State of Missouri
Department of Natural Resources

DNR/DEQ/HWP/FFS
West Lake Landfill

STANDARD LEVEL IV
REPORT OF ANALYSIS

WORK ORDER #13-10043-OR

November 6, 2013

EBERLINE ANALYTICAL/OAK RIDGE LABORATORY
OAK RIDGE, TN

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Eberline Services – Oak Ridge Laboratory

LABORATORY DATA SUPPORT CHECKLIST

MP-001-3

Eberline Services Work Order # 13-10043

The checklist items listed below are to be initialed by appropriate staff upon completion/verification.

Date for Partial	Initials	Date	Initials	Checklist Items
		10/10/13	KC	Sample Log-In
		11/4/13	JG	Data Compilation
		11-5-13	MLT	First Technical Data Review
		11/5/13	MSH	Second Technical Data Review
		11/6/13	G	Data Entry/Electronic Deliverable
		11/6/13	G	Case Narrative
		11/06/13	EJT	Electronic Deliverable Proof
		11/6/13	MSH	Samples Analyzed within Holding Time Yes? [X] No? [ ]
		11/20/13	MSH	QA/QC Review
				Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

Technical/Clerical Corrections, Signatures Needed, Problems, Etc	Date/Initials

Date package approved by: _____ 11/21/13

Laboratory Manager Date

Copy No. _____

SECTION I

CHAIN OF CUSTODY
& pH CHECK

Page: 1 of 1
Project #: NJ09WLAK
GEL Quote #:
COC Number (1):
PO Number:

GEL Chain of Custody and Analytical Request

See www.gel.com for GEL's Sample Acceptance SOP

GEL Work Order Number:

GEL Laboratories, LLC
2040 Savage Road
Charleston, SC 29407
Phone: (843) 556-8171
Fax: (843) 766-1178

Client Name: MDNR HWP FFS Phone #: 314-877-3046
Project/Site Name: West Lake Landfill Fax #:
Address: 917 N. Hwy 67 Suite 104 Florissant, MO 63031
Collected by: Shawn Muenks Send Results To: Rita Alexander (rita.alexander@dnr.mo.gov)

Sample Analysis Requested (5) (Fill in the number of containers for each test)

Sample ID (* For composites - indicate start and stop date/time)		*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive	TSCA Regulated	Total number of containers	Isotopic Iodine 131 (Gamma Emitter) Ra 226, 228										<-- Preservative Type (6)	Comments Note: extra sample is required for sample specific QC
WLL20131008E1	4	10/8/2013	1015	N	N	GW				1										No Preservative	
WLL201310008E2	5	10/8/2013	1015	N	Y	GW				1										No Preservative	
WLL20131008F1	6	10/8/2013	1110	N	N	GW				1										No Preservative	
WLL20131008F2	7	10/8/2013	1110	N	Y	GW				1										No Preservative	

13-10043

REC'D OCT 10 2013

TAT Requested: Normal: X Rush: Specify: (Subject to Surcharge) Fax Results: Yes / No Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*

Sample Collection Time Zone: Eastern Pacific Central Other _____ Mountain

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 Shawn Muenks	10/8/13	1632	1 Kristen Coulter	10/10/13	930
2			2		
3			3		

Sample Shipping and Delivery Details

GEL PM:
Method of Shipment: Date Shipped:
Airbill #:
Airbill #:

1.) Chain of Custody Number = Client Determined
2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite
3.) Field Filtered: For liquid matrices, indicate with a - **Y** - for yes the sample was field filtered or - **N** - for sample was not field filtered.
4.) Matrix Codes: **DW**=Drinking Water, **GW**=Groundwater, **SW**=Surface Water, **WW**=Waste Water, **W**=Water, **ML**=Misc Liquid, **SO**=Soil, **SD**=Sediment, **SL**=Sludge, **SS**=Solid Waste, **O**=Oil, **F**=Filter, **P**=Wipe, **U**=Urine, **F**=Fecal, **N**=N
5.) Sample Analysis Requested: Analytical method requested (i.e. **8260B**, **6010B/7470A**) and number of containers provided for each (i.e. *8260B* - **3**, *6010B/7470A* - **1**).
6.) Preservative Type: **HA** = Hydrochloric Acid, **NI** = Nitric Acid, **SH** = Sodium Hydroxide, **SA** = Sulfuric Acid, **AA** = Ascorbic Acid, **HX** = Hexane, **ST** = Sodium Thiosulfate, If no preservative is added = leave field blank

For Lab Receiving Use Only
Custody Seal Intact? *YES* *NO*
Cooler Temp: *C*

WHITE = LABORATORY **YELLOW = FILE** **PINK = CLIENT**

Page: 1 of 2
Project #: NJ09WLAK
GEL Quote #:
COC Number (1):
PO Number:

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Client Name: MDNR HWP FFS Phone #: 314-877-3046

Project/Site Name: West Lake Landfill Fax #:

Address: 917 N. Hwy 67 Suite 104 Florissant, MO 63031

Collected by: Shawn Muenks Send Results To: Rita Alexander (rita.alexander@dnr.mo.gov)

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Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Should this sample be considered: Radioactive	TSCA Regulated	Total number of containers	Isotopic Ra 226, 228										<-- Preservative Type (6) / Comments Note: extra sample is required for sample specific QC
WLL20131008K1 8	10/8/2013	1505	N	N	GW				1										No Preservative
WLL201310008K2 9	10/8/2013	1505	N	Y	GW				1										No Preservative

13-10043

REC'D OCT 10 2013

TAT Requested: Normal: X Rush: Specify: (Subject to Surcharge) Fax Results: Yes / No Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*

Sample Collection Time Zone: Eastern / Pacific / Central / Other _____ / Mountain

Chain of Custody Signatures

Relinquished By (Signed)	Date	Time	Received by (signed)	Date	Time
1 Shawn Muenks	10/08/13	1632	1 Kristen Corlett	10/10/13	930
2			2		
3			3		

Sample Shipping and Delivery Details

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Method of Shipment: Date Shipped:
Airbill #:
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For Lab Receiving Use Only
Custody Seal Intact? *YES* *NO*
Cooler Temp: *C*

WHITE = LABORATORY YELLOW = FILE PINK = CLIENT

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Sample ID (* For composites - indicate start and stop date/time)	*Date Collected (mm-dd-yy)	*Time Collected (Military) (hhmm)	QC Code (2)	Field Filtered (3)	Sample Matrix (4)	Radioactive	TSCA Regulated	Total number of containers	Isotn Isoil Ra 226, 228										<-- Preservative Type (6)	Comments Note: extra sample is required for sample specific QC
WLL20131009L1 10	10/9/2013	955	N	N	GW				1											No Preservative
WLL201310009L2 11	10/9/2013	955	N	Y	GW				1											No Preservative

13-10043

REC'D OCT 10 2013

TAT Requested: Normal: X Rush: Specify: (Subject to Surcharge) Fax Results: Yes / No Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / Level 4

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*

Sample Collection Time Zone
Eastern Pacific
Central Other _____
Mountain

Chain of Custody Signatures

	Relinquished By (Signed)	Date	Time		Received by (signed)	Date	Time
1	Shawn Muenks	10/09/13	1201	1	Kristin Cerlata	10/10/13	930
2				2			
3				3			

Sample Shipping and Delivery Details

GEL PM:
Method of Shipment: Date Shipped:
Airbill #:
Airbill #:

1.) Chain of Custody Number = Client Determined
2.) QC Codes: **N** = Normal Sample, **TB** = Trip Blank, **FD** = Field Duplicate, **EB** = Equipment Blank, **MS** = Matrix Spike Sample, **MSD** = Matrix Spike Duplicate Sample, **G** = Grab, **C** = Composite
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For Lab Receiving Use Only
Custody Seal Intact? *YES* *NO*
Cooler Temp: *C*

WHITE = LABORATORY **YELLOW = FILE** **PINK = CLIENT**

EBERLINE SERVICES Oak Ridge Laboratory	Internal Chain of Custody	Work Order #	13-10043
		Lab Deadline	10/31/2013
		Analysis	UUISO - Level 4
		Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
8 10/10/13 Fxns 04, 06, 08, 10 ~~& 12~~ are TOTAL Fxns 05, 07, 09 & 11 are DISSOLVED	04	53	RR1.5
	05	47	RR1.5
	06	56	RR1.5
	07	52	RR1.5
	08	49	RR1.5
	09	45	RR1.5
	10	48	RR1.5
	11	57	RR1.5

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room	JWD	10/18/13 0500
Relinquished by	Sample Storage	Rough Prep	(Prep)	Separations	Count Room	JWD	10/21/13 0500
Received by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	0700 TM	10/21/13
Relinquished by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	1015 TM	10/24/13
Received by	Sample Storage	Rough Prep	Prep	Separations	~~Count Room~~	<0/5	<10/24
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	1CB	10/24/13 1432
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES Oak Ridge Laboratory	Internal Chain of Custody	Work Order #	13-10043
		Lab Deadline	10/31/2013
		Analysis	ThISO - Level 4
		Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
9/10/13	04	53	RR1.5
Fxns 04, 06, 08, 10 ~~& 12~~ are TOTAL	05	47	RR1.5
	06	56	RR1.5
	07	52	RR1.5
	08	49	RR1.5
Fxns 05, 07, 09 & 11 are DISSOLVED	09	45	RR1.5
	10	48	RR1.5
	11	57	RR1.5

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	10/18/13 0800
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	10/18/13 1815
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	0700 JM	10/21/13
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	1030 JM	10/24/13
Received by	Sample Storage	Rough Prep	Prep	Separations	~~Count Room~~	[illegible]	10/30/10/24
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	ICB	10/24/13 1437
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES Oak Ridge Laboratory	Internal Chain of Custody	Work Order #	13-10043
		Lab Deadline	10/31/2013
		Analysis	Ra226 - Level 4
		Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
10/10/13	04	53	RR1.5
Fxns 04, 06, 08, 10 ~~& 12~~ are TOTAL	05	47	RR1.5
	06	56	RR1.5
Fxns 05, 07, 09 & 11 are DISSOLVED	07	52	RR1.5
	08	49	RR1.5
	09	45	RR1.5
	10	48	RR1.5
	11	57	RR1.5

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/18/13 0830
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/18/13 1840
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/21-13 0800
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/24-13 1045
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KB	10/24/13 1047
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/25 0817
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES Oak Ridge Laboratory	Internal Chain of Custody	Work Order #	13-10043
		Lab Deadline	10/31/2013
		Analysis	Ra228 - Level 4
		Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
10/10/13	04	53	RR1.5
Fxns 04, 06, 08, 10 ~~& 12~~ 9 are TOTAL	05	47	RR1.5
	06	56	RR1.5
	07	52	RR1.5
	08	49	RR1.5
Fxns 05, 07, 09 & 11 are DISSOLVED	09	45	RR1.5
	10	48	RR1.5
	11	57	RR1.5

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/18/13 0500
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/18/13 1840
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10-21-13 0400
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10-24-13 1045
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	ICB	10/24/13 1047
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10/25 0807
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		10-25-13 1045
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		11-4-13 0835
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		11/4/13 0878
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		11/4/13 1047
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES

Sample Receiving Report
(Volumes, pH, & CPM)

Internal Work Order
13-10043
Received By
KCOULSTON

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	RR1.5		
02	BLANK	0		WA	RR1.5		
03	DUP	0		WA	RR1.5		
04	WLL20131008E1 /	1		WA	RR1.5	4.00	53
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	53
05	WLL201310008E2 /	1		WA	RR1.5	4.00	47
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	47
06	WLL20131008F1 /	1		WA	RR1.5	4.00	56
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	56
07	WLL20131008F2 /	1		WA	RR1.5	4.00	52
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	52
08	WLL20131008K1 /	1		WA	RR1.5	4.00	49
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	49
09	WLL201310008K2 /	1		WA	RR1.5	4.00	45
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	45
10	WLL20131009L1 /	1		WA	RR1.5	4.00	48
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	48
11	WLL201310009L2 /	1		WA	RR1.5	4.00	57
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	4.0000	57

EJT 10/10/13

Received by: Kristen Coulston Date: 10/10/13

MP-001, Rev 5
Effective: 11/22/02

SECTION II

SAMPLE ACKNOWLEDGEMENT

Client Name	Contract/PO	Project Type	Date Received	Required Turnaround Days	Eberline Services Work Order
Missouri Dept. of Natural Resources	C310163001	Environmental	10/10/2013	28	13-10043
Project Name	**Client WO**	**Sample Disp**	**Lab Deadline**	**Internal Deadline**	**Client Deadline**
C310163001	West Lake Landfill	W	10/31/2013	11/06/2013	11/07/2013

Internal ID	Client ID	Sample Date	Matrix	Storage	Ra226	Ra228	Th230	U,U,SO																				Ttl
01	LCS	10/10/13	WA	RR1.5	X	X	X	X																				4
02	BLANK	10/10/13	WA	RR1.5	X	X	X	X																				4
03	DUP	10/10/13	WA	RR1.5	X	X	X	X																				4
04	WLL20131008E1	10/08/13 11:15	WA	RR1.5	X	X	X	X																				4
05	WLL201310008E2	10/08/13 11:15	WA	RR1.5	X	X	X	X																				4
06	WLL20131008F1	10/08/13 12:10	WA	RR1.5	X	X	X	X																				4
07	WLL20131008F2	10/08/13 12:10	WA	RR1.5	X	X	X	X																				4
08	WLL20131008K1	10/08/13 16:05	WA	RR1.5	X	X	X	X																				4
09	WLL201310008K2	10/08/13 16:05	WA	RR1.5	X	X	X	X																				4
10	WLL20131009L1	10/09/13 10:55	WA	RR1.5	X	X	X	X																				4
11	WLL201310009L2	10/09/13 10:55	WA	RR1.5	X	X	X	X																				4
																												0
																												0
																												0
																												0
																												0
																												0
																												0
																												0
																												0
		Totals Per Analysis (non QA samples)			8	8	8	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

EBERLINE SERVICES

Sample Log In Report

Oak Ridge Laboratory
601 Scarboro Rd.
Oak Ridge, TN 37830

Voice: (865) 481-0683
Fax: (865) 483-4621

Invoice	Accounts Payable
	Missouri Dept. of Natural Resources
	917 Hwy 67 North #104
	Florissant, MO 63031
Voice	314-877-3252
Fax	314-877-3254
Contact	Eric Gilstrap
Voice	314-877-3252
Fax	314-877-3254

Report Data	Rita Alexander
	Missouri DNR
	917 N Hwy 67, Suite 104
	Florissant, MO 63031
Voice	314-877-3046
Fax	314-877-3254

Printed: 10/10/2013 12:01 PM

Eberline Services – Oak Ridge Laboratory

SAMPLE RECEIPT CHECKLIST
MP-001-2

WORK ORDER # 13-10043

SAMPLE MATRIX/MATRICES: (CIRCLE ONE OR BOTH)

AQUEOUS NON-AQUEOUS

(CIRCLE EITHER YES, NO, OR N/A)

WERE SAMPLES:

Received in good condition?	Y	N	
If aqueous, properly preserved	Y	N	N/A

WERE CHAIN OF CUSTODY SEALS:

Present on outside of package?	Y	N
Unbroken on outside of package?	Y	N
Present on samples?	Y	N
Unbroken on samples?	Y	N
Was chain of custody present upon sample receipt?	Y	N

IF THE RESPONSE TO ANY OF THE ABOVE IS **NO**, A DISCREPANT SAMPLE RECEIPT REPORT (DSR) HAS BEEN ISSUED.

REMARKS: _____

SIGNATURE: Kristen Caldwell DATE: 10/10/13

SECTION III

CASE NARRATIVE

EBERLINE SERVICES

EBERLINE ANALYTICAL CORPORATION
601 SCARBORO ROAD
OAK RIDGE, TENNESSEE 37830
PHONE (865) 481-0683
FAX (865) 483-4621

EBS-OR-36342

November 6, 2013

Rita Alexander
Missouri Dept. of Natural Resources
St. Louis Field Office
917 Hwy. 67 North, Suite 104
Florissant, MO 63031

CASE NARRATIVE
Work Order# 13-10043-OR

SAMPLE RECEIPT

This work order contains eight water samples received 10/10/2013. These samples were analyzed for Isotopic Uranium, Isotopic Thorium and Radium-226/228.

CLIENT ID	LAB ID	CLIENT ID	LAB ID
WLL20131008E1	13-10043-04	WLL20131008K1	13-10043-08
WLL201310008E2	13-10043-05	WLL201310008K2	13-10043-09
WLL20131008F1	13-10043-06	WLL20131009L1	13-10043-10
WLL20131008F2	13-10043-07	WLL201310009L2	13-10043-11

The file name for these samples is 1310043.XLS.

ANALYTICAL METHODS

Isotopic Uranium was analyzed using Method EML U-02 Modified. Isotopic Thorium was analyzed using Method EML Th-01 Modified. Radium-226 was analyzed using EPA Method 903.0 Modified. Radium-228 was analyzed using EPA Method 904.0 Modified.

ANALYTICAL RESULTS

ISOTOPIC URANIUM

Samples were prepared by removing representative aliquots followed by mixed acid digestions as appropriate. Uranium was selectively extracted by ion exchange. Uranium was eluted, micro-precipitated and mounted on micro-porous filter media. Sample activities were then determined by alpha spectroscopy using energy specific regions of interest for Uranium-234, Uranium-235 and Uranium-238. Chemical recovery was determined by the use of a Uranium-232 tracer. Activity of the Uranium-232 tracer was determined by alpha spectroscopy using an energy specific region of interest.

ANALYTICAL RESULTS CONTINUED

ISOTOPIC URANIUM CONTINUED

Samples demonstrated acceptable results for all Uranium analyses. Chemical recovery was slightly low for sample fraction -06 (Client ID: WLL20131008F1). Chemical recovery was acceptable for all other samples. The Uranium-234, Uranium-235 and Uranium-238 method blank demonstrated acceptable results. Results for the Uranium-234, Uranium-235 and Uranium-238 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Uranium-234 and Uranium-238 laboratory control sample demonstrated an acceptable percent recovery.

ISOTOPIC THORIUM

Samples were prepared by removing representative aliquots followed by mixed acid digestions as appropriate. Thorium was selectively extracted by ion exchange. Thorium was eluted, micro-precipitated and mounted on micro-porous filter media. Sample activities were then determined by alpha spectroscopy using energy specific regions of interest for Thorium-228, Thorium-230 and Thorium-232. Chemical recovery was determined by the use of a Thorium-229 tracer. Activity of the Thorium-229 tracer was determined by alpha spectroscopy using an energy specific region of interest.

Samples demonstrated acceptable results for all Thorium analyses. Chemical recovery was acceptable for all samples. The Thorium-228, Thorium-230 and Thorium-232 method blank demonstrated acceptable results. Results for the Thorium-228, Thorium-230 and Thorium-232 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Thorium-228, Thorium-230 and Thorium-232 laboratory control sample demonstrated an acceptable percent recovery.

RADIUM-226

Samples were prepared by removing representative aliquots followed by mixed acid digestions as appropriate. This was followed by precipitations of Radium/Barium Sulfate. Precipitates were dissolved in alkaline EDTA. Radium was selectively precipitated and then mounted on micro-porous filter media. Samples were counted by alpha spectroscopy using an energy specific region of interest for Radium-226. Inherent self-absorption from elemental Barium was corrected for in the final result. Chemical recovery was calculated by the use of a Barium-133 tracer, which was determined by HPGe gamma spectroscopy.

Samples demonstrated acceptable results for all Radium-226 analyses. Chemical recovery was acceptable for all samples. The Radium-226 method blank demonstrated acceptable results. Results for the Radium-226 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the Radium-226 laboratory control sample demonstrated an acceptable percent recovery.

