	2.00	2.083E-003	1.804E-003
Th-229	4,858.46	4,739.14	5,119.48	3.00	3.125E-003	2.083E-003
Np-237	4,783.89	4,768.97	4,806.26	0.00	0.000E+000	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	2.00	2.083E-003	1.804E-003
Am-243	5,231.34	5,052.36	5,305.92	2.00	2.083E-003	1.804E-003
U-232	5,253.71	5,059.82	5,402.86	7.00	7.292E-003	2.946E-003
Th-228	5,447.61	5,186.59	5,507.27	11.00	1.146E-002	3.608E-003
Po-210	5,276.09	5,231.34	5,291.00	1.00	1.042E-003	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	11.00	1.146E-002	3.608E-003
Am-241	5,484.90	5,298.46	5,604.22	11.00	1.146E-002	3.608E-003
Cm-245	5,417.78	5,395.41	5,447.61	6.00	6.250E-003	2.756E-003
Pu-236	5,760.83	5,611.67	5,887.60	10.00	1.042E-002	3.455E-003
Cm-244	5,775.74	5,641.51	5,902.52	10.00	1.042E-002	3.455E-003
Th-227	6,074.04	5,932.35	6,178.45	4.00	4.167E-003	2.329E-003
Cm-242	6,148.62	6,118.79	6,178.45	1.00	1.042E-003	1.473E-003

Comment:

Analyst: 60040

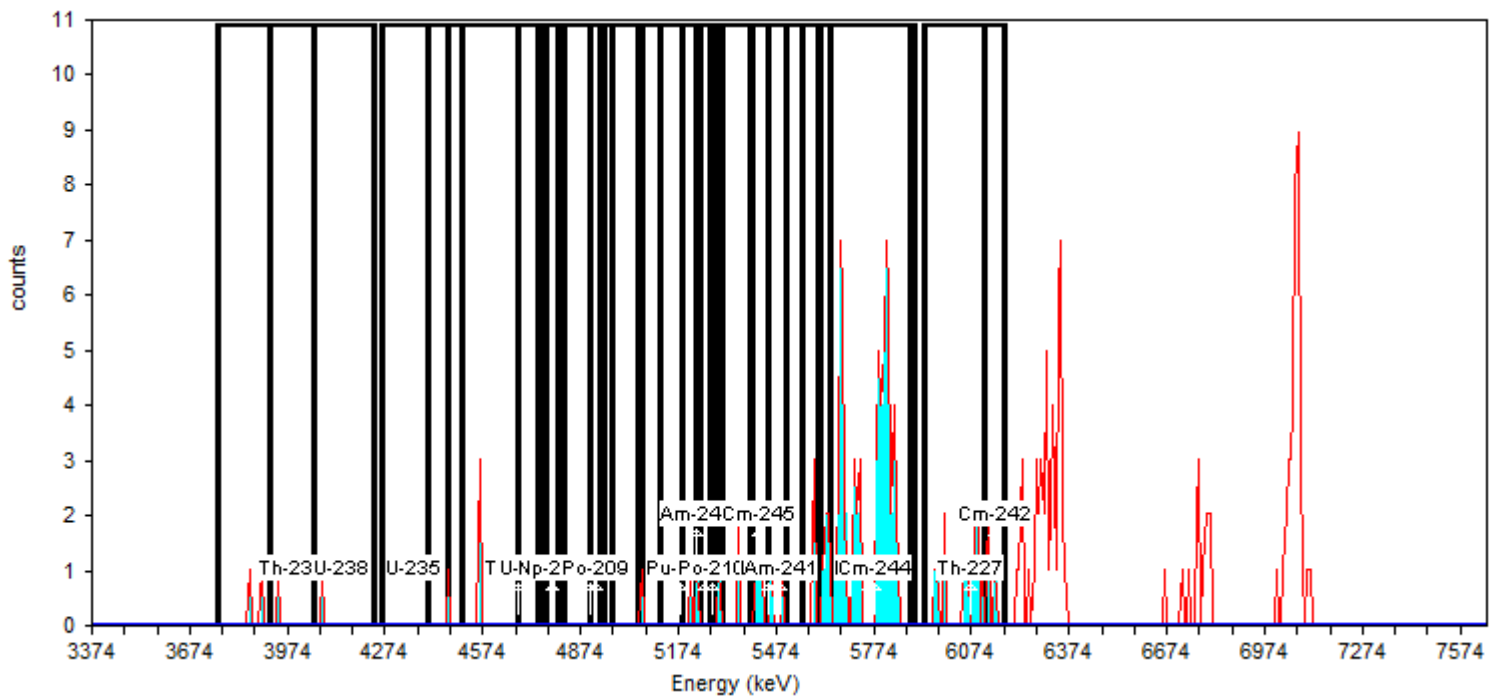
Description:

## Batch

## Acquisition

Energy Calibration Equation:

Gain = 7.4575 keV / Ch  
Offset = 3,366.95 keV  
Quadratic = 0.0000 keV / Ch<sup>2</sup>



## General Analysis

Analysis Method: Absolute ROI Analysis, Set Name = 11/05\_BackgroundROI, Nuclide Library: Background ROI Library  
Total Background Counts: 210.00