RADIUM-228

Following alpha spectroscopy analysis of Radium-226, Barium/Radium Sulfate precipitates were redissolved and allowed for sufficient ingrowth of the Actinium-228 daughter. After ingrowth, Actinium-228 was selectively precipitated. Precipitates were filtered and beta emissions for Actinium-

ANALYTICAL RESULTS CONTINUED

RADIUM-228 CONTINUED

228 were then counted on a gas proportional counter. Chemical recovery was determined by the use of a Barium-133 tracer, the activity of which was determined by HPGe gamma spectroscopy and an elemental Yttrium carrier by gravimetric measurements. The product of these two recoveries was used to calculate chemical yield.

Samples demonstrated acceptable results for all Radium-228 analyses. Chemical recovery was acceptable for all samples. The Radium-228 method blank demonstrated results greater than the detection limit. Results for the Radium-228 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Radium-228 laboratory control sample demonstrated an acceptable percent recovery.

CERTIFICATION OF ACCURACY

I certify that this data report is in compliance with the terms and conditions of the Purchase Order, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hard copy data package has been authorized by the cognizant project manager or his/her designee to be accurate as verified by the following signature.

M.R. McDougall
Laboratory Manager

Date: 11/6/2013

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SECTION IV

ANALYTICAL RESULTS SUMMARY

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Florissant, MO 63031

Affiliation: DNR/DEQ/HWP/FFS
SDG: 1310043
Matrix: Water

Final Report of Analysis
Date Reported: 11/6/2013

Client ID	Lab ID	Date Analyzed	Analyte	Method	Result	Error	MDA	Unit	Qualifer
KNOWN	13-10043-01	10/25/13	Radium-226	EPA 903.0 Modified	10.27	0.47	0.25	pCi/l	
KNOWN	13-10043-01	11/04/13	Radium-228	EPA 904.0 Modified	8.49	0.43	1.21	pCi/l	
KNOWN	13-10043-01	10/24/13	Thorium-228	EML Th-01 Modified	4.87	0.18	0.10	pCi/l	
KNOWN	13-10043-01	10/24/13	Thorium-230	EML Th-01 Modified	5.46	0.15	0.07	pCi/l	
KNOWN	13-10043-01	10/24/13	Thorium-232	EML Th-01 Modified	4.87	0.18	0.06	pCi/l	
KNOWN	13-10043-01	10/24/13	Uranium-234	EML U-02 Modified	8.14	0.29	0.08	pCi/l	
KNOWN	13-10043-01	10/24/13	Uranium-238	EML U-02 Modified	7.93	0.29	0.05	pCi/l	
SPIKE	13-10043-01	10/25/13	Radium-226	EPA 903.0 Modified	10.63	1.36	0.25	pCi/l	
SPIKE	13-10043-01	11/04/13	Radium-228	EPA 904.0 Modified	8.96	0.95	1.21	pCi/l	
SPIKE	13-10043-01	10/24/13	Thorium-228	EML Th-01 Modified	5.37	0.83	0.10	pCi/l	
SPIKE	13-10043-01	10/24/13	Thorium-230	EML Th-01 Modified	6.03	0.91	0.07	pCi/l	
SPIKE	13-10043-01	10/24/13	Thorium-232	EML Th-01 Modified	5.62	0.86	0.06	pCi/l	
SPIKE	13-10043-01	10/24/13	Uranium-234	EML U-02 Modified	7.12	0.97	0.08	pCi/l	
SPIKE	13-10043-01	10/24/13	Uranium-235	EML U-02 Modified	0.62	0.21	0.07	pCi/l	
SPIKE	13-10043-01	10/24/13	Uranium-238	EML U-02 Modified	7.67	1.03	0.05	pCi/l	
BLANK	13-10043-02	10/25/13	Radium-226	EPA 903.0 Modified	-0.10	0.09	0.34	pCi/l	U
BLANK	13-10043-02	11/04/13	Radium-228	EPA 904.0 Modified	2.33	0.61	1.01	pCi/l	
BLANK	13-10043-02	10/24/13	Thorium-228	EML Th-01 Modified	0.03	0.09	0.19	pCi/l	U
BLANK	13-10043-02	10/24/13	Thorium-230	EML Th-01 Modified	0.36	0.18	0.16	pCi/l	
BLANK	13-10043-02	10/24/13	Thorium-232	EML Th-01 Modified	0.04	0.06	0.12	pCi/l	U
BLANK	13-10043-02	10/24/13	Uranium-234	EML U-02 Modified	0.10	0.07	0.07	pCi/l	J
BLANK	13-10043-02	10/24/13	Uranium-235	EML U-02 Modified	0.04	0.05	0.06	pCi/l	U
BLANK	13-10043-02	10/24/13	Uranium-238	EML U-02 Modified	0.10	0.07	0.06	pCi/l	J

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SDG: 1310043
Matrix: Water

Client ID	Lab ID	Date Analyzed	Analyte	Method	Result	Error	MDA	Unit	Qualifer
WLL20131008E1 DUP	13-10043-03	10/25/13	Radium-226	EPA 903.0 Modified	5.72	1.06	0.38	pCi/l	
WLL20131008E1 DUP	13-10043-03	11/04/13	Radium-228	EPA 904.0 Modified	3.57	0.96	1.66	pCi/l	
WLL201310008E2 DUP	13-10043-03	10/24/13	Thorium-228	EML Th-01 Modified	0.11	0.14	0.23	pCi/l	U
WLL201310008E2 DUP	13-10043-03	10/24/13	Thorium-230	EML Th-01 Modified	0.06	0.11	0.19	pCi/l	U
WLL201310008E2 DUP	13-10043-03	10/24/13	Thorium-232	EML Th-01 Modified	0.03	0.09	0.19	pCi/l	U
WLL20131008F1 DUP	13-10043-03	10/24/13	Uranium-234	EML U-02 Modified	0.34	0.34	0.40	pCi/l	U
WLL20131008F1 DUP	13-10043-03	10/24/13	Uranium-235	EML U-02 Modified	0.05	0.19	0.49	pCi/l	U
WLL20131008F1 DUP	13-10043-03	10/24/13	Uranium-238	EML U-02 Modified	0.41	0.37	0.40	pCi/l	J
WLL20131008E1	13-10043-04	10/25/13	Radium-226	EPA 903.0 Modified	5.04	0.88	0.20	pCi/l	
WLL20131008E1	13-10043-04	11/04/13	Radium-228	EPA 904.0 Modified	2.25	0.69	1.21	pCi/l	
WLL20131008E1	13-10043-04	10/24/13	Thorium-228	EML Th-01 Modified	0.63	0.30	0.23	pCi/l	
WLL20131008E1	13-10043-04	10/24/13	Thorium-230	EML Th-01 Modified	0.81	0.34	0.13	pCi/l	
WLL20131008E1	13-10043-04	10/24/13	Thorium-232	EML Th-01 Modified	0.66	0.30	0.14	pCi/l	
WLL20131008E1	13-10043-04	10/24/13	Uranium-234	EML U-02 Modified	4.24	0.78	0.15	pCi/l	
WLL20131008E1	13-10043-04	10/24/13	Uranium-235	EML U-02 Modified	0.43	0.24	0.18	pCi/l	
WLL20131008E1	13-10043-04	10/24/13	Uranium-238	EML U-02 Modified	2.61	0.57	0.10	pCi/l	
WLL201310008E2	13-10043-05	10/25/13	Radium-226	EPA 903.0 Modified	3.18	0.67	0.17	pCi/l	
WLL201310008E2	13-10043-05	11/04/13	Radium-228	EPA 904.0 Modified	1.55	0.65	1.23	pCi/l	J
WLL201310008E2	13-10043-05	10/24/13	Thorium-228	EML Th-01 Modified	0.05	0.11	0.21	pCi/l	U
WLL201310008E2	13-10043-05	10/24/13	Thorium-230	EML Th-01 Modified	0.17	0.16	0.17	pCi/l	J
WLL201310008E2	13-10043-05	10/24/13	Thorium-232	EML Th-01 Modified	0.07	0.10	0.15	pCi/l	U
WLL201310008E2	13-10043-05	10/24/13	Uranium-234	EML U-02 Modified	4.06	0.76	0.17	pCi/l	
WLL201310008E2	13-10043-05	10/24/13	Uranium-235	EML U-02 Modified	0.21	0.16	0.15	pCi/l	J
WLL201310008E2	13-10043-05	10/24/13	Uranium-238	EML U-02 Modified	2.40	0.55	0.23	pCi/l	

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Affiliation: DNR/DEQ/HWP/FFS
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Matrix: Water

Client ID	Lab ID	Date Analyzed	Analyte	Method	Result	Error	MDA	Unit	Qualifer
WLL20131008F1	13-10043-06	10/25/13	Radium-226	EPA 903.0 Modified	24.23	2.21	0.32	pCi/l	
WLL20131008F1	13-10043-06	11/04/13	Radium-228	EPA 904.0 Modified	3.50	0.74	1.22	pCi/l	
WLL20131008F1	13-10043-06	10/24/13	Thorium-228	EML Th-01 Modified	0.03	0.14	0.29	pCi/l	U
WLL20131008F1	13-10043-06	10/24/13	Thorium-230	EML Th-01 Modified	0.49	0.25	0.18	pCi/l	
WLL20131008F1	13-10043-06	10/24/13	Thorium-232	EML Th-01 Modified	0.10	0.12	0.16	pCi/l	U
WLL20131008F1	13-10043-06	10/24/13	Uranium-234	EML U-02 Modified	0.55	0.58	0.60	pCi/l	U
WLL20131008F1	13-10043-06	10/24/13	Uranium-235	EML U-02 Modified	0.00	0.49	1.06	pCi/l	U
WLL20131008F1	13-10043-06	10/24/13	Uranium-238	EML U-02 Modified	0.16	0.41	0.85	pCi/l	U
WLL20131008F2	13-10043-07	10/25/13	Radium-226	EPA 903.0 Modified	23.62	2.15	0.37	pCi/l	
WLL20131008F2	13-10043-07	11/04/13	Radium-228	EPA 904.0 Modified	3.08	0.75	1.29	pCi/l	
WLL20131008F2	13-10043-07	10/24/13	Thorium-228	EML Th-01 Modified	-0.01	0.14	0.33	pCi/l	U
WLL20131008F2	13-10043-07	10/24/13	Thorium-230	EML Th-01 Modified	0.45	0.25	0.22	pCi/l	J
WLL20131008F2	13-10043-07	10/24/13	Thorium-232	EML Th-01 Modified	0.07	0.12	0.21	pCi/l	U
WLL20131008F2	13-10043-07	10/24/13	Uranium-234	EML U-02 Modified	0.74	0.47	0.33	pCi/l	J
WLL20131008F2	13-10043-07	10/24/13	Uranium-235	EML U-02 Modified	0.17	0.29	0.52	pCi/l	U
WLL20131008F2	13-10043-07	10/24/13	Uranium-238	EML U-02 Modified	0.13	0.19	0.29	pCi/l	U
WLL20131008K1	13-10043-08	10/25/13	Radium-226	EPA 903.0 Modified	1.29	0.54	0.27	pCi/l	
WLL20131008K1	13-10043-08	11/04/13	Radium-228	EPA 904.0 Modified	2.18	0.70	1.25	pCi/l	
WLL20131008K1	13-10043-08	10/24/13	Thorium-228	EML Th-01 Modified	0.02	0.08	0.21	pCi/l	U
WLL20131008K1	13-10043-08	10/24/13	Thorium-230	EML Th-01 Modified	0.11	0.14	0.17	pCi/l	U
WLL20131008K1	13-10043-08	10/24/13	Thorium-232	EML Th-01 Modified	-0.01	0.08	0.17	pCi/l	U
WLL20131008K1	13-10043-08	10/24/13	Uranium-234	EML U-02 Modified	1.11	0.44	0.17	pCi/l	
WLL20131008K1	13-10043-08	10/24/13	Uranium-235	EML U-02 Modified	0.20	0.22	0.29	pCi/l	U
WLL20131008K1	13-10043-08	10/24/13	Uranium-238	EML U-02 Modified	0.59	0.32	0.24	pCi/l	

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SDG: 1310043
Matrix: Water

Client ID	Lab ID	Date Analyzed	Analyte	Method	Result	Error	MDA	Unit	Qualifer
WLL201310008K2	13-10043-09	10/25/13	Radium-226	EPA 903.0 Modified	1.18	0.50	0.23	pCi/l	
WLL201310008K2	13-10043-09	11/04/13	Radium-228	EPA 904.0 Modified	5.68	0.84	1.21	pCi/l	
WLL201310008K2	13-10043-09	10/24/13	Thorium-228	EML Th-01 Modified	0.19	0.17	0.16	pCi/l	J
WLL201310008K2	13-10043-09	10/24/13	Thorium-230	EML Th-01 Modified	0.20	0.17	0.14	pCi/l	J
WLL201310008K2	13-10043-09	10/24/13	Thorium-232	EML Th-01 Modified	0.03	0.09	0.20	pCi/l	U
WLL201310008K2	13-10043-09	10/24/13	Uranium-234	EML U-02 Modified	0.85	0.39	0.24	pCi/l	
WLL201310008K2	13-10043-09	10/24/13	Uranium-235	EML U-02 Modified	0.07	0.14	0.26	pCi/l	U
WLL201310008K2	13-10043-09	10/24/13	Uranium-238	EML U-02 Modified	0.55	0.30	0.17	pCi/l	
WLL20131009L1	13-10043-10	10/25/13	Radium-226	EPA 903.0 Modified	2.22	0.83	0.51	pCi/l	
WLL20131009L1	13-10043-10	11/04/13	Radium-228	EPA 904.0 Modified	6.77	1.84	3.24	pCi/l	
WLL20131009L1	13-10043-10	10/24/13	Thorium-228	EML Th-01 Modified	1.58	0.48	0.19	pCi/l	
WLL20131009L1	13-10043-10	10/24/13	Thorium-230	EML Th-01 Modified	2.30	0.61	0.17	pCi/l	
WLL20131009L1	13-10043-10	10/24/13	Thorium-232	EML Th-01 Modified	1.62	0.49	0.16	pCi/l	
WLL20131009L1	13-10043-10	10/24/13	Uranium-234	EML U-02 Modified	1.03	0.36	0.12	pCi/l	
WLL20131009L1	13-10043-10	10/24/13	Uranium-235	EML U-02 Modified	0.17	0.16	0.15	pCi/l	J
WLL20131009L1	13-10043-10	10/24/13	Uranium-238	EML U-02 Modified	1.19	0.39	0.14	pCi/l	
WLL201310009L2	13-10043-11	10/25/13	Radium-226	EPA 903.0 Modified	1.61	0.66	0.51	pCi/l	
WLL201310009L2	13-10043-11	11/04/13	Radium-228	EPA 904.0 Modified	6.36	1.22	1.98	pCi/l	
WLL201310009L2	13-10043-11	10/24/13	Thorium-228	EML Th-01 Modified	0.15	0.20	0.32	pCi/l	U
WLL201310009L2	13-10043-11	10/24/13	Thorium-230	EML Th-01 Modified	0.45	0.27	0.24	pCi/l	J
WLL201310009L2	13-10043-11	10/24/13	Thorium-232	EML Th-01 Modified	0.18	0.16	0.17	pCi/l	J
WLL201310009L2	13-10043-11	10/24/13	Uranium-234	EML U-02 Modified	0.31	0.22	0.21	pCi/l	J
WLL201310009L2	13-10043-11	10/24/13	Uranium-235	EML U-02 Modified	0.08	0.14	0.25	pCi/l	U
WLL201310009L2	13-10043-11	10/24/13	Uranium-238	EML U-02 Modified	0.06	0.10	0.14	pCi/l	U

SECTION V

ANALYTICAL STANDARD

QA/QC REVIEWED
Date 1/16/95 Initials [illegible]

U-8

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

Radionuclide:	U-238NAT	Customer:	TMA EBERLINE
Half Life:	(4.468 ± 0.005) x 10^9 years	P.O.No.:	OR2778
Catalog No.:	7338	Reference Date:	January 1 1995 12:00 PST.
Source No.:	479-50	Contained Radioactivity:	(Total U) 8.016 μCi
		Contained Radioactivity:	(Total U) 297 kBq

Description of Solution

a. Mass of solution: 65.2896 g in a 50 ml flame sealed ampoule

b. Chemical form: Uranyl Nitrate in H2O

c. Carrier content: None

d. Density: Approximately 1.3202 g/ml @ 20°C.

Radioimpurities: Refer to attached technical data sheet

Radioactive Daughters: Refer to attached technical data sheet

Radionuclide Concentration

(Total U) 0.1228 μCi/g.

Method of Calibration

Activity calculations are based upon known specific activity and mass.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±3.0%
b. Random uncertainty in assay:	±0.0%
c. Random uncertainty in weighing(s):	±2.0%
d. Total uncertainty at the 99% confidence level:	±3.6%

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

ERIC ALLAS
QUALITY CONTROL

29 DECEMBER 1994
Date Signed

ISOTOPE PRODUCTS LABORATORIES
3017 N. SAN FERNANDO BLVD.
BURBANK, CALIFORNIA 91504
818·843·7000 FAX 818·843·6168

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

MP-009

Rev.8; 11/01/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

CURRENT DATE: 8/30/2013 0:00

SOLUTION REFERENCE #: IPL 479-50

SOLUTION #: U-8

Principal Radionuclide	Half Life, Years	Half Life, Days
$^{234, 235, 238}U$	4.468E+09	1.632E+12

Radionuclide: $^{234, 235, 238}U$

Reference Date: 1/1/1995 0:00

Certified Activity: 8.016E+00 µCi

Certified Concentration: µCi per gram

Ampoule /Solution Gross	97.6400	Weight, Grams
Empty Ampoule	32.5020	Weight, Grams
Solution Net	65.1380	Weight, Grams
Total Activity in Ampoule	8.0160	µCi

Chemical Composition of Standard Solution

Uranyl nitrate in dilute HNO_3

Dilution Instructions:

Dilution Solvent Used: 1M HNO_3

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 8.0160 µCi Which Equals 1.780E+07 dpm at the date listed above

And after dilution the activity of this solution is 1.77955E+04 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: August 20, 2014

Verified & Approved By _____ Date: 8/29/2013 0:00

QC Approval _____ Date: 9/4/13

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP-009

Rev.8; 11/01/03
Title: **Radioactive Reference Standards Solutions & Records**

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

MP-009
Solution Reference # IPL 479-50

Date 8/29/2013 0:00
Solution # U-8a

Principal Radionuclide	Half Life, Years	Half Life, Days
$^{234, 235, 238}U$	4.468E+09	1.632E+12

Radionuclide of Interest $^{234, 235, 238}U$
Parent Solution Conc. 1.7796E+04 dpm/ml

Reference Date 1/1/1995 0:00

Chemical Composition of Standard Solution
Uranly Nitrate in 1M HNO_3

Dilution Instructions:

Dilution Solvent Used 1M HNO_3

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 4.0000 ml
Total Activity: 7.1182E+04 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 7.1182E+01 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Isotopic Distribution as:
U-238 Atom % = 48.239 U-238 = 71.182 dpm/ml X 0.48249 = 34.345 dpm/ml
U-235 Atom % = 2.25 U-235 = 71.182 dpm/ml X 0.0225 = 1.602 dpm/ml
U-234 Atom % = 49.501 U-238 = 71.182 dpm/ml X 0.49501 = 35.236 dpm/ml
All values +/- 3.6%

Isotopic ratios from manufacturer's data sheet

Expiration Date: August 20, 2014

Verified & Approved By _____ Date: 8/29/2013 0:00

QC Approval _____ Date: 9/4/13

RECORD COPY

Tracer Solution for Environmental Analysis & Disequilibrium Studies

Product Description & Measurement Certificate

Description	Principal radionuclide:	**uranium 232** (U-232)	Product code: **UDP10050**
	Daughter Nuclide:	Th-228	Batch Number: 92/232/67

Measurement	Reference date:	01 March 2000
	Radioactive concentration U-232	6.739E+03 becquerels per gram of solution
	which is equivalent to	1.821E-01 microcuries per gram of solution
	Mass of solution	5.356 grams
	Volume of solution	5.035 millilitres
	Total activity of U-232	3.61E+04 becquerels
	which is equivalent to	9.76E-01 microcuries

Method of measurement (see reverse of this certificate)

Accuracy Random uncertainty is: ± 0.7% Systematic uncertainty: ± 0.5%
Overall uncertainty in the radioactive concentration quoted above: ± 1.7%
Overall uncertainty is defined on the reverse of this certificate.

Radionuclidic Purity Any radioactive impurities measured are listed below, expressed as percentages of the activity of the principle radionuclide at the reference date .

Th-228 and daughter activity removed 2 Feb 2000
U-232 daughters activity will increase with time. By alpha 88% U-232, 12% daughters on 1/3/00

Isotopic Purity The isotopic composition, expressed as atom per cent at the reference date .

Not measured

Chemical Composition Calculated weight of U-232, 4.42E-08 grams, as 2M HNO3 solution in a flame sealed glass vial.
This Tracer solution has been produced 'carrier free'.

Physical Data Recommended half life of uranium 232: 6.980E+01 years
Principle energies of alpha emissions (MeV): 5.263 31.7%, 5.320 68.0%
Branching ratio for alpha emission: 100%
Calculated specific activity of uranium 232: 8.167E+05 Bq per microgram U-232.

Remarks For safety information and notes to ensure correct usage by all persons handling this radioactive Tracer solution please read the instructions accompanying the package.

AEA Technology operates a quality management system which has been independently audited and approved to ISO 9001.

Approved Signatory

Roger Wiltshire

Project Ref. AE2315

Roger Wiltshire

Prepared and characterised in the UK, for world wide distribution by **Isotrak, AEA Technology, QSA.**

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

MP-009

Rev.8; 11/01/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

CURRENT DATE: 12/13/2012 0:00

SOLUTION REFERENCE #: AEA/Amersham 92/232/67

SOLUTION #: U-10

Principal Radionuclide	Half Life, Years	Half Life, Days
^{232}U	7.200E+01	2.630E+04

Radionuclide: ^{232}U

Reference Date: 3/1/2000 0:00

Certified Activity: 9.760E-01 µCi

Certified Concentration: µCi per gram

Ampoule /Solution Gross: Weight, Grams

Empty Ampoule: Weight, Grams

Solution Net: Weight, Grams

Total Activity in Ampoule: 0.9760 µCi

Chemical Composition of Standard Solution

$^{232}U(NO_3)_6$ in 2M HNO_3

Dilution Instructions:

Dilution Solvent Used: 2M HNO_3

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 0.9760 µCi Which Equals 2.167E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.167E+03 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: December 7, 2013

Verified & Approved By _____ Date: 12/13/2012 0:00

QC Approval _____ Date: 12/13/12

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QUALITY CONTROL PROGRAM
MP-009

Rev.8; 11/01/03
Title: **Radioactive Reference Standards Solutions & Records**

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

MP-009
Solution Reference # AEA/Amersham 92/232/67
Date 12/7/2012 0:00
Solution # U-10a

Principal Radionuclide	Half Life, Years	Half Life, Days
^{232}U	7.200E+01	2.630E+04

Radionuclide of Interest ^{232}U
Parent Solution Conc. 2.167E+03 dpm/ml
Reference Date 3/1/2000 0:00

Chemical Composition of Standard Solution
$^{232}U(NO_3)_6$ in 2M HNO_3

Dilution Instructions:
Dilution Solvent Used 2M HNO_3

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 10.0000 ml
Total Activity: 2.1670E+04 dpm
Final Volume: 1000.00 ml
Final Activity Concentration: 2.1670E+01 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: December 7, 2013

Verified & Approved By _____ Date: 12/13/2012 0:00

QC Approval _____ Date: 12/13/12

QA/QC REVIEWED
Date 10/14/91 Initials WT

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

Received
OCT 14 1991
TMA/Eberline
Oak Ridge Lab

Radionuclide	Th-230	Customer:	TMA EBERLINE
Half Life:	(7.54 ± 0.03) x 10^4 years	P.O.No.:	TT4944
Catalog No.:	7230	Reference Date:	November 1 1991 12:00 PST.
Source No.:	388-116	Contained Radioactivity:	1.036 µCi.

Description of Solution

a. Mass of solution: 5.0042 grams.
b. Chemical form: Th(NO3)4 in 0.1N HNO3
c. Carrier content: None added
d. Density: 1.0016 gram/ml @ 20°C.

Radioimpurities

See attached technical data sheet

Radioactive Daughters

See attached technical data sheet

Radionuclide Concentration

0.207 µCi/gram.

Method of Calibration

Weighed aliquots of the solution were assayed using a liquid scintillation counter.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration: ±2.0%
b. Random uncertainty in assay: ±0.5%
c. Random uncertainty in weighing(s): ±0.2%
d. Total uncertainty at the 99% confidence level: ±2.7%

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Notes

1. Nuclear data were taken from "Table of Isotopes", Seventh Edition, edited by Virginia S. Shirley.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay(and later NIST certification) of Standard Reference Materials. (As in NRC Regulatory Guide 4.15)

QUALITY CONTROL

ISOTOPE PRODUCTS LABORATORIES
1800 No. Keystone Street.,
Burbank, California 91504
(818) 843 - 7000

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EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

MP-009
Solution Reference # IPL 388-116

Date 3/4/2013 0:00
Solution # Th-1b

Principal Radionuclide	Half Life, Years	Half Life, Days
^{230}Th	7.540E+04	2.754E+07

Radionuclide of Interest ^{230}Thorium
Parent Solution Conc. 2.30E+03 dpm/ml

Reference Date 11/1/1991 0:00

Chemical Composition of Standard Solution
$^{230}Th(NO_3)_4$ in 0.1N HNO_3

Dilution Instructions:

Dilution Solvent Used 0.1N HNO_3

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 10.0000 ml
Total Activity: 2.2999E+04 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 2.2999E+01 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: March 4, 2014

Recertified By _____ Date: 3/21/2013 0:00

Verified & Approved By _____ Date: 3/21/13

QC Approval _____ Date: 3/21/13

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Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

CURRENT DATE: 3/4/2013 0:00

SOLUTION REFERENCE #: IPL 388-116

SOLUTION #: Th-1

Principal Radionuclide	Half Life, Years	Half Life, Days
^{230}Th	7.540E+04	2.754E+07

Radionuclide: ^{230}Thorium

Reference Date: 11/1/1991 0:00

Certified Activity: 1.036E+00 µCi

Certified Concentration: µCi per gram

Ampoule /Solution Gross	9.2660	Weight, Grams
Empty Ampoule	4.6218	Weight, Grams
Solution Net	4.6442	Weight, Grams
Total Activity in Ampoule	1.0360	µCi

Chemical Composition of Standard Solution

$^{230}Th(NO_3)_4$ in 0.1N HNO_3

Dilution Instructions:

Dilution Solvent Used: 0.1N HNO_3

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 1.0360 µCi Which Equals 2.300E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.300E+03 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: March 4, 2014

Recertified By _____ Date: 3/21/2013 0:00

QC Approval _____ Date: 3/21/13

Th-8

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

Radionuclide:	Th-232	Customer:	TMA EBERLINE
Half Life:	(1.405 ± 0.006) x 10^10 years	P.O.No.:	VH1632
Catalog No.:	7232	Reference Date:	November 1 1993 12:00 PST.
Source No.:	435-104-2	Contained Radioactivity:	(Th-232) 0.0933 µCi.
		Contained Radioactivity:	(Th-232) 3.45 kBq.

Description of Solution

a. Mass of solution: 11.9712 g (in a 10 ml flame sealed ampoule)

b. Chemical form: Th(NO3)4 in water

c. Carrier content: None added

d. Density: Approx. 1.21 g/ml @ 20°C.

Radioimpurities None detected (other than daughters).

Radioactive Daughters

Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Po-212, Tl-208

Radionuclide Concentration

(Th-232) 0.00779 µCi/g.

Method of Calibration

Activity calculations are based upon known specific activity and mass.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration: ±3.0%

b. Random uncertainty in assay: ±0.0%

c. Random uncertainty in weighing(s): ±2.0%

d. Total uncertainty at the 99% confidence level: ±3.6%

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

Anna U. Khan

QUALITY CONTROL

Nov. 8, 1993

Date Signed

ISOTOPE PRODUCTS LABORATORIES
1800 North Keystone Street
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(818) 843 - 7000

EBERLINE SERVICES

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EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

CURRENT DATE: 9/23/2013 0:00

SOLUTION REFERENCE #: IPL 435-104-2

SOLUTION #: Th-8

Principal Radionuclide	Half Life, Years	Half Life, Days
^{232}Th, ^{228}Th	1.405E+10	5.132E+12

Radionuclide: $^{232\&228}Th$

Reference Date: 11/1/1993 0:00

Certified Activity: 9.330E-02 µCi

Certified Concentration: µCi per gram

Ampoule /Solution Gross	18.8415	Weight, Grams
Empty Ampoule	6.9296	Weight, Grams
Solution Net	11.9119	Weight, Grams
Total Activity in Ampoule	0.0933	µCi

Chemical Composition of Standard Solution

$Th(NO_3)_4$ in H2O

Dilution Instructions:

Dilution Solvent Used: 1% Nitric Acid

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 0.0933 µCi Which Equals 2.071E+05 dpm at the date listed above

And after dilution the activity of this solution is 2.071E+02 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: September 23, 2014

Verified & Approved By _____ Date: 9/23/2013 0:00

QC Approval _____ Date: 9/27/13

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MP-009

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Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

MP-009
Solution Reference # IPL 435-104-2

Date 9/23/2013 0:00
Solution # Th-8b

Principal Radionuclide	Half Life, Years	Half Life, Days
$^{228\&232}Th$	1.405E+10	5.132E+12

Radionuclide of Interest $^{228\&232}Th$
Parent Solution Conc. 2.07E+02 dpm/ml

Reference Date 11/1/1993 0:00

Chemical Composition of Standard Solution
$Th(NO_3)_4$ in 1% HNO_3

Dilution Instructions:

Dilution Solvent Used 1% Nitric Acid

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 500.0000 ml
Total Activity: 1.0355E+05 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 1.0355E+02 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: September 23, 2014

Verified & Approved By _____ Date: 9/23/2013 0:00

QC Approval _____ Date: 9/27/13

Th-18

Isotope Products Laboratories
An Eckert & Ziegler Company

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

Radionuclide:	Th-229	**Customer:**	EBERLINE SERVICES
Half-life:	7340 ± 160 years	**P.O. No.:**	00009633
Catalog No.:	7229	**Reference Date:**	15-Jan-02 12:00 PST
Source No.:	867-54	**Contained Radioactivity: (Th-229 only)**	1.013 µCi 37.48 kBq

Physical Description:

A. Mass of solution: 5.0147 g in 5 mL flame-sealed ampoule
B. Chemical form: $Th(NO_3)_4$ in 0.1M HNO_3
C. Carrier content: 10µg Th/mL
D. Density: 1.0016 g/mL @ 20°C.

Radioimpurities:

None detected (daughters in equilibrium)

Radionuclide Concentration: 0.2020 µCi/g, 7.474 kBq/g

Method of Calibration:

This source was prepared from a weighed aliquot of solution whose activity in µCi/g was determined using gamma ray spectrometry.
Peak energy used for integration: 193.5 keV
Branching ratio used: 0.0441 gammas per decay

Uncertainty of Measurement:

A. Type A (random) uncertainty: ± 0.7 %
B. Type B (systematic) uncertainty: ± 3.0 %
C. Uncertainty in aliquot weighing: ± 0.0 %
D. Total uncertainty at the 99% confidence level: ± 3.1 %

Notes:

- See reverse side for leak test(s) performed on this source.
- IPL participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
- Nuclear data was taken from IAEA Technical Report Series No. 261.
- This solution has a working life of 5 years.

Ann U Khan
Quality Control

9-Jan-02
Date Signed

IPL Ref. No.: 867-54

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

MP-009

Rev.8; 1/10/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

CURRENT DATE: 9/23/2013 0:00

SOLUTION REFERENCE #: IPL 867-54

SOLUTION #: Th-18

Principal Radionuclide	Half Life, Years	Half Life, Days
^{229}Th	7.340E+03	2.681E+06

Radionuclide: ^{229}Th

Reference Date: 1/15/2002 0:00

Certified Activity: 1.013E+00 µCi

Certified Concentration: µCi per gram

Ampoule /Solution Gross	8.7752	Weight, Grams
Empty Ampoule	3.7591	Weight, Grams
Solution Net	5.0161	Weight, Grams
Total Activity in Ampoule	1.0130	µCi

Chemical Composition of Standard Solution

$^{229}Th(NO_3)_4$ in 0.1M HNO_3

Dilution Instructions:

Dilution Solvent Used: 0.1 M HNO_3

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 1.0130 µCi Which Equals 2.249E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.249E+03 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: September 23, 2014

Verified & Approved By _____ Date: 9/23/2013 0:00

QC Approval _____ Date: 9/27/13

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP-009

Rev.7; 9/29/99
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

MP-009
Solution Reference # IPL 867-54

Date 9/23/2013 0:00
Solution # Th-18a

Principal Radionuclide	Half Life, Years	Half Life, Days
^{229}Th	7.340E+03	2.681E+06

Radionuclide of Interest ^{229}Th
Parent Solution Conc. 2.25E+03 dpm/ml

Reference Date 1/15/2002 0:00

Chemical Composition of Standard Solution
$TH(NO_3)_4$ in 0.1M HNO_3

Dilution Instructions:

Dilution Solvent Used 0.1M HNO_3

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 10.0000 ml
Total Activity: 2.2490E+04 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 2.2490E+01 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: September 23, 2014

Verified & Approved By _____ Date: 9/23/2013 0:00

QC Approval _____ Date: 9/27/13

Ba-6
(& 6a)

National Institute of Standards & Technology

Certificate

ORIGINAL

Standard Reference Material 4251C
Barium-133 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive barium-133 chloride, non-radioactive barium chloride, and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of ionization chambers and solid-state gamma-ray spectrometry systems.

Radiological Hazard

The SRM ampoule contains barium-133 with a total activity of approximately 2.5 MBq. Barium-133 decays by electron capture and during the decay process X-rays and gamma rays with energies from 4 to 400 keV are emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. Appropriate shielding and/or distance should be used to minimize personnel exposure. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard

The SRM ampoule contains hydrochloric acid (HCl) with a concentration of 1 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution.

Storage and Handling

The SRM should be stored and used at a temperature between 5 and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least June 2004.

The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) both because of the radioactivity and because of the strong acid.

Preparation

This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, J.M.R. Hutchinson, Group Leader. The overall technical direction and physical measurements leading to certification were provided by L.L. Lucas of the Radioactivity Group and D.B. Golas, Nuclear Energy Institute Research Associate.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by N.M. Trahey.

Gaithersburg, Maryland 20899
October 1994

Thomas E. Gills, Chief
Standard Reference Materials Program

*Notes and references are on pages 5 and 6.

0041

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

QCP-009

Rev.8; 11/10/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
QCP 009-1

CURRENT DATE: 6/16/2013 0:00

SOLUTION REFERENCE #: NIST SRM4251C

SOLUTION #: Ba-6

Principal Radionuclide	Half Life, Years	Half Life, Days
^{133}Barium	1.048E+01	3.828E+03

Radionuclide: ^{133}Barium

Reference Date: 9/1/1993 0:00

Certified Activity: µCi

Certified Concentration: 1.318E+01 µCi per gram

Ampoule /Solution Gross	9.3081	Weight, Grams
Empty Ampoule	4.2582	Weight, Grams
Solution Net	5.0499	Weight, Grams
Total Activity in Ampoule	66.5577	µCi

Chemical Composition of Standard Solution

$^{133}BaCl_2$ in 1M HCl

Dilution Instructions:

Dilution Solvent Used: 1M HCl

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 66.5577 µCi Which Equals 1.478E+08 dpm at the date listed above

And after dilution the activity of this solution is 1.478E+05 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: June 16, 2014

Verified & Approved By _____ Date: 7/1/13

QC Approval _____ Date: 7/2/13

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

QCP-009

Rev.8; 11/10/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS

SECONDARY DILUTION RECERTIFICATION

QCP-009-1-A

Solution Reference # NIST SRM4251C

Date 6/18/13

Solution # Ba-6a

Principal Radionuclide	Half Life, Years	Half Life, Days
^{133}Ba	1.048E+01	3.828E+03

Radionuclide of Interest ^{133}Ba

Parent Solution Conc. 1.48E+05 dpm/ml

Reference Date 9/1/1993 0:00

Chemical Composition of Standard Solution

$^{133}BaCl_2$ in 1M HCl

Dilution Instructions:

Dilution Solvent Used 1M HCl

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 25.0000 ml

Total Activity: 3.6950E+06 dpm

Final Volume: 1000.00 ml

Final Activity Concentration: 3.6950E+03 dpm/ml

NOTES:

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: June 18, 2014

Verified & Approved By _____ Date: 7/1/13

QC Approval _____ Date: 7/2/13

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

Ra-5
QA/QC REVIEWED
Date 2/8/94 Initials MT

Radionuclide:	Ra-226	Customer:	TMA EBERLINE
Half Life:	1600 ± 7 years	P.O.No.:	VH1888
Catalog No.:	7226	Reference Date:	February 1 1994 12:00 PST.
Source No.:	453-26	Contained Radioactivity: (Ra-226)	1.001 μCi.
		Contained Radioactivity: (Ra-226)	37.0 kBq.

Description of Solution

a. Mass of solution: 5.1864 g (in a 5 ml Flame Sealed Ampoule)

b. Chemical form: Ra(NO3)2 in 1 N HNO3

c. Carrier content: None added

d. Density: 1.0318 g/ml @ 20°C.

Radioimpurities None detected(other than daughters)

Radioactive Daughters

Rn-222, Po-218, At-218, Pb-214, Bi-214, Po-214, Tl-210, Pb-210, Bi-210, Po-210 and Tl-206.

Radionuclide Concentration

(Ra-226) 0.1929 μCi/g.

Method of Calibration

Weighed aliquots of the solution were assayed using gamma spectrometry:
Energy peak(s) integrated under: 186 keV.
Branching ratio(s) used: 0.0351 gamma rays per decay.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration: ±3.4%

b. Random uncertainty in assay: ±3.1%

c. Random uncertainty in weighing(s): ±0.2%

d. Total uncertainty at the 99% confidence level: ±4.6%

NIST Traceability

This calibration is implicitly traceable to the National Institute of Standards and Technology.

Leak Test(s)

See reverse side for Leak Test(s) applied to this source.

Notes

1. Nuclear data were taken from "Table of Radioactive Isotopes", edited by Virginia S. Shirley, 1986.
2. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).