# Nuclide Summary (ROI)

<u>RegionName</u>	<u>Peak Energy</u> (keV)	<u>Start Energy</u> (keV)	<u>End Energy</u> (keV)	<u>GrossCounts</u>	<u>Count Rate</u> (CPM)	<u>CR Uncertainty</u> (CPM)
Th-232	3,985.93	3,754.75	4,053.05	3.00	3.125E-003	2.083E-003
U-238	4,135.08	3,918.81	4,239.49	2.00	2.083E-003	1.804E-003
U-235	4,358.81	4,261.86	4,463.21	1.00	1.042E-003	1.473E-003
Th-230	4,679.48	4,403.55	4,746.60	4.00	4.167E-003	2.329E-003
U-234	4,709.31	4,507.96	4,821.17	3.00	3.125E-003	2.083E-003
Pu-242	4,903.21	4,679.48	4,947.95	0.00	0.000E+000	1.473E-003
Th-229	4,858.46	4,739.14	5,119.48	1.00	1.042E-003	1.473E-003
Np-237	4,783.89	4,768.97	4,806.26	0.00	0.000E+000	1.473E-003
Po-209	4,918.12	4,903.21	4,933.04	0.00	0.000E+000	1.473E-003
Pu-239	5,179.14	4,970.33	5,238.80	3.00	3.125E-003	2.083E-003
Am-243	5,231.34	5,052.36	5,305.92	4.00	4.167E-003	2.329E-003
U-232	5,253.71	5,059.82	5,402.86	6.00	6.250E-003	2.756E-003
Th-228	5,447.61	5,186.59	5,507.27	12.00	1.250E-002	3.756E-003
Po-210	5,276.09	5,231.34	5,291.00	1.00	1.042E-003	1.473E-003
Pu-238	5,469.98	5,268.63	5,552.01	10.00	1.042E-002	3.455E-003
Am-241	5,484.90	5,298.46	5,604.22	13.00	1.354E-002	3.898E-003
Cm-245	5,417.78	5,395.41	5,447.61	4.00	4.167E-003	2.329E-003
Pu-236	5,760.83	5,611.67	5,887.60	72.00	7.500E-002	8.900E-003
Cm-244	5,775.74	5,641.51	5,902.52	67.00	6.979E-002	8.590E-003
Th-227	6,074.04	5,932.35	6,178.45	16.00	1.667E-002	4.295E-003
Cm-242	6,148.62	6,118.79	6,178.45	3.00	3.125E-003	2.083E-003

# Run Logs



# Alpha Spectroscopy Run Log

## Detector: AV147

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/16/15 15:47	140	IC 160-223444/1		223444			PS
10/26/15 19:10	60	ICV 160-223562/1		223562			PS
09/01/16 15:17	960	ICB 160-268019/1		268019			PS
09/06/16 15:28	60	CCV 160-268312/1		268312			PS
09/09/16 09:10	1	PULSER 160-268746/1		268746			ALD
09/09/16 10:34	240	160-18555-3	WR111-Composite Air Sample-High Vol	268746	266788	A-01-R	ALD

## Detector: AV154

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/16/15 15:52	140	IC 160-223451/1		223451			PS
10/26/15 19:11	60	ICV 160-223569/1		223569			PS
09/01/16 15:17	960	ICB 160-268026/1		268026			PS
09/06/16 12:40	60	CCV 160-268317/1		268317			PS
09/08/16 10:49	1	PULSER 160-268654/1		268654			ALD
09/08/16 16:01	240	LCS 160-266788/2-A		268654	266788	A-01-R	ALD

## Detector: AV158

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/16/15 15:53	140	IC 160-223455/1		223455			PS
10/26/15 19:13	60	ICV 160-223573/1		223573			PS
09/02/16 10:55	960	ICB 160-268118/1		268118			PS
09/06/16 15:24	60	CCV 160-268318/1		268318			PS
09/08/16 10:49	1	PULSER 160-268655/1		268655			ALD
09/08/16 16:01	240	LCSD 160-266788/3-A		268655	266788	A-01-R	ALD

## Detector: AV165

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/16/15 18:58	140	IC 160-223462/1		223462			PS
10/26/15 20:27	60	ICV 160-223580/1		223580			PS
09/01/16 15:17	960	ICB 160-268037/1		268037			PS
09/06/16 15:29	60	CCV 160-268323/1		268323			PS
09/07/16 12:23	1	PULSER 160-268472/1		268472			ALD
09/07/16 14:44	240	MB 160-266788/1-A		268472	266788	A-01-R	ALD

## Detector: AV168

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/16/15 18:59	140	IC 160-223465/1		223465			PS
10/26/15 20:32	60	ICV 160-223583/1		223583			PS
09/02/16 10:55	960	ICB 160-268124/1		268124			PS
09/06/16 13:59	60	CCV 160-268326/1		268326			PS
09/07/16 12:23	1	PULSER 160-268475/1		268475			ALD
09/07/16 14:44	240	160-18555-1	WR111-Composite Air Sample-BZ	268475	266788	A-01-R	ALD

## Alpha Spectroscopy Run Log

Detector: AV169

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/16/15 18:59	140	IC 160-223466/1		223466			PS
10/26/15 20:28	60	ICV 160-223584/1		223584			PS
09/01/16 15:17	960	ICB 160-268041/1		268041			PS
09/06/16 13:59	60	CCV 160-268327/1		268327			PS
09/07/16 12:23	1	PULSER 160-268476/1		268476			ALD
09/07/16 14:44	240	160-18555-2	WR111-Composite Air Sample-Low Vol	268476	266788	A-01-R	ALD

# Shipping and Receiving Documents

Earth City, MO 63045  
phone 314.298.8566 fax 314.298.8757

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

**TestAmerica Laboratories, Inc.**

[illegible]

## Login Sample Receipt Checklist

Client: EA Engineering, Science, and Technology

Job Number: 160-18555-1

**Login Number: 18555**

**List Source: TestAmerica St. Louis**

**List Number: 1**

**Creator: Daniels, Brian J**

Question	Answer	Comment
Radioactivity wasn't checked or is $\leq$ background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	False	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is $<6\text{mm}$ (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	False	