Ana U. Kuen
QUALITY CONTROL

Feb. 3, 1994
Date Signed

ISOTOPE PRODUCTS LABORATORIES
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Burbank, California 91504
(818) 843 - 7000

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP 009

Rev.8; 11/01/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

CURRENT DATE: 11/9/2012 0:00
SOLUTION REFERENCE #: IPL 453-26
SOLUTION #: Ra-5

Principal Radionuclide	Half Life, Years	Half Life, Days
^{226}Radium	1.600E+03	5.844E+05

Radionuclide: ^{226}Radium
Reference Date: 2/1/1994 0:00
Certified Activity: 1.001E+00 µCi
Certified Concentration: µCi per gram

Ampoule /Solution Gross: Weight, Grams
Empty Ampoule: Weight, Grams
Solution Net: Weight, Grams
Total Activity in Ampoule: 1.0010 µCi

Chemical Composition of Standard Solution
$^{226}Ra(NO_3)_2$ in 1M HNO_3

Dilution Instructions:

Dilution Solvent Used: 1M HNO_3

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 1.0010 µCi Which Equals 2.222E+06 dpm at the date listed above

And after dilution the activity of this solution is 2.222E+03 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: November 9, 2013

Verified & Approved By _____ Date: 11/9/2012

QC Approval _____ Date: 11/12/12

0045

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP 009

Rev.8; 11/01/03
Title: **Radioactive Reference Standards Solutions & Records**

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

MP 009
Solution Reference # IPL-453-26

Date 11/9/2012 0:00
Solution # Ra-5b

Principal Radionuclide	Half Life, Years	Half Life, Days
^{226}Radium	1.600E+03	5.844E+05

Radionuclide of Interest ^{226}Radium
Parent Solution Conc. 2.22E+03 dpm/ml

Reference Date 2/1/1994 0:00

Chemical Composition of Standard Solution
$^{226}Ra(NO_3)_2$ in 1M HNO_3

Dilution Instructions:

Dilution Solvent Used 1M HNO_3

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 20.0000 ml
Total Activity: 4.4440E+04 dpm
Final Volume: 1000.00 ml

Final Activity Concentration: 4.4440E+01 dpm/ml
This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

NOTES:

Expiration Date: November 9, 2013

Verified & Approved By _____ Date: 11/9/2012 0:00

QC Approval _____ Date: 11/12/12

RA-11

ANALYTICS

1380 Seaboard Industrial Blvd.
Atlanta, Georgia 30318 · U.S.A.

Phone (404) 352-8677
Fax (404) 352-2837

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

62680-416

Ra-228 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked using a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

ANALYTICS maintains traceability to the National Institute of Standards and Technology through Measurements Assurance Programs as described in USNRC Reg. Guide 4.15, Revision 1.

New vial from the 6/11/01 Shipment.
P.S. Different activity Level
8/9/11

ISOTOPE:	Ra-228
ACTIVITY (dps):	2.585 E3
HALF-LIFE:	5.75 years
CALIBRATION DATE:	November 7, 2001 12:00 EST
TOTAL UNCERTAINTY*:	4.0%
SYSTEMATIC:	3.0%
RANDOM:	1.0%

*99% Confidence Level

Impurities: γ-impurities (other than decay products) <0.1%

5.07198 grams 0.1M HCl solution with 50 μg/g Ba carrier.

P O NUMBER 9508, Item 1 (Part #4339A)

SOURCE PREPARED BY: M. D. Currie
M. D. Currie, Radiochemist

Q A APPROVED: 11/7/01

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

MP-009

Rev.8; 1/10/03
Title: Radioactive Reference Standards Solutions & Records

EBERLINE SERVICES - OAK RIDGE LABORATORY
RADIOACTIVE REFERENCE SOLUTIONS
RECERTIFICATION
MP 009

CURRENT DATE: 3/11/2013 0:00

SOLUTION REFERENCE #: Analytics 62680-416

SOLUTION #: Ra-11

Principal Radionuclide	Half Life, Years	Half Life, Days
^{228}Ra	5.750E+00	2.100E+03

Radionuclide: ^{228}Ra

Reference Date: 11/7/2001 0:00

Certified Activity: 6.986E-02 µCi

Certified Concentration: µCi per gram

Ampoule /Solution Gross	9.4982	Weight, Grams
Empty Ampoule	4.4895	Weight, Grams
Solution Net	5.0087	Weight, Grams
Total Activity in Ampoule	0.0699	µCi

Chemical Composition of Standard Solution

$^{228}Ra(NO_3)_2$ in 0.5 M HCl

Dilution Instructions:

Dilution Solvent Used: 0.5 M HCl

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 0.0699 µCi Which Equals 1.551E+05 dpm at the date listed above

And after dilution the activity of this solution is 1.551E+02 dpm/ml

This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.

Expiration Date: March 26, 2014

Recertified By _____ Date: 5/30/13

QC Approval _____ Date: 5/30/13

SECTION VI

QUALITY CONTROL SAMPLE RESULTS SUMMARY

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	UUISO	1	pCi	I	Missouri Dept. of Natural Resources

Laboratory Control Sample

Analyte	Normalized Difference	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
U-234	1.78	87.56%	15.40%	100.00%	3.60%	8.14E+00	2.93E-01	7.12E+00	1.10E+00	U-8a	3.52E+01	3.60E+00	5.13E-01
U-238	0.43	96.74%	15.23%	100.00%	3.60%	7.93E+00	2.85E-01	7.67E+00	1.17E+00	U-8a	3.44E+01	3.60E+00	5.13E-01

Matrix Spike

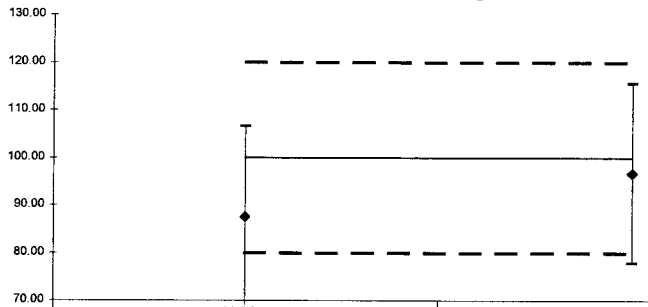
Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

Replicate Sample / QC Summary

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	LCS ND	MS % R	MS ND	Rep RPD	Rep ND
U-234	0.60	46.57	5.47E-01	5.78E-01	3.41E-01	3.41E-01	0.88	OK	OK			NA	OK
U-238	0.89	86.81	1.64E-01	4.10E-01	4.15E-01	3.74E-01	0.97	OK	OK			NA	OK
U-235	0.17	200.00	0.00E+00	4.89E-01	4.59E-02	1.91E-01		OK	OK			OK	OK

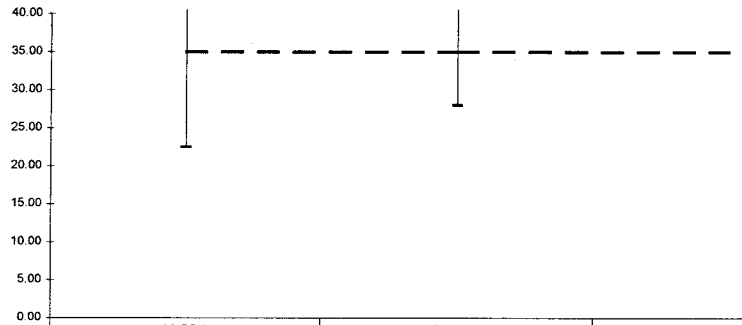
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	UUISO	1	pCi	I	Missouri Dept. of Natural Resources

LCS % Recovery



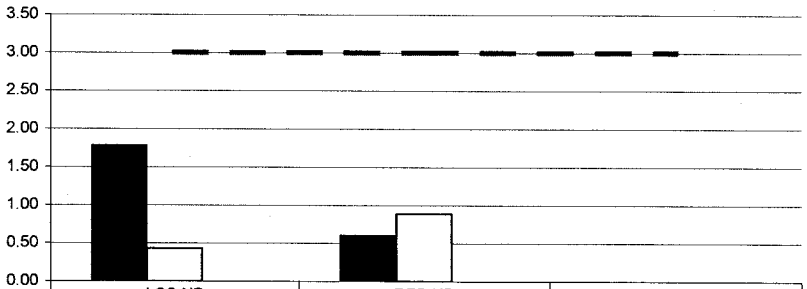
	U-234	U-238
Lower Error	68.56	77.91
Upper Error	106.57	115.56
%R	87.56	96.74
LCL	80	80
Mean	100	100
UCL	120	120

Replicate Sample RPD



	U-234	U-238	U-235
Lower Error	70.69	145.65	1683.16
Upper Error	22.45	27.97	-1283.16
RPD	46.57	86.81	200.00
CL	35	35	35

Normalized Difference



	LCS ND	REP ND	MS ND
U-234	1.78	0.60	0.00
U-238	0.43	0.89	0.00
	0.00	0.00	0.00
UCL	3	3	3

No Matrix Spike

Version

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	ThISO	1	pCi	I	Missouri Dept. of Natural Resources

Laboratory Control Sample

Analyte	Normalized Difference	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
TH-228	0.99	110.10%	18.07%	100.00%	3.60%	4.87E+00	1.75E-01	5.37E+00	9.70E-01	Th-8b	1.04E+02	3.60E+00	1.05E-01
TH-230	0.94	110.37%	19.49%	100.00%	2.70%	5.46E+00	1.47E-01	6.03E+00	1.17E+00	Th-1b	2.35E+01	2.70E+00	5.15E-01
TH-232	1.47	115.37%	17.62%	100.00%	3.60%	4.87E+00	1.75E-01	5.62E+00	9.91E-01	Th-8b	1.04E+02	3.60E+00	1.05E-01

Matrix Spike

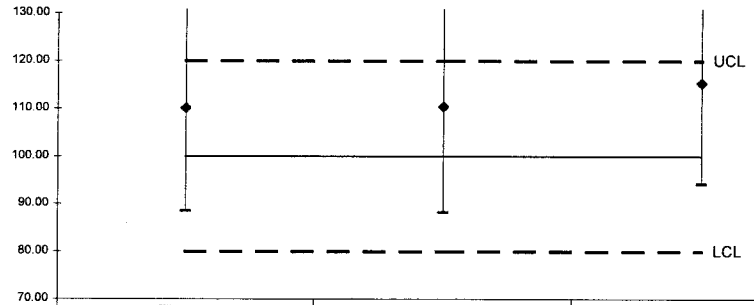
Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

Replicate Sample / QC Summary

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	LCS ND	MS % R	MS ND	Rep RPD	Rep ND
TH-228	0.66	76.55	4.86E-02	1.05E-01	1.09E-01	1.44E-01	1.10	OK	OK			NA	OK
TH-230	1.05	89.57	1.69E-01	1.64E-01	6.45E-02	1.06E-01	1.10	OK	OK			NA	OK
TH-232	0.46	64.71	6.63E-02	1.02E-01	3.39E-02	9.29E-02	1.15	OK	OK			NA	OK

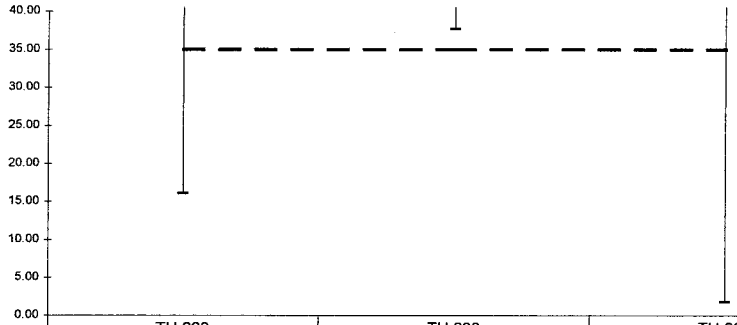
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	ThISO	1	pCi	I	Missouri Dept. of Natural Resources

LCS % Recovery



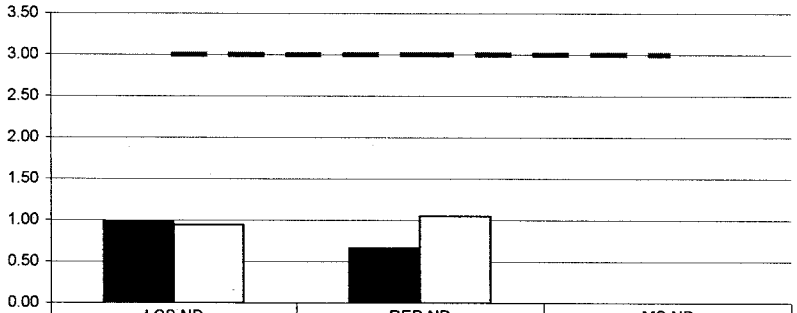
	TH-228	TH-230	TH-232
Lower Error	88.43	88.18	94.15
Upper Error	131.77	132.57	136.60
%R	110.10	110.37	115.37
LCL	80	80	80
Mean	100	100	100
UCL	120	120	120

Replicate Sample RPD



	TH-228	TH-230	TH-232
Lower Error	137.06	141.46	127.66
Upper Error	16.04	37.68	1.77
RPD	76.55	89.57	64.71
CL	35	35	35

Normalized Difference



	LCS ND	REP ND	MS ND
TH-228	0.99	0.66	0.00
TH-230	0.94	1.05	0.00
'UCL	3	3	3

No Matrix Spike

Eberline Services
Analysis Control Chart

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	Ra226	1	pCi	l	Missouri Dept. of Natural Resources

Laboratory Control Sample

Analyte	Normalized Difference	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-226	0.26	103.46%	24.70%	100.00%	4.60%	1.03E+01	4.73E-01	1.06E+01	2.63E+00	Ra-5b	4.41E+01	4.60E+00	5.18E-01

Matrix Spike

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

Replicate Sample

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU
RA-226	0.63	12.65	5.04E+00	1.38E+00	5.72E+00	1.61E+00

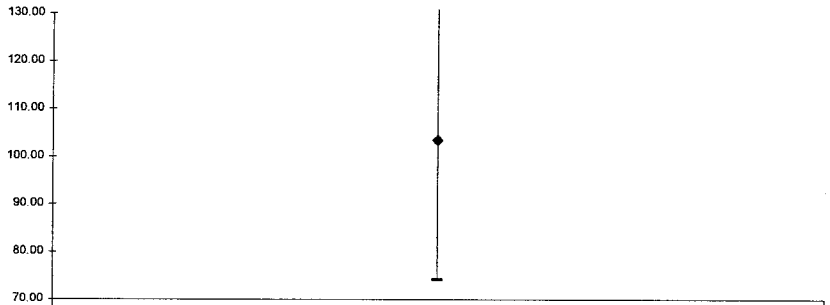
QC Summary

LCS Relative Bias	LCS % R	LCS ND	MS % R	MS ND	Rep RPD	Rep ND
1.03	OK	OK			NA	OK

Version

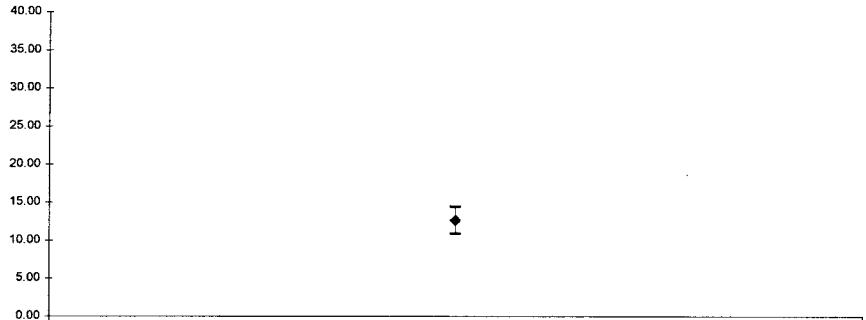
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	Ra226	1	pCi	I	Missouri Dept. of Natural Resources

LCS % Recovery



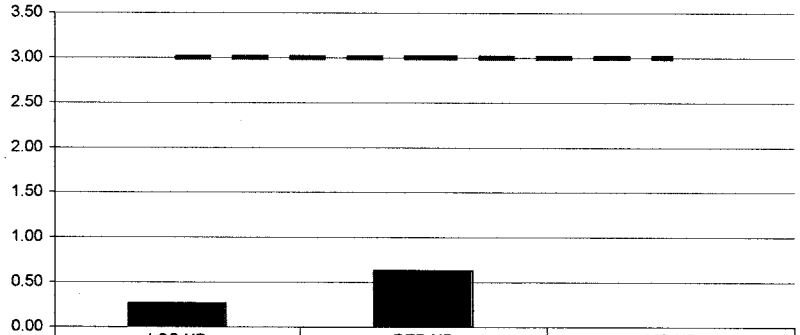
	RA-226
Lower Error	74.15
Upper Error	132.76
%R	103.46
LCL	80
Mean	100
UCL	120

Replicate Sample RPD



	RA-226
Lower Error	14.41
Upper Error	10.89
RPD	12.65
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-226	0.26	0.63	0.00
UCL	3	3	3

No Matrix Spike

Version

Eberline Services
Analysis Control Chart

Printed: 11/4/2013 12:03 PM
Page 1 of 2

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	Ra228	1	pCi	I	Missouri Dept. of Natural Resources

Laboratory Control Sample

Analyte	Normalized Difference	LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-228	0.41	105.59%	24.98%	100.00%	5.10%	8.49E+00	4.33E-01	8.96E+00	2.24E+00	Ra-11	3.67E+01	5.10E+00	5.13E-01

Matrix Spike

Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Result	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)

Replicate Sample

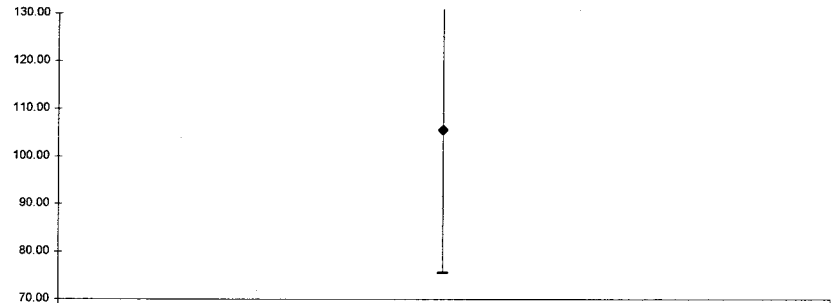
Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU
RA-228	1.70	45.33	2.25E+00	8.60E-01	3.57E+00	1.25E+00

QC Summary

LCS Relative Bias	LCS % R	LCS ND	MS % R	MS ND	Rep RPD	Rep ND
1.06	OK	OK			NA	OK

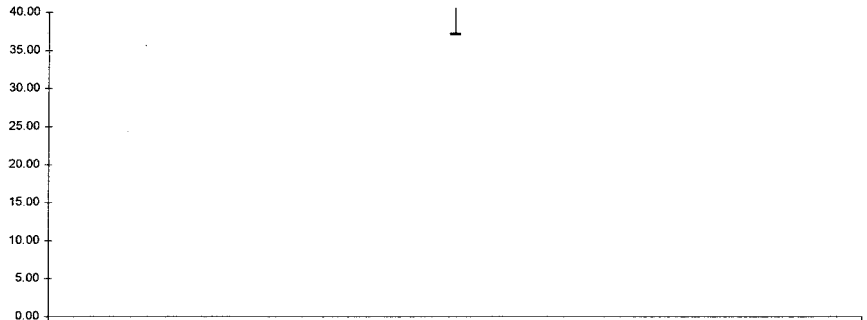
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
13-10043	Ra228	1	pCi	I	Missouri Dept. of Natural Resources

LCS % Recovery



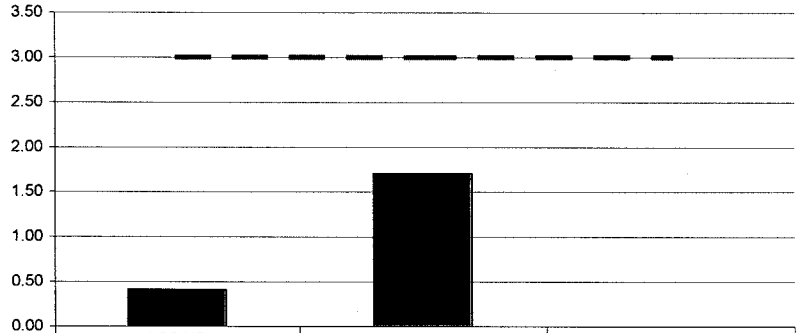
	RA-228
Lower Error	75.51
Upper Error	135.67
%R	105.59
LCL	80
Mean	100
UCL	120

Replicate Sample RPD



	RA-228
Lower Error	53.55
Upper Error	37.12
RPD	45.33
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-228	0.41	1.70	0.00
UCL	3	3	3

No Matrix Spike

Version

0057

SECTION VII

LABORATORY TECHNICIAN'S NOTES & RUN LOGS

ISO-U NOTES

EBERLINE SERVICES **Work Order Analysis Notes**	**Oak Ridge Laboratory** **601 Scarboro Rd.** **Oak Ridge, TN 37830** **Voice: 865.481.0683** **www.eberlineservices.com**	Internal Work Order	13-10043
		Analysis Code	UUISO
		Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:15	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO PRESERVE SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED TO SEPARATIONS

JWOLFE 10/18/13

EBERLINE SERVICES

Work Order Analysis Notes

Oak Ridge Laboratory
601 Scarboro Rd.
Oak Ridge, TN 37830
Voice: 865.481.0683
www.eberlineservices.com

Internal Work Order	13-10043
Analysis Code	UUISO
Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:15	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO PRESERVE SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED TO SEPARATIONS
2	10/23/13 14:38	CHEM	RMARTZ	ADDED ~5 MLS OF CONCENTRATED HCL TO BEAKERS AND TOOK TO DRYNESS. ADDED ~15 MLS OF 8N HCL TO BEAKERS AND ALLOWED TO COOL. TRANSFERRED SAMPLES TO NEW, LABELED C-TUBES WITH 8N HCL TO A VOLUMNE OF ~35 MLS. PRECONDITIONED RESIN COLUMN WITH 35 ML 8N HCL & CENTRIFUGED SAMPLES; ADDED SAMPLES TO COLUMNS; AFTER SAMPLES RAN THROUGH COLUMNS, ADDED 35 ML 8N HCL/NH4I & LET RUN THROUGH, FOLLOWED UP WITH ADDING 35 ML 6.5N HCL/0.04N HF & THEN 10 ML 6.5N HCL. ELUTED SAMPLES WITH 50 ML 0.5N HCL INTO CLEAN 100 ML BEAKERS. TOOK SAMPLES TO DRYNESS ON HOTPLATE & ADDED 10 ML CONCENTRATED HCL TO SAMPLES; TRANSFERRED SAMPLES INTO C-TUBES WITH D.I. H2O.
3	10/24/13 09:38	CHEM	RMARTZ	ADDED 0.1 ML NEODYMIUM CARRIER, 0.3 ML TITANOUS CHLORIDE, & 1 ML HF TO C-TUBES; LET SET SIT IN ICE BATH FOR ONE HOUR. SET UP FILTERS BY ADDING ALCOHOL & CARBON SUBSTRATE THEN ADDED SAMPLES; WHEN SAMPLES WERE THROUGH FILTERS, ADDED 10 ML DI H2O RINSES FROM C-TUBES, REMOVED FILTERS, LET DRY IN DESSICATOR, THEN SENT SET TO COUNT ROOM.

10/24/13

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
13-10043	
Analysis Code	Run
UUISO	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
014370P	Nitric Acid	Reagent Grade	JWOLFE	10/18/2013
014305P	Anion Exchange Resin	Reagent Grade	RMARTZ	10/23/2013
014253S	HCl - HF	6.5N - 0.04N	RMARTZ	10/23/2013
014429S	HCl - NH4I	8N - 0.1M	RMARTZ	10/23/2013
014255S	Hydrochloric Acid	0.5N	RMARTZ	10/23/2013
014254S	Hydrochloric Acid	6.5N	RMARTZ	10/23/2013
014251S	Hydrochloric Acid	8N	RMARTZ	10/23/2013
014042S	Carbon substrate	Solution	RMARTZ	10/24/2013
013221P	Hydrofluoric Acid	Reagent Grade	RMARTZ	10/24/2013
014041S	Neodymium Carrier	1 mg/ml	RMARTZ	10/24/2013
013574P	Reagent Alcohol	Reagent Grade	RMARTZ	10/24/2013
014220P	Titanous Chloride	Reagent Grade	RMARTZ	10/24/2013

Alpha #3

Date	Sample #	Client	Food Time	CT Time	Analysis	Tech
10/21/13	1310041A (6,9)	UCOR	1354	2hr 50min	PU	KB
10/21/13	1310041A (4,6)	UCOR	1356	2hr 50min	PUNT	KB
10/21/13	1310037A (1-10)	EMS	1357	2hr 50min	UU	KB
~~10/21/13~~	~~1310037A~~	KB 10/21/13				
10/21/13	1310083A (1-4)	Parsons	1714	5hr 35mins	PU	KB
10/21/13	1310072A (1-8)	MPA	1715	2hr 50min	Rab	KB
10/22/13	Daily Pulse	[illegible]	0515	10	[illegible]	C
10/22/13	1310038A (9-19)	Eng. Man	0758	2hr	Rab	C
10/22/13	~~1310041A~~ 1310038A (2,3)	Eng Man	1018	2hr	UUIgo	C
10/22/13	1310006A (1-11)	NYPE	1058	2hr	Rab	C
10/22/13	1310038A (18,19)	Eng Man	1716	2hr	UUIgo	C
10/22/13	1310038A (5-16)	ENG MANAGE	1518	2HR 50min	IGO-TH	AG
10/23/13	Daily Pulse	[illegible]	0522	10	NA	C
10/23/13	1310038A (17-19)	Eng. Man	0579	2hr	ThIgo	C
10/23/13	1310042A (15-19)	Miss. Rept.	1023	2hr	UUIgo	C
10/23/13	1310082A (1-7)	PCC Structural	1024	2hr	ThIgo	C
10/23/13	1310042A (1,2)	Miss. Rept.	1024	2hr	ThIgo	C
10/23/13	1310042A (11-19)	Miss. Rept.	1326	2hr 50min	ThIgo	C
10/24/13	Daily Pulse	[illegible]	0507	10	[illegible]	C
10/24/13	1310092A (4)	UCOR	1105	2hr 50min	Th	KB
10/24/13	1310092A (4)	UCOR	1105	2hr 50min	ThNT	KB
10/24/13	1310043A (1-11)	MDNR	1104	2hr 50min	UU	KB
10/24/13	1310092A (4)	UCOR	1107	2hr 50min	UUNT	KB

ISO TH NOTES

EBERLINE SERVICES **Work Order Analysis Notes**	**Oak Ridge Laboratory** **601 Scarboro Rd.** **Oak Ridge, TN 37830** **Voice: 865.481.0683** **www.eberlineservices.com**	Internal Work Order	13-10043
		Analysis Code	ThISO
		Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:15	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO PRESERVE SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED TO SEPARATIONS

JWolfe
10/18/13

EBERLINE SERVICES

Work Order Analysis Notes

Oak Ridge Laboratory
601 Scarboro Rd.
Oak Ridge, TN 37830
Voice: 865.481.0683
www.eberlineservices.com

Internal Work Order	13-10043
Analysis Code	ThISO
Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:15	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO PRESERVE SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED TO SEPARATIONS
2	10/23/13 14:40	CHEM	RMARTZ	ADDED ~5 MLS OF CONCENTRATED HNO3 TO BEAKERS AND TOOK TO DRYNESS. ADDED ~15 MLS OF 8N HNO3 TO BEAKERS AND ALLOWED TO COOL. TRANSFERRED SAMPLES TO NEW, LABELED C-TUBES WITH 8N HNO3 TO A VOLUMNE OF ~35 MLS. PRECONDITIONED RESIN COLUMN WITH 50 ML 8N HNO3 & CENTRIFUGED SAMPLES; ADDED SAMPLES TO COLUMNS; AFTER SAMPLES RAN THROUGH THE COLUMNS, ADDED 40 ML 8N HNO3 & LET RUN THROUGH, & ELUTED SAMPLES WITH 50 ML 8N HCL INTO CLEAN 100 ML BEAKERS. TOOK SAMPLES TO DRYNESS ON HOTPLATE & ADDED 10 ML CONCENTRATED HCL TO SAMPLES; TRANSFERRED SAMPLES INTO C-TUBES WITH D.I. H2O.
3	10/24/13 09:50	CHEM	RMARTZ	ADDED 0.75 ML 0.1MG/ML CERIUM CARRIER & 1 ML HF TO C-TUBES & LET SET SIT IN ICE BATH FOR ONE HOUR; SET UP FILTERS BY ADDING ALCOHOL & CARBON SUBSTRATE THEN ADDED SAMPLES; WHEN SAMPLES WERE THROUGH FILTERS, ADDED 10 ML DI H2O RINSES FROM C-TUBES, REMOVED FILTERS, LET DRY IN DESSICATOR, THEN SENT SET TO COUNT ROOM.

10/24/13

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
13-10043	
Analysis Code	Run
ThISO	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
014370P	Nitric Acid	Reagent Grade	JWOLFE	10/18/2013
014305P	Anion Exchange Resin	Reagent Grade	RMARTZ	10/23/2013
014251S	Hydrochloric Acid	8N	RMARTZ	10/23/2013
014252S	Nitric Acid	8N	RMARTZ	10/23/2013
014042S	Carbon substrate	Solution	RMARTZ	10/24/2013
014040S	Cerrium Carrier	0.1mg/ml	RMARTZ	10/24/2013
013221P	Hydrofluoric Acid	Reagent Grade	RMARTZ	10/24/2013
013574P	Reagent Alcohol	Reagent Grade	RMARTZ	10/24/2013

Alpha #1

Date	Sample #	Client	Load Time	CT Time	Manager	Tech
10/24/13	Daily Pulse	LAB	0507	10	[illegible]	C
10/24/13	1310043A (1-8)	MDNR	1204	2hr 50	TH	KB

Alpha #2

Date	Sample #	Client	Load Time	CT Time	Analyst	Tech
10/21/13	1310065A (6-7)	Weston	1355	2hr50	Th	KB
10/21/13	1310041A (1-4)	UCOR	1355	2hr50	PU	KB
10/21/13	1310037A (19-20)	EMS	1713	2hr50	UU	KB
10/21/13	1310070A (1-4)	Access	1713	2hr50	Rak	KB
10/22	Daily Pulse	LAB	0515	10	[illegible]	[illegible]
10/22/13	1310041A (1-4,6)	UCOR	1017	2hr	UUZ	C
10/22/13	1310038A (1)	Eng Man	1018	2hr	UUZ	C
10/22/13	1310038A (12-17)	Eng Man	1315	2hr	UUZ	C
10/23	Daily Pulse	LAB	0522	10	[illegible]	[illegible]
10/23/13	1310042A (9-14)	Miss. Dept.	1023	2hr	UUZ	C
10/24/13	Daily Pulse	LAB	0507	10	[illegible]	[illegible]
10/24/13	1310043A (9-11)	MDNR	1104	2hr50	Th	KB
10/24/13	1310092A (1-3)	UCOR	1105	2hr50	Th	KB

RA-226 NOTES

EBERLINE SERVICES **Work Order Analysis Notes**	**Oak Ridge Laboratory** **601 Scarboro Rd.** **Oak Ridge, TN 37830** **Voice: 865.481.0683** **www.eberlineservices.com**	Internal Work Order	13-10043
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:12	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

JWolfe
10/18/13

EBERLINE SERVICES **Work Order Analysis Notes**	**Oak Ridge Laboratory** **601 Scarboro Rd.** **Oak Ridge, TN 37830** **Voice: 865.481.0683** **www.eberlineservices.com**	Internal Work Order	13-10043
		Analysis Code	Ra226
		Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:12	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	10/21/13 11:10	CHEM	TSMITH	Dissolved samples from prep in EDTA.
3	10/24/13 10:34	CHEM	TSMITH	Followed steps 12.1 to 12.8 in AP-006 rev. 12 . (Sringe filtered samples. Precipitated and filtered samples, obtained final weights, and took to count room)

10-24-13
JM

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
13-10043	
Analysis Code	Run
Ra226	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
014145P	Ammonium Hydroxide	Reagent Grade	JWOLFE	10/18/2013
014233D05	Ammonium Sulfate	200 mg/ml	JWOLFE	10/18/2013
014007D05	Barium Carrier	1 mg/ml	JWOLFE	10/18/2013
013965D03	Lead Carrier	166 mg/ml	JWOLFE	10/18/2013
014370P	Nitric Acid	Reagent Grade	JWOLFE	10/18/2013
014423S	EDTA	0.25M	TSMITH	10/21/2013
011383P	Acetic Acid	Reagent Grade	TSMITH	10/24/2013
014233D02	Ammonium Sulfate	200 mg/ml	TSMITH	10/24/2013

Alpha #1

Date	Sample #	Client	Start Time	Count Time	Analyst	Tech
10/24/13	Daily Pulse	LAB	0707	10	mp	C
10/24/13	1310043A (1-8)	MDNR	1204	2hr50	TK	KB
10/24/13	1310092A (1-4)	UCOR	1413	2hr50mins	Am^{241}	KB
10/24/13	1310092A (1-4)	UCOR	1414	2hr50	Am^{243}	KB
10/24/13	1310092A (1-8)	MDNR	1720	2hr50min	Rale	KB
10/25/13	Daily Pulse	LAB	0722	10	mp	C
10/25/13	1310043A (1-8)	Miss. Dept	0856	2hr50	RaL	C

Alpha #2

Date	Sample #	Client	Load Time	CT Time	Analyst	Tech
10/21/13	1310065A (6-7)	Weston	1355	2hr50 min	Th	KB
10/21/13	1310041A (1-4)	UCOR	1355	2hr50 min	PU	KB
10/21/13	1310037A (19-20)	EMS	1713	2hr50 min	UU	KB
10/21/13	1310070A (1-4)	Access	1713	2hr50 min	Rale	KB
10/22/13	Daily Pulse	LAB	0515	10 min	[illegible]	C
10/22/13	1310041A (1-4,6)	UCOR	1017	2hr	UUZ50	C
10/22/13	1310038A (1)	Eng Man	1018	2hr	UUZ50	C
10/22/13	1310038A (12-17)	Eng Man	1315	2hr	UUZ50	C
10/23/13	Daily Pulse	LAB	0522	10 min	[illegible]	
10/23/13	1310042A (9-14)	Miss. Dept.	1023	2hr	UUZ50	C
10/24/13	Daily Pulse	LAB	0507	10 min	[illegible]	C
10/24/13	1310043A (9-11)	MDNR	1104	2hr50 min	Th	KB
10/24/13	1310092A (1-3)	UCOR	1105	2hr50 min	Th	KB
10/24/13	1310092A (1-4)	UCOR	1414	2hr50mins	UU	KB
10/24/13	1310092A (1-2)	UCOR	1415	2hr50 min	PU	KB
10/24/13	1310042A (9-14)	MDNR	1721	2hr50 min	Rale	KB
10/25/13	Daily Pulse	LAB	0522	10 min	[illegible]	C
10/25/13	1310043A (9-11)	Miss. Dept.	0556	2hr	Rale	C
10/25/13	1310084A (1-3)	Unitech	0557	2hr	UUZ50	C

RA-228 NOTES

EBERLINE SERVICES **Work Order Analysis Notes**	**Oak Ridge Laboratory** **601 Scarboro Rd.** **Oak Ridge, TN 37830** **Voice: 865.481.0683** **www.eberlineservices.com**	Internal Work Order	13-10043
		Analysis Code	Ra228
		Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:12	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

JWolfe
10/18/13

EBERLINE SERVICES

Work Order Analysis Notes

Oak Ridge Laboratory
601 Scarboro Rd.
Oak Ridge, TN 37830
Voice: 865.481.0683
www.eberlineservices.com

Internal Work Order	13-10043
Analysis Code	Ra228
Run Number	1

#	Date	Dept	User	Notes
1	10/18/13 08:12	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	10/25/13 12:27	CHEM	TSMITH	Placed filters from count room into labeled centrifuge tubes. Added EDTA to samples and swirled.
3	10/29/13 11:22	CHEM	TSMITH	Followed steps 12.1 to 12.7 in AP-007 rev. 17 . (Chemical cleanup for Ra 228)
4	11/04/13 07:00	CHEM	TSMITH	Followed steps 12.7 to 12.15 in AP-007 . (Precipitated samples, hot bathed, centrifuged, and discarded supernate. Dissolved precip, precipitated samples, hot bathed, centrifuged, and discarded supernate. Dissolved precip, precipitated and filtered samples, obtained final weights, covered with aluminum foil, and took to count room)

11-4-13
JM

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
13-10043	
Analysis Code	Run
Ra228	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
014145P	Ammonium Hydroxide	Reagent Grade	JWOLFE	10/18/2013
014233D05	Ammonium Sulfate	200 mg/ml	JWOLFE	10/18/2013
014007D05	Barium Carrier	1 mg/ml	JWOLFE	10/18/2013
013965D03	Lead Carrier	166 mg/ml	JWOLFE	10/18/2013
014370P	Nitric Acid	Reagent Grade	JWOLFE	10/18/2013
014433S	EDTA	0.25M	TSMITH	10/25/2013
014373D05	Ammonium Sulfide	2%	TSMITH	10/29/2013
014373D04	Ammonium Sulfide	2%	TSMITH	10/29/2013
013965D04	Lead Carrier	1.5 mg/ml	TSMITH	10/29/2013
014353P	Nitric Acid	Reagent Grade	TSMITH	10/29/2013
014357S	Yttrium Carrier	9 mg/ml	TSMITH	10/29/2013
014317D01	Ammonium Oxalate	5%	TSMITH	11/4/2013
014352D02	Nitric Acid	1N	TSMITH	11/4/2013
014352D01	Nitric Acid	6N	TSMITH	11/4/2013
013065D14	Sodium Hydroxide	10M	TSMITH	11/4/2013
014436S	Sodium Hydroxide	18M	TSMITH	11/4/2013

LB4110 Rep

Date	Sample #	Client	Load Time	CT Time	Analyst	Tech
10/27/17	1710094Pb(1-4)	UCOR	1238	2h	Pb210	KB
10/27/17	1710094Pb(1-4)	UCOR	1239	2h	Pb210	KB
10/27/17	1710099Pb(1-4)	UCOR	1240	2h	Pb210	KB
11/1/17	E7F0L	LAB	0519	30min	LB	C
11/1/17	B1L6D0e	LAB	0559	60min	LB	C
11/1/17	1710092RA(1-4)	UCOR	0740	2h	RAS	C
11/1/17	1710094RA(1-4)	UCOR	0740	2h	RAS	C
11/1/17	1710099RA(1-4)	UCOR	0740	2h	RAS	C
11/2/17	Weekly Bkgd	Lab	1011	12 hrs	αβ	KB
11/4/17	E7FAC	LAB	0507	30min	LB	C
11/4/17	B1L6D0e	LAB	0542	60min	LB	
11/4/17	1310043RA(1-4) ~~1710043RA(1-4)~~	Miss. Rep.	0844	2h	RAS	C

SECTION VIII

ANALYTICAL DATA (ISOTOPIC URANIUM)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

13-10043
UUISO
Run 1

Work Order	13-10043
Analysis Code	UUISO
Run	1
Date Received	10/10/2013
Lab Deadline	10/31/2013
Client	Missouri Dept. of Natural Resources
Project	C310163001
Report Level	4
Activity Units	pCi
Aliquot Units	l
Matrix	WA
Method	EML U-02 Modified
Instrument Type	Alpha Spectroscopy
Radiometric Tracer	U-232
Radiometric Sol#	U-10a
Tracer Act (dpm/g)	19.005
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/10/13 00:00	1.0000E+00
02	MBL	BLANK		10/10/13 00:00	1.0000E+00
03	DUP	WLL20131008F1	56	10/08/13 12:10	5.0000E-01
04	TRG	WLL20131008E1	53	10/08/13 11:15	5.0000E-01
05	TRG	WLL201310008E2	47	10/08/13 11:15	5.0000E-01
06	DO	WLL20131008F1	56	10/08/13 12:10	5.0000E-01
07	TRG	WLL20131008F2	52	10/08/13 12:10	5.0000E-01
08	TRG	WLL20131008K1	49	10/08/13 16:05	5.0000E-01
09	TRG	WLL201310008K2	45	10/08/13 16:05	5.0000E-01
10	TRG	WLL20131009L1	48	10/09/13 10:55	5.0000E-01
11	TRG	WLL201310009L2	57	10/09/13 10:55	5.0000E-01

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
UUISO
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	0.6096	11.6		0.00								
02	MBL	0.6075	11.5		0.00								
03	DUP	0.6057	11.5		0.00								
04	TRG	0.6015	11.4		0.00								
05	TRG	0.6014	11.4		0.00								
06	DO	0.6033	11.5		0.00								
07	TRG	0.6046	11.5		0.00								
08	TRG	0.6037	11.5		0.00								
09	TRG	0.6036	11.5		0.00								
10	TRG	0.6041	11.5		0.00								
11	TRG	0.6038	11.5		0.00								

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
UUISO
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			10/18/13 08:18	JWOLFE				
02	MBL			10/18/13 08:18	JWOLFE				
03	DUP			10/18/13 08:18	JWOLFE				
04	TRG			10/18/13 08:18	JWOLFE				
05	TRG			10/18/13 08:18	JWOLFE				
06	DO			10/18/13 08:18	JWOLFE				
07	TRG			10/18/13 08:18	JWOLFE				
08	TRG			10/18/13 08:18	JWOLFE				
09	TRG			10/18/13 08:18	JWOLFE				
10	TRG			10/18/13 08:18	JWOLFE				
11	TRG			10/18/13 08:18	JWOLFE				

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

9084

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-UUISO-1

Run: 1
Analysis Code: UUISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	U-234	LCS	LCS	pCi/l	7.12E+00	9.72E-01	7.77E-02	8.14E+00	87.56	OK		OK	
02	U-234	MBL	BLANK	pCi/l	9.60E-02	7.13E-02	7.20E-02					OK	OK
03	U-234	DUP	WLL20131008F1	pCi/l	3.41E-01	3.41E-01	3.98E-01				NA	OK	
04	U-234	TRG	WLL20131008E1	pCi/l	4.24E+00	7.84E-01	1.50E-01					OK	
05	U-234	TRG	WLL201310008E2	pCi/l	4.06E+00	7.63E-01	1.71E-01					OK	
06	U-234	DO	WLL20131008F1	pCi/l	5.47E-01	5.77E-01	5.96E-01					OK	
07	U-234	TRG	WLL20131008F2	pCi/l	7.43E-01	4.71E-01	3.33E-01					OK	
08	U-234	TRG	WLL20131008K1	pCi/l	1.11E+00	4.38E-01	1.66E-01					OK	
09	U-234	TRG	WLL201310008K2	pCi/l	8.49E-01	3.86E-01	2.40E-01					OK	
10	U-234	TRG	WLL20131009L1	pCi/l	1.03E+00	3.57E-01	1.20E-01					OK	
11	U-234	TRG	WLL201310009L2	pCi/l	3.10E-01	2.17E-01	2.06E-01					OK	

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-UUISO-1

Run	Analysis Code	Eberline Services Work Order	Client
1	UUISO	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	U-234	LCS	10/10/13 00:00	1.00E+00	112.27	0.00	0.00			
02	U-234	MBL	10/10/13 00:00	1.00E+00	124.05	0.00	0.00			
03	U-234	DUP	10/08/13 12:10	5.00E-01	35.62	0.00	0.00			
04	U-234	TRG	10/08/13 11:15	5.00E-01	111.97	0.00	0.00			
05	U-234	TRG	10/08/13 11:15	5.00E-01	110.86	0.00	0.00			
06	U-234	DO	10/08/13 12:10	5.00E-01	20.12	0.00	0.00			
07	U-234	TRG	10/08/13 12:10	5.00E-01	38.05	0.00	0.00			
08	U-234	TRG	10/08/13 16:05	5.00E-01	69.43	0.00	0.00			
09	U-234	TRG	10/08/13 16:05	5.00E-01	69.30	0.00	0.00			
10	U-234	TRG	10/09/13 10:55	5.00E-01	103.36	0.00	0.00			
11	U-234	TRG	10/09/13 10:55	5.00E-01	84.69	0.00	0.00			

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-UUISO-1

Run	Analysis Code	Eberline Services Work Order	Client
1	UUISO	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	U-234	LCS	10/24/13 11:06		A_Spec	Alpha_035	170	5.50 E+02	0.00 E+00	18.3
02	U-234	MBL	10/24/13 11:06		A_Spec	Alpha_037	170	8.00 E+00	0.00 E+00	17.8
03	U-234	DUP	10/24/13 11:06		A_Spec	Alpha_039	170	4.49 E+00	3.00 E-03	19.7
04	U-234	TRG	10/24/13 11:06		A_Spec	Alpha_040	170	1.70 E+02	0.00 E+00	19
05	U-234	TRG	10/24/13 11:06		A_Spec	Alpha_041	170	1.63 E+02	8.00 E-03	19.2
06	U-234	DO	10/24/13 11:06		A_Spec	Alpha_042	170	3.83 E+00	1.00 E-03	18.5
07	U-234	TRG	10/24/13 11:06		A_Spec	Alpha_043	170	1.07 E+01	2.00 E-03	20
08	U-234	TRG	10/24/13 11:06		A_Spec	Alpha_044	170	2.78 E+01	1.00 E-03	19.2
09	U-234	TRG	10/24/13 11:06		A_Spec	Alpha_045	170	2.11 E+01	5.00 E-03	19.1
10	U-234	TRG	10/24/13 11:06		A_Spec	Alpha_046	170	3.58 E+01	1.00 E-03	17.9
11	U-234	TRG	10/24/13 11:06		A_Spec	Alpha_047	170	9.00 E+00	0.00 E+00	18.2

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-UUISO-1

Run: 1
Analysis Code: UUISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	U-238	LCS	LCS	pCi/l	7.67E+00	1.03E+00	5.38E-02	7.93E+00	96.74	OK		OK	
02	U-238	MBL	BLANK	pCi/l	1.04E-01	7.13E-02	5.71E-02					OK	OK
03	U-238	DUP	WLL20131008F1	pCi/l	4.15E-01	3.72E-01	3.96E-01				NA	OK	
04	U-238	TRG	WLL20131008E1	pCi/l	2.61E+00	5.72E-01	1.04E-01					OK	
05	U-238	TRG	WLL201310008E2	pCi/l	2.40E+00	5.52E-01	2.35E-01					OK	
06	U-238	DO	WLL20131008F1	pCi/l	1.64E-01	4.10E-01	8.52E-01					OK	
07	U-238	TRG	WLL20131008F2	pCi/l	1.27E-01	1.95E-01	2.90E-01					OK	
08	U-238	TRG	WLL20131008K1	pCi/l	5.95E-01	3.20E-01	2.38E-01					OK	
09	U-238	TRG	WLL201310008K2	pCi/l	5.53E-01	3.02E-01	1.67E-01					OK	
10	U-238	TRG	WLL20131009L1	pCi/l	1.19E+00	3.87E-01	1.37E-01					OK	
11	U-238	TRG	WLL201310009L2	pCi/l	6.27E-02	9.60E-02	1.43E-01					OK	

Preliminary Data Report & Analytical Calculations
Work Order: 13-10043-UUISO-1

Run: 1
Analysis Code: UUISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	U-238	LCS	10/10/13 00:00	1.00E+00	112.27	0.00	0.00			
02	U-238	MBL	10/10/13 00:00	1.00E+00	124.05	0.00	0.00			
03	U-238	DUP	10/08/13 12:10	5.00E-01	35.62	0.00	0.00			
04	U-238	TRG	10/08/13 11:15	5.00E-01	111.97	0.00	0.00			
05	U-238	TRG	10/08/13 11:15	5.00E-01	110.86	0.00	0.00			
06	U-238	DO	10/08/13 12:10	5.00E-01	20.12	0.00	0.00			
07	U-238	TRG	10/08/13 12:10	5.00E-01	38.05	0.00	0.00			
08	U-238	TRG	10/08/13 16:05	5.00E-01	69.43	0.00	0.00			
09	U-238	TRG	10/08/13 16:05	5.00E-01	69.30	0.00	0.00			
10	U-238	TRG	10/09/13 10:55	5.00E-01	103.36	0.00	0.00			
11	U-238	TRG	10/09/13 10:55	5.00E-01	84.69	0.00	0.00			

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-UUISO-1

Run	Analysis Code	Eberline Services Work Order	Client
1	UUISO	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	U-238	LCS	10/24/13 11:06		A_Spec	Alpha_035	170	5.95 E+02	1.00 E-03	18.3
02	U-238	MBL	10/24/13 11:06		A_Spec	Alpha_037	170	8.66 E+00	2.00 E-03	17.8
03	U-238	DUP	10/24/13 11:06		A_Spec	Alpha_039	170	5.49 E+00	3.00 E-03	19.7
04	U-238	TRG	10/24/13 11:06		A_Spec	Alpha_040	170	1.05 E+02	1.00 E-03	19
05	U-238	TRG	10/24/13 11:06		A_Spec	Alpha_041	170	9.64 E+01	2.10 E-02	19.2
06	U-238	DO	10/24/13 11:06		A_Spec	Alpha_042	170	1.15 E+00	5.00 E-03	18.5
07	U-238	TRG	10/24/13 11:06		A_Spec	Alpha_043	170	1.83 E+00	1.00 E-03	20
08	U-238	TRG	10/24/13 11:06		A_Spec	Alpha_044	170	1.50 E+01	0.00 E+00	19.2
09	U-238	TRG	10/24/13 11:06		A_Spec	Alpha_045	170	1.38 E+01	1.00 E-03	19.1
10	U-238	TRG	10/24/13 11:06		A_Spec	Alpha_046	170	4.17 E+01	2.00 E-03	17.9
11	U-238	TRG	10/24/13 11:06		A_Spec	Alpha_047	170	1.83 E+00	1.00 E-03	18.2

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-UUISO-1

Run: 1
Analysis Code: UUISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	U-235	LCS	LCS	pCi/l	6.20E-01	2.07E-01	6.67E-02					OK	
02	U-235	MBL	BLANK	pCi/l	4.19E-02	5.07E-02	6.18E-02					OK	OK
03	U-235	DUP	WLL20131008F1	pCi/l	4.59E-02	1.91E-01	4.91E-01				OK	OK	
04	U-235	TRG	WLL20131008E1	pCi/l	4.31E-01	2.38E-01	1.85E-01					OK	
05	U-235	TRG	WLL201310008E2	pCi/l	2.05E-01	1.62E-01	1.47E-01					OK	
06	U-235	DO	WLL20131008F1	pCi/l	0.00E+00	4.89E-01	1.06E+00					INV	
07	U-235	TRG	WLL20131008F2	pCi/l	1.72E-01	2.93E-01	5.15E-01					OK	
08	U-235	TRG	WLL20131008K1	pCi/l	1.97E-01	2.17E-01	2.95E-01					OK	
09	U-235	TRG	WLL201310008K2	pCi/l	7.38E-02	1.41E-01	2.60E-01					OK	
10	U-235	TRG	WLL20131009L1	pCi/l	1.71E-01	1.57E-01	1.48E-01					OK	
11	U-235	TRG	WLL201310009L2	pCi/l	8.49E-02	1.45E-01	2.55E-01					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-UUISO-1

Client	Eberline Services Work Order	Analysis Code	Run
Missouri Dept. of Natural Resources	13-10043	UUISO	1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	U-235	LCS	10/10/13 00:00	1.00E+00	112.27	0.00	0.00			
02	U-235	MBL	10/10/13 00:00	1.00E+00	124.05	0.00	0.00			
03	U-235	DUP	10/08/13 12:10	5.00E-01	35.62	0.00	0.00			
04	U-235	TRG	10/08/13 11:15	5.00E-01	111.97	0.00	0.00			
05	U-235	TRG	10/08/13 11:15	5.00E-01	110.86	0.00	0.00			
06	U-235	DO	10/08/13 12:10	5.00E-01	20.12	0.00	0.00			
07	U-235	TRG	10/08/13 12:10	5.00E-01	38.05	0.00	0.00			
08	U-235	TRG	10/08/13 16:05	5.00E-01	69.43	0.00	0.00			
09	U-235	TRG	10/08/13 16:05	5.00E-01	69.30	0.00	0.00			
10	U-235	TRG	10/09/13 10:55	5.00E-01	103.36	0.00	0.00			
11	U-235	TRG	10/09/13 10:55	5.00E-01	84.69	0.00	0.00			

Preliminary Data Report & Analytical Calculations
Work Order: 13-10043-UUISO-1

Client	Eberline Services Work Order	Analysis Code	Run
Missouri Dept. of Natural Resources	13-10043	UUISO	1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	U-235	LCS	10/24/13 11:06		A_Spec	Alpha_035	170	3.88 E+01	1.00 E-03	18.3
02	U-235	MBL	10/24/13 11:06		A_Spec	Alpha_037	170	2.83 E+00	1.00 E-03	17.8
03	U-235	DUP	10/24/13 11:06		A_Spec	Alpha_039	170	4.90 E-01	3.00 E-03	19.7
04	U-235	TRG	10/24/13 11:06		A_Spec	Alpha_040	170	1.40 E+01	0.00 E+00	19
05	U-235	TRG	10/24/13 11:06		A_Spec	Alpha_041	170	6.66 E+00	2.00 E-03	19.2
06	U-235	DO	10/24/13 11:06		A_Spec	Alpha_042	170	1.00 E+00	0.00 E+00	18.5
07	U-235	TRG	10/24/13 11:06		A_Spec	Alpha_043	170	2.00 E+00	0.00 E+00	20
08	U-235	TRG	10/24/13 11:06		A_Spec	Alpha_044	170	4.00 E+00	0.00 E+00	19.2
09	U-235	TRG	10/24/13 11:06		A_Spec	Alpha_045	170	1.49 E+00	3.00 E-03	19.1
10	U-235	TRG	10/24/13 11:06		A_Spec	Alpha_046	170	4.83 E+00	1.00 E-03	17.9
11	U-235	TRG	10/24/13 11:06		A_Spec	Alpha_047	170	2.00 E+00	0.00 E+00	18.2

Count Room Report
Client: Missouri Dept. of Natural

13-10043-UUISO-1 (pCi/l) in WA
Tracer ID: U-10a

2.15

75-42

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	10/10/13 00:00	1.0000	0.6096	11.5854		0.00		
02	MBL	BLANK	10/10/13 00:00	1.0000	0.6075	11.5455		0.00		
03	DUP	WLL20131008F1	10/08/13 12:10	0.5000	0.6057	11.5113		0.00		
04	TRG	WLL20131008E1	10/08/13 11:15	0.5000	0.6015	11.4315		0.00		
05	TRG	WLL201310008E2	10/08/13 11:15	0.5000	0.6014	11.4296		0.00		
06	DO	WLL20131008F1	10/08/13 12:10	0.5000	0.6033	11.4657		0.00		
07	TRG	WLL20131008F2	10/08/13 12:10	0.5000	0.6046	11.4904		0.00		
08	TRG	WLL20131008K1	10/08/13 16:05	0.5000	0.6037	11.4733		0.00		
09	TRG	WLL201310008K2	10/08/13 16:05	0.5000	0.6036	11.4714		0.00		
10	TRG	WLL20131009L1	10/09/13 10:55	0.5000	0.6041	11.4809		0.00		
11	TRG	WLL201310009L2	10/09/13 10:55	0.5000	0.6038	11.4752		0.00		

Eberline Services
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 10/18/2013 8:18 AM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
13-10043	1	UUISO	10/18/2013 8:17	JWOLFE	JW	

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estimate	Known pCi	Error Estimate	Added pCi	Error Estimate
U-234	U-8a	35.240	10/18/2013	0.500	0.5125				8.14	0.293	0.00	0.000	0.00	0.000	0.00	0.000
U-238	U-8a	34.350	10/18/2013	0.500	0.5125				7.93	0.285	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	U-232	U-10a	19.005	10/18/2013	0.6096	0.6400
02	U-232	U-10a	19.005	10/18/2013	0.6075	0.6400
03	U-232	U-10a	19.005	10/18/2013	0.6057	0.6400
04	U-232	U-10a	19.005	10/18/2013	0.6015	0.6400
05	U-232	U-10a	19.005	10/18/2013	0.6014	0.6400
06	U-232	U-10a	19.005	10/18/2013	0.6033	0.6400
07	U-232	U-10a	19.005	10/18/2013	0.6046	0.6400
08	U-232	U-10a	19.005	10/18/2013	0.6037	0.6400
09	U-232	U-10a	19.005	10/18/2013	0.6036	0.6400
10	U-232	U-10a	19.005	10/18/2013	0.6041	0.6400
11	U-232	U-10a	19.005	10/18/2013	0.6038	0.6400

Balance Printer Tapes

Tracer

0.6096 g
0.6075 g
-0.6057 g
-0.6015 g
-0.6014 g
-0.6033 g
-0.6046 g
-0.6037 g
-0.6036 g
-0.6041 g
-0.6038 g

LCS

0.5125 g

Matrix Spike

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
13-10043	1	UUISO	liters	10/31/2013	JWOLFE

Lab Fraction	Missouri Dept. of Natural Resources Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	WLL20131008F1	DUP					5.0000E-01	5.0000E-01				
04	WLL20131008E1	TRG					5.0000E-01	5.0000E-01				
05	WLL201310008E2	TRG					5.0000E-01	5.0000E-01				
06	WLL20131008F1	DO					5.0000E-01	5.0000E-01				
07	WLL20131008F2	TRG					5.0000E-01	5.0000E-01				
08	WLL20131008K1	TRG					5.0000E-01	5.0000E-01				
09	WLL201310008K2	TRG					5.0000E-01	5.0000E-01				
10	WLL20131009L1	TRG					5.0000E-01	5.0000E-01				
11	WLL201310009L2	TRG					5.0000E-01	5.0000E-01				

Comments	

Technician: JWOlfe Date: 10/18/13

KB 10/24/13

Apex-Alpha™

Sample Description: SPIKE
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 01
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_035
Chamber Serial Number: 04026477A
Detector Serial Number: 58771
Env. Background: System Bkgd 70368
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Sample Date/Time: 10/24/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:19 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.610 mL
Effective Efficiency: 0.2050 +/- 0.0113
Counting Efficiency: 0.1826 +/- 0.0032 on 12/16/2012 5:49:42 PM
Chem. Recovery Factor: 1.1227 +/- 0.0648

Control Certificate Name: NatU_U-8A
Chem. Recov. of Control: U-238 0.942987 +/- 0.070618
Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.273	401.32	9.79	0.68	0.00E+000	31.8
U-234		4.730	550.00	8.37	0.00	0.00E+000	47.6
U-235		4.384	38.83	31.53	0.17	0.00E+000	5.9
U-238		4.154	594.83	8.04	0.17	0.00E+000	37.3

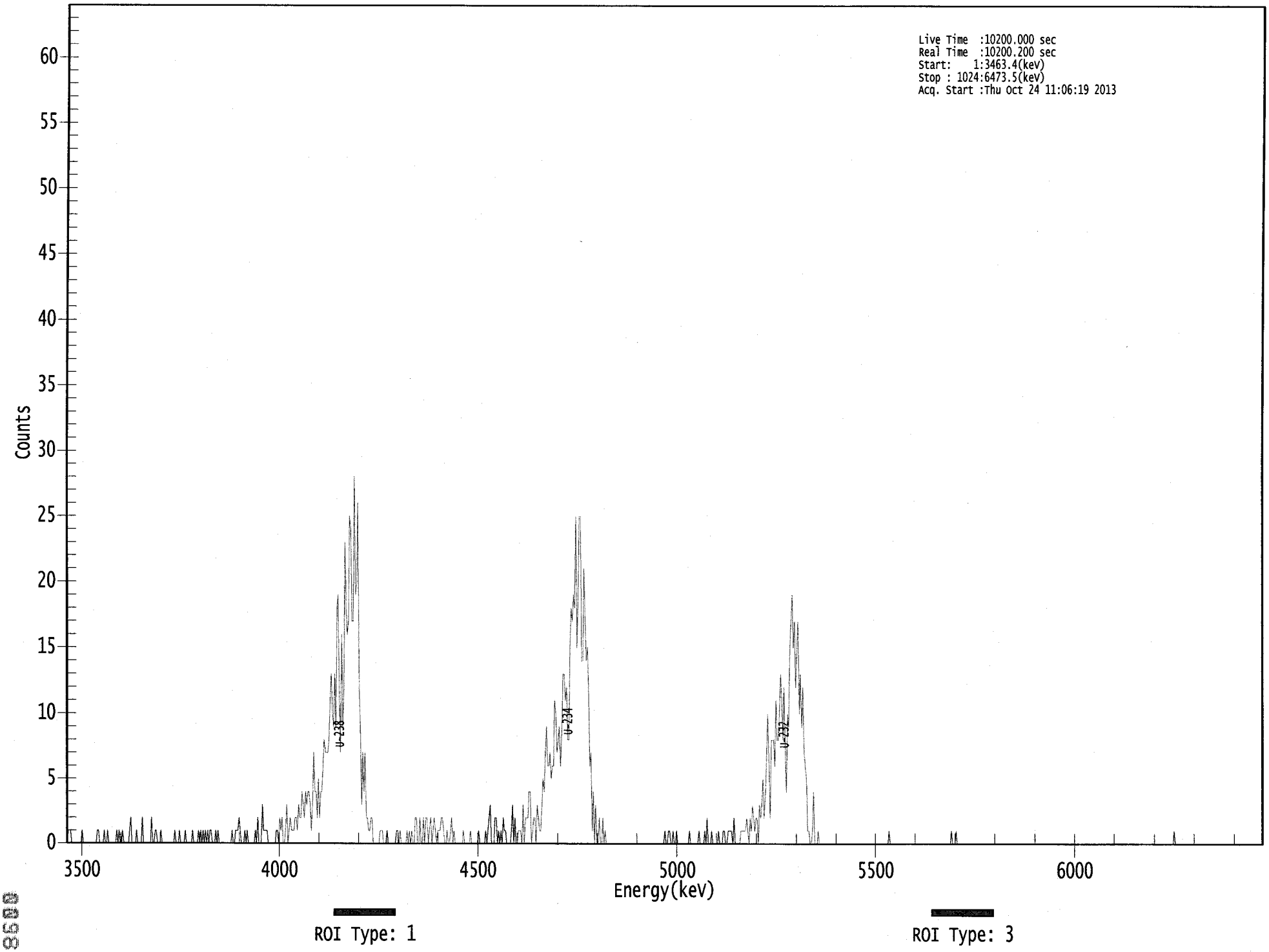
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.994	5302.50*	5.20E+000 +/- 5.60E-001	7.31E-002 +/- 7.88E-003
U-234	0.993	4761.50*	7.12E+000 +/- 9.72E-001	7.77E-002 +/- 8.37E-003
U-235	1.000	4385.50*	6.20E-001 +/- 2.07E-001	6.67E-002 +/- 7.19E-003
U-238	0.994	4184.40*	7.67E+000 +/- 1.03E+000	5.38E-002 +/- 5.80E-003

AG
10/24/13

0000071873.CNF



0098

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*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 01

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	1	1	1	0	0	0	0
9:	0	0	0	0	0	1	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	1	1	0	0	0	0
33:	1	0	0	1	0	0	0	0
41:	0	0	0	1	0	1	0	0
49:	1	0	0	0	0	0	1	2
57:	0	0	0	0	1	0	0	0
65:	0	2	0	0	0	0	0	0
73:	0	2	0	0	1	1	0	0
81:	0	1	0	0	0	0	0	0
89:	0	0	0	0	0	1	0	0
97:	0	1	0	0	0	0	1	0
105:	0	0	0	0	1	0	0	0
113:	0	1	0	1	0	1	0	1
121:	0	1	0	1	1	0	0	0
129:	1	0	1	0	0	0	0	0
137:	0	0	0	0	0	0	1	0
145:	0	1	1	1	2	1	0	0
153:	0	1	0	1	0	0	0	0
161:	0	0	1	0	2	0	0	0
169:	3	1	1	1	1	0	0	0
177:	0	0	0	0	1	1	0	2
185:	1	2	0	0	1	3	0	1
193:	2	1	1	1	2	2	1	3
201:	2	2	4	3	2	4	3	4
209:	4	3	1	3	7	4	4	2
217:	5	2	4	4	6	8	7	7
225:	7	8	11	13	10	9	13	9
233:	18	19	11	7	16	9	12	23
241:	18	16	17	25	24	17	17	28
249:	19	20	26	12	9	3	7	4
257:	7	2	2	1	1	2	2	0
265:	0	0	0	0	0	1	1	1
273:	0	0	0	1	0	0	0	0
281:	0	0	0	1	1	0	1	0
289:	0	0	0	0	1	0	1	0
297:	1	0	0	2	2	0	0	2
305:	0	0	2	0	2	2	0	1
313:	2	0	1	2	1	0	1	1
321:	1	2	2	1	0	0	1	0
329:	0	1	2	0	1	0	0	0
337:	0	0	0	0	1	0	0	0
345:	0	0	1	0	0	0	0	0
353:	0	1	0	0	0	0	0	1
361:	0	1	2	3	0	0	0	2

369:	2	0	1	0	1	0	2	1

Sample Title: 01

Channel								
377:	1	0	0	0	0	1	3	0
385:	2	0	0	1	1	1	0	3
393:	0	2	2	2	4	4	0	1
401:	2	2	0	3	2	1	1	3
409:	5	4	7	9	6	6	7	5
417:	6	6	11	10	7	8	9	6
425:	9	13	13	11	12	8	8	15
433:	18	17	19	18	25	15	19	25
441:	25	14	14	21	17	14	15	12
449:	6	7	1	4	0	3	0	0
457:	2	0	0	2	0	1	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	1	0	0	1	1	0	0	1
521:	0	0	1	0	0	0	0	0
529:	0	0	0	0	0	1	0	0
537:	0	0	0	0	0	1	0	0
545:	0	0	1	0	2	0	0	0
553:	1	0	0	0	0	0	1	0
561:	0	0	1	1	0	0	1	1
569:	1	1	0	2	0	0	0	0
577:	0	1	1	1	1	1	2	1
585:	0	2	1	3	2	1	2	2
593:	0	3	2	3	5	2	4	6
601:	10	6	2	8	8	8	6	11
609:	8	8	10	13	11	8	12	7
617:	4	10	9	15	17	19	15	17
625:	12	15	17	10	13	9	12	7
633:	6	5	1	1	0	0	1	4
641:	0	0	0	1	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	1	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	1	0	0
761:	0	1	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 01

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	1	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

LCB 10/24/13

Sample Description: BLANK
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 02
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_037
Chamber Serial Number: 04026478A
Detector Serial Number: 91133
Env. Background: System Bkgd 70369
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Sample Date/Time: 10/24/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:21 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.608 mL
Effective Efficiency: 0.2212 +/- 0.0118
Counting Efficiency: 0.1783 +/- 0.0033 on 1/26/2013 3:28:25 PM
Chem. Recovery Factor: 1.2405 +/- 0.0701

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.298	431.49	9.44	0.51	0.00E+000	10.0
U-234		4.708	8.00	73.50	0.00	0.00E+000	2.9
U-235		4.374	2.83	120.53	0.17	0.00E+000	2.9
U-238		4.126	8.66	68.12	0.34	0.00E+000	2.9

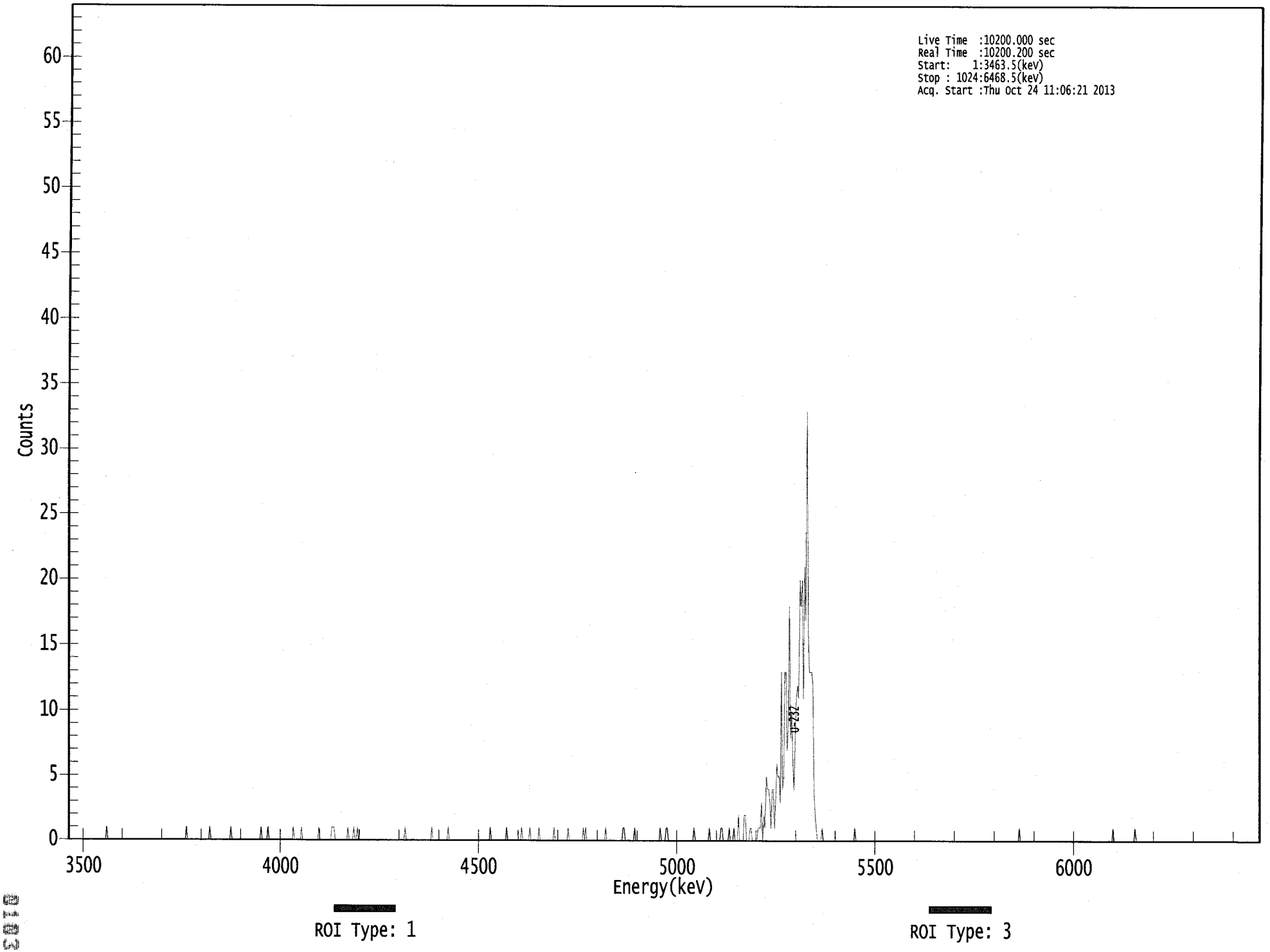
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	1.000	5302.50*	5.18E+000 +/- 5.42E-001	6.30E-002 +/- 6.59E-003
U-234	0.980	4761.50*	9.60E-002 +/- 7.13E-002	7.20E-002 +/- 7.53E-003
U-235	0.999	4385.50*	4.19E-002 +/- 5.07E-002	6.18E-002 +/- 6.47E-003
U-238	0.976	4184.40*	1.04E-001 +/- 7.13E-002	5.71E-002 +/- 5.98E-003

AG 10/24/13

0000071874.CNF



```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 02

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	1	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	1	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	1	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	1	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	1	0
169:	0	0	0	0	1	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	1	0	0	0	0	0
201:	0	1	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	1	0	0	0	0	0	0	0
225:	0	0	0	1	1	1	0	0
233:	0	0	0	0	0	0	0	0
241:	0	1	0	0	0	0	1	0
249:	0	1	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	1	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	1	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	1
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	1	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 02

Channel								
377:	0	1	0	0	0	0	0	0
385:	0	0	0	0	0	0	1	0
393:	0	0	0	0	0	1	0	0
401:	0	0	0	0	0	1	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	1	0	0	0	0	0
425:	0	0	0	0	0	0	1	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	1	0	1	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	1	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	1	1	0
481:	0	0	0	0	0	0	0	1
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	1	0	0
513:	0	0	1	1	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	1	0	0	0	0	0
545:	0	0	0	0	0	0	0	1
553:	0	0	0	0	0	0	0	0
561:	0	1	1	0	0	0	0	0
569:	1	0	0	0	1	0	0	0
577:	2	0	0	0	0	2	2	0
585:	0	0	1	1	0	0	0	0
593:	0	1	1	1	3	0	2	1
601:	5	4	4	3	1	4	4	1
609:	3	6	5	5	3	13	4	5
617:	13	13	7	9	18	8	10	6
625:	4	8	11	12	11	20	18	20
633:	11	21	17	33	16	13	13	13
641:	12	4	2	1	0	0	0	0
649:	1	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	1	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 02

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	1	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	1	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	1	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

ICB 10/24/13

Apex-Alpha™

Sample Description: WLL20131008F1-DUP
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 03
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_039
Chamber Serial Number: 06027396A
Detector Serial Number: 83109
Env. Background: System Bkgd 70370
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:23 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.606 mL
Effective Efficiency: 0.0700 +/- 0.0062
Counting Efficiency: 0.1965 +/- 0.0034 on 4/20/2013 2:01:25 PM
Chem. Recovery Factor: 0.3562 +/- 0.0323

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.284	136.15	16.86	0.85	0.00E+000	6.8
U-234		4.739	4.49	98.45	0.51	0.00E+000	3.0
U-235		4.406	0.49	416.98	0.51	0.00E+000	3.0
U-238		4.130	5.49	88.08	0.51	0.00E+000	3.0

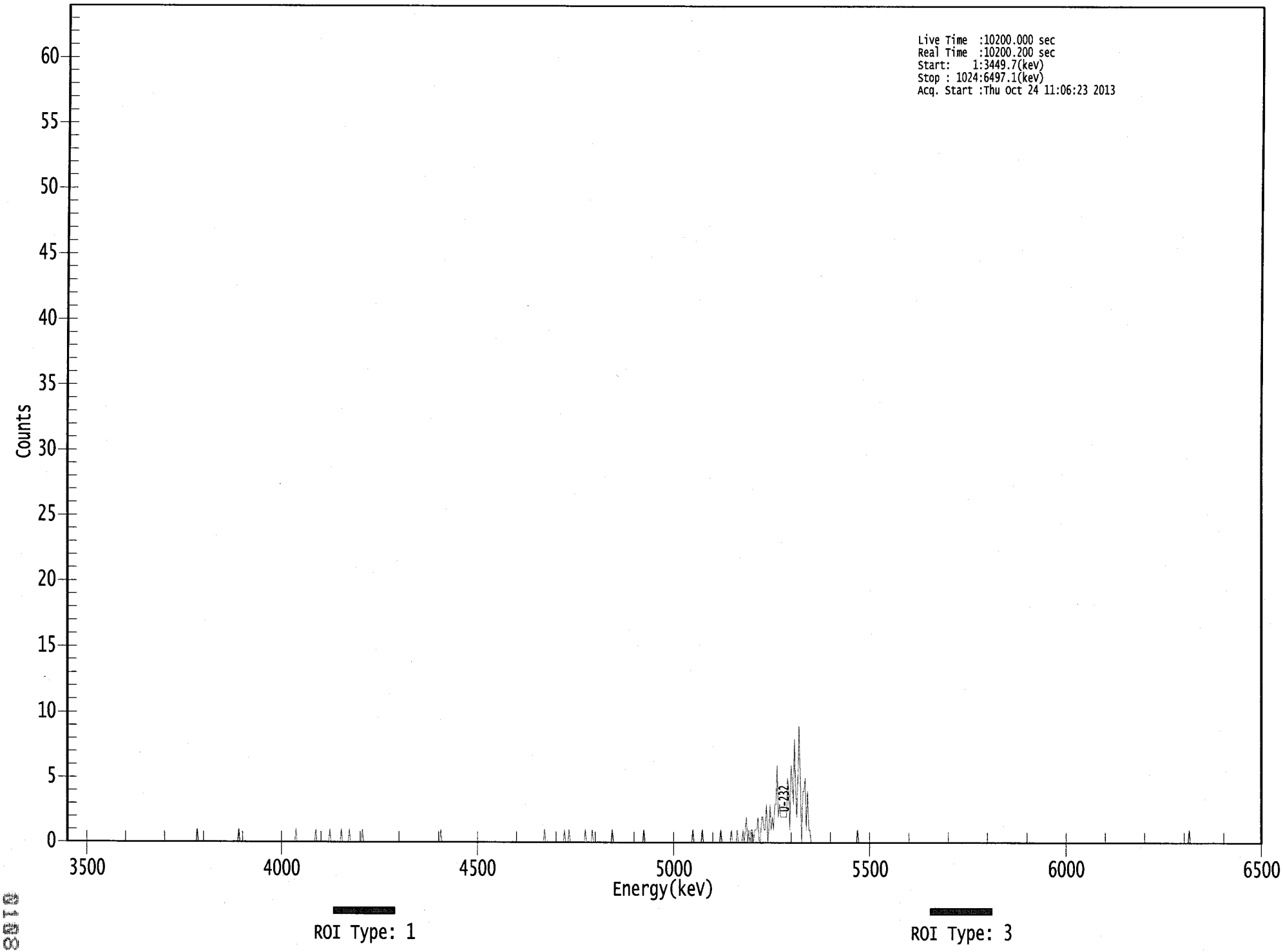
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.998	5302.50*	1.03E+001 +/- 1.80E+000	4.54E-001 +/- 7.93E-002
U-234	0.996	4761.50*	3.41E-001 +/- 3.41E-001	3.98E-001 +/- 6.95E-002
U-235	0.997	4385.50*	4.59E-002 +/- 1.91E-001	4.91E-001 +/- 8.57E-002
U-238	0.979	4184.40*	4.15E-001 +/- 3.72E-001	3.96E-001 +/- 6.92E-002

AG
10/24/13

0000071875.CNF



```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 03

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	1	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	1	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	1	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	1	0
217:	0	0	0	0	0	0	0	0
225:	0	0	1	0	0	0	0	0
233:	0	0	0	0	1	0	0	0
241:	0	0	0	1	0	0	0	0
249:	0	0	0	0	0	0	1	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	1	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 03

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	1	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	1	0	0	0	1
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	1	0	0
449:	0	0	0	1	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	1	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	1
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	1	0	0	0	0	0	0
545:	0	1	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	1	0	0	0	0	0	0
569:	0	0	1	0	0	0	0	1
577:	0	0	0	0	1	0	1	2
585:	0	1	0	1	1	0	1	1
593:	1	2	0	0	2	2	1	1
601:	3	0	1	3	1	2	1	3
609:	3	6	2	3	2	2	2	2
617:	2	2	5	4	1	6	5	3
625:	8	4	2	6	9	4	0	4
633:	4	5	1	4	1	1	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	1	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 03

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	1	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB
10/24/13

Apex-Alpha™

Sample Description: WLL20131008E1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 04
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_040
Chamber Serial Number: 06027396B
Detector Serial Number: 91135
Env. Background: System Bkgd 70371
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:25 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.601 mL
Effective Efficiency: 0.2128 +/- 0.0116
Counting Efficiency: 0.1900 +/- 0.0033 on 12/16/2012 5:49:33 PM
Chem. Recovery Factor: 1.1197 +/- 0.0640

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.291	410.98	9.68	1.02	0.00E+000	44.5
U-234		4.739	170.00	15.08	0.00	0.00E+000	19.8
U-235		4.377	14.00	54.22	0.00	0.00E+000	3.0
U-238		4.171	104.83	19.16	0.17	0.00E+000	6.7

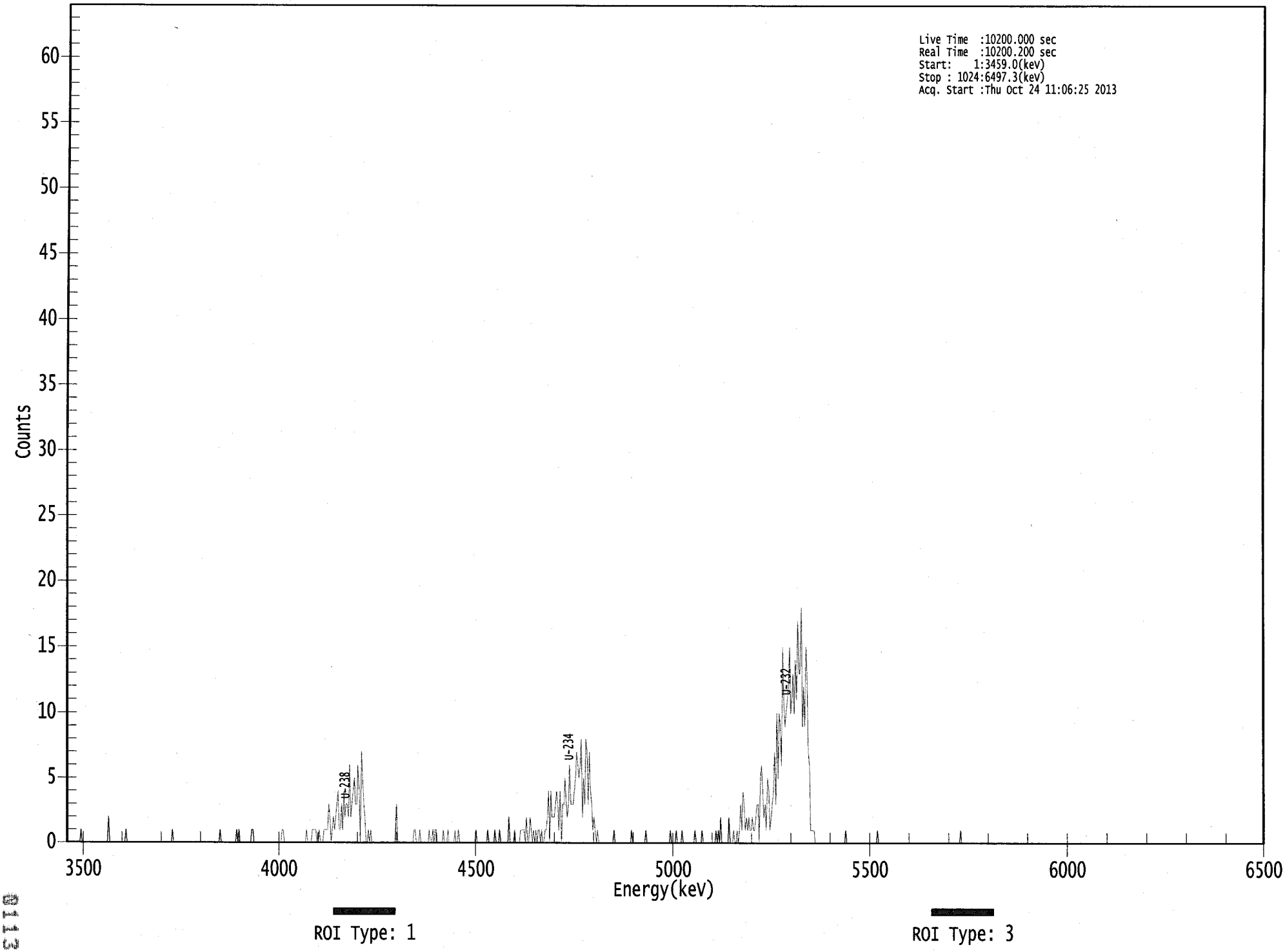
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.999	5302.50*	1.03E+001 +/- 1.10E+000	1.57E-001 +/- 1.68E-002
U-234	0.997	4761.50*	4.24E+000 +/- 7.84E-001	1.50E-001 +/- 1.60E-002
U-235	0.999	4385.50*	4.31E-001 +/- 2.38E-001	1.85E-001 +/- 1.97E-002
U-238	0.999	4184.40*	2.61E+000 +/- 5.72E-001	1.04E-001 +/- 1.11E-002

AG
10/24/13

0000071876.CNF



****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 04

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	1	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	2	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	1	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	1	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	1	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	1	0	1	0	0	0
153:	0	0	0	0	0	0	0	1
161:	1	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	1	1	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	1	0
209:	0	0	0	1	1	1	1	0
217:	0	1	0	0	0	1	1	1
225:	1	3	2	0	1	2	1	2
233:	3	4	1	1	3	1	4	2
241:	3	3	2	6	2	3	4	5
249:	3	3	6	4	0	7	5	3
257:	2	0	0	1	0	1	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	3	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	1	1	0	0	0	1
305:	0	0	0	0	0	0	0	1
313:	0	0	1	0	1	1	0	0
321:	0	0	0	1	0	0	0	1
329:	0	0	0	0	0	1	0	0
337:	1	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	1
353:	0	0	0	0	0	0	0	0
361:	0	1	0	0	0	0	0	1

369:	0	0	0	1	0	0	0	0

Sample Title: 04

Channel								
377:	0	0	0	2	0	0	0	0
385:	1	0	0	0	0	1	1	1
393:	1	0	2	0	0	2	1	0
401:	1	0	1	0	1	1	0	1
409:	0	0	1	1	2	4	0	4
417:	2	2	2	3	4	3	1	4
425:	0	3	3	5	3	2	3	6
433:	3	3	3	4	5	7	6	5
441:	6	8	2	5	3	8	7	3
449:	7	4	3	1	2	1	0	1
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	1	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	1	0	0	0
489:	0	0	0	0	0	0	0	0
497:	1	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	1	0	0
521:	0	0	1	0	0	0	0	1
529:	0	0	0	0	0	0	0	0
537:	0	0	1	0	0	0	0	0
545:	1	0	0	0	0	0	0	0
553:	0	0	0	0	1	0	1	0
561:	2	0	0	0	0	0	0	2
569:	0	0	0	1	0	0	1	0
577:	1	3	1	4	3	1	2	1
585:	2	1	1	2	1	1	2	3
593:	3	0	5	6	4	2	3	1
601:	5	4	1	2	3	4	7	3
609:	10	5	10	9	6	15	11	9
617:	10	11	12	15	10	11	13	10
625:	14	11	17	13	13	18	9	12
633:	9	15	13	7	6	1	1	1
641:	1	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	1	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	1	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	1	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 04

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

ICB 10/24/13

Apex-Alpha™

Sample Description: WLL201310008E2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 05
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_041
Chamber Serial Number: 05026930A
Detector Serial Number: 91087
Env. Background: System Bkgd 70372
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:27 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.601 mL
Effective Efficiency: 0.2125 +/- 0.0116
Counting Efficiency: 0.1917 +/- 0.0033 on 8/10/2013 2:59:03 PM
Chem. Recovery Factor: 1.1086 +/- 0.0634

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.275	410.49	9.68	0.51	0.00E+000	38.6
U-234		4.723	162.64	15.44	1.36	0.00E+000	8.2
U-235		4.401	6.66	78.18	0.34	0.00E+000	3.0
U-238		4.146	96.43	20.39	3.57	0.00E+000	6.2

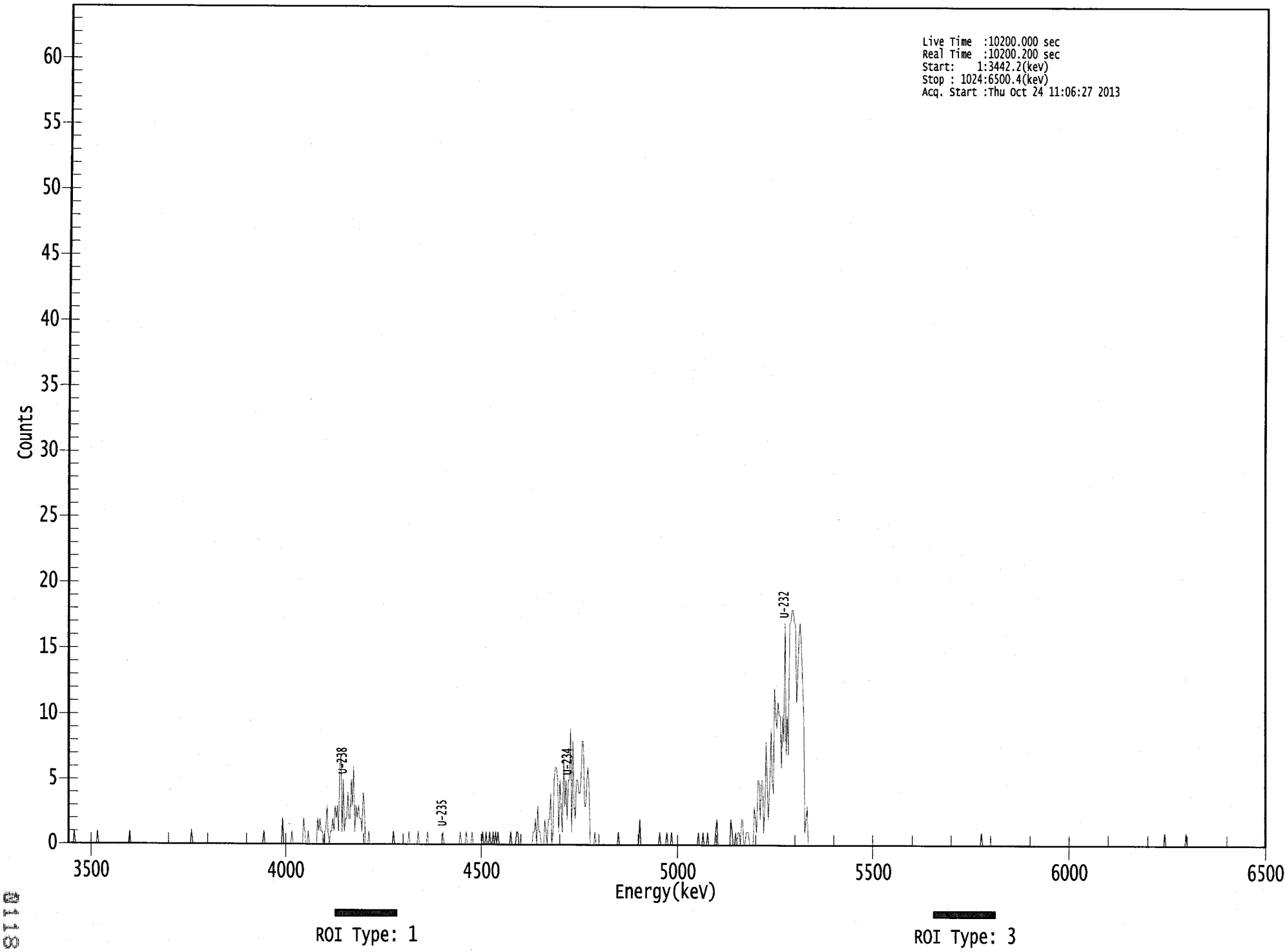
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.995	5302.50*	1.03E+001 +/- 1.10E+000	1.31E-001 +/- 1.40E-002
U-234	0.989	4761.50*	4.06E+000 +/- 7.63E-001	1.71E-001 +/- 1.83E-002
U-235	0.998	4385.50*	2.05E-001 +/- 1.62E-001	1.47E-001 +/- 1.57E-002
U-238	0.990	4184.40*	2.40E+000 +/- 5.52E-001	2.35E-001 +/- 2.51E-002

AG
10/24/13

0000071877.CNF



8118

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 05

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	1	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	1	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	1	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	1	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	1	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	2	0	0	0	0	0	0	0
193:	1	0	0	0	0	0	0	0
201:	0	0	2	1	0	0	1	0
209:	0	0	0	0	0	0	2	1
217:	2	1	1	0	1	1	3	1
225:	0	1	1	2	1	3	2	3
233:	1	6	7	1	5	1	2	2
241:	4	2	2	5	3	6	1	3
249:	2	3	2	2	1	4	3	0
257:	0	0	1	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	1
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	1	0	0	0
297:	0	0	0	0	1	0	0	0
305:	0	0	0	0	1	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	1	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	1	0	0	0	0	1	0	0
345:	0	0	1	0	0	0	0	0
353:	0	0	0	1	0	0	1	0
361:	0	1	0	0	1	0	1	0

369:	1	0	0	0	0	0	0	0

Sample Title: 05

Channel								
377:	0	0	0	1	0	0	0	0
385:	1	1	0	0	0	0	0	0
393:	0	0	0	0	0	0	1	1
401:	2	0	3	1	1	0	0	0
409:	2	1	0	2	2	4	0	1
417:	5	6	6	5	1	5	3	1
425:	7	3	5	2	5	5	9	1
433:	8	3	2	5	5	4	4	5
441:	8	8	3	3	5	6	4	0
449:	0	0	0	1	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	1
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	2	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	1	0	0	0	0	0
513:	1	0	0	0	1	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	1	0	0	0	1
545:	0	0	0	1	0	0	0	0
553:	0	0	1	2	0	0	0	0
561:	0	0	0	0	0	0	0	2
569:	1	0	0	1	0	1	1	0
577:	2	2	0	0	1	1	1	0
585:	0	0	0	3	2	1	5	5
593:	2	5	5	1	3	8	4	2
601:	5	9	5	4	12	10	9	11
609:	10	10	6	10	8	17	7	10
617:	7	17	17	18	18	17	17	11
625:	13	16	17	15	13	10	1	2
633:	3	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	1	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 05

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	1	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	1	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

ICB
10/24/13

Apex-Alpha™

Sample Description: WLL20131008F1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 06
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_042
Chamber Serial Number: 05026930B
Detector Serial Number: 84185
Env. Background: System Bkgd 70373
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:29 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.603 mL
Effective Efficiency: 0.0372 +/- 0.0045
Counting Efficiency: 0.1846 +/- 0.0032 on 12/16/2012 5:49:29 PM
Chem. Recovery Factor: 0.2012 +/- 0.0246

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.285	71.98	23.29	1.02	0.00E+000	4.4
U-234		4.749	3.83	102.72	0.17	0.00E+000	3.0
U-235		4.397	0.00	1960.0	0.00	0.00E+000	0.0
U-238		4.176	1.15	249.59	0.85	0.00E+000	3.0

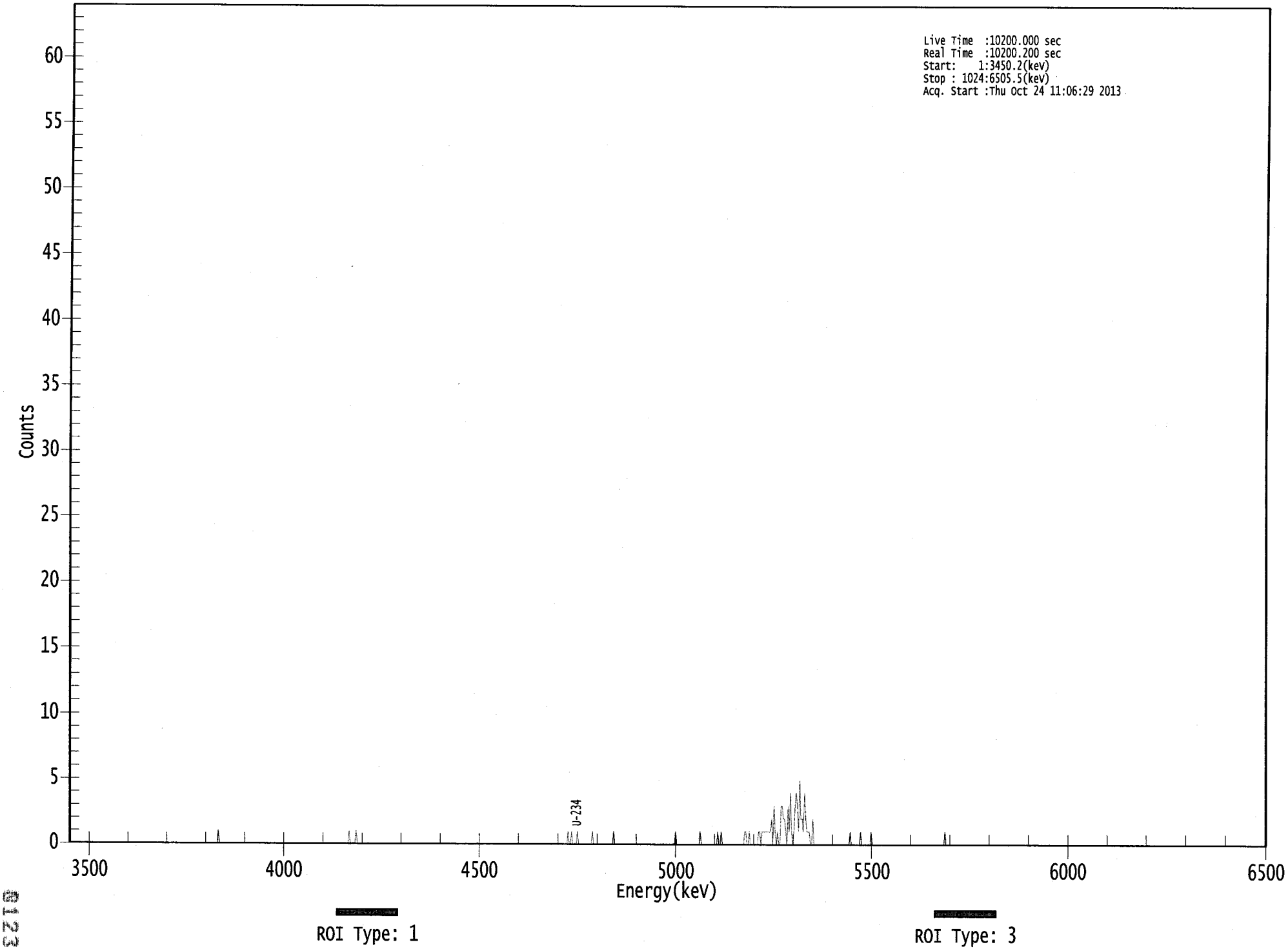
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.998	5302.50*	1.03E+001 +/- 2.44E+000	9.01E-001 +/- 2.14E-001
U-234	0.999	4761.50*	5.47E-001 +/- 5.77E-001	5.96E-001 +/- 1.42E-001
U-235	0.999	4385.50*	0.00E+000 +/- 4.89E-001	1.06E+000 +/- 2.51E-001
U-238	0.999	4184.40*	1.64E-001 +/- 4.10E-001	8.52E-001 +/- 2.02E-001

AG
10/24/13

0000071878.CNF



01423

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 06

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	1	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	1	0	0	0	0	0	1	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 06

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	1	0	0	1	0
433:	0	0	0	1	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	1	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	1	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	1
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	1	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	1	0	0	1	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	1	1	0	0	1	0
585:	0	0	0	0	0	0	1	1
593:	0	1	1	1	1	1	1	1
601:	1	2	0	3	1	0	1	0
609:	0	3	3	2	2	1	0	3
617:	1	4	1	0	1	3	4	3
625:	1	5	2	2	1	4	2	1
633:	1	1	0	0	2	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	1	0	0	0
673:	0	0	0	0	0	1	0	0
681:	0	0	0	0	0	0	1	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	1	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 06

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

KB 10/24/13

Sample Description: WLL20131008F2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 07
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_043
Chamber Serial Number: 04026481A
Detector Serial Number: 91088
Env. Background: System Bkgd 70374
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:31 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.605 mL
Effective Efficiency: 0.0762 +/- 0.0065
Counting Efficiency: 0.2003 +/- 0.0035 on 8/11/2013 2:21:17 PM
Chem. Recovery Factor: 0.3805 +/- 0.0333

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.286	147.98	16.18	1.02	0.00E+000	15.3
U-234		4.745	10.66	61.14	0.34	0.00E+000	3.0
U-235		4.434	2.00	169.74	0.00	0.00E+000	3.0
U-238		4.181	1.83	152.56	0.17	0.00E+000	3.0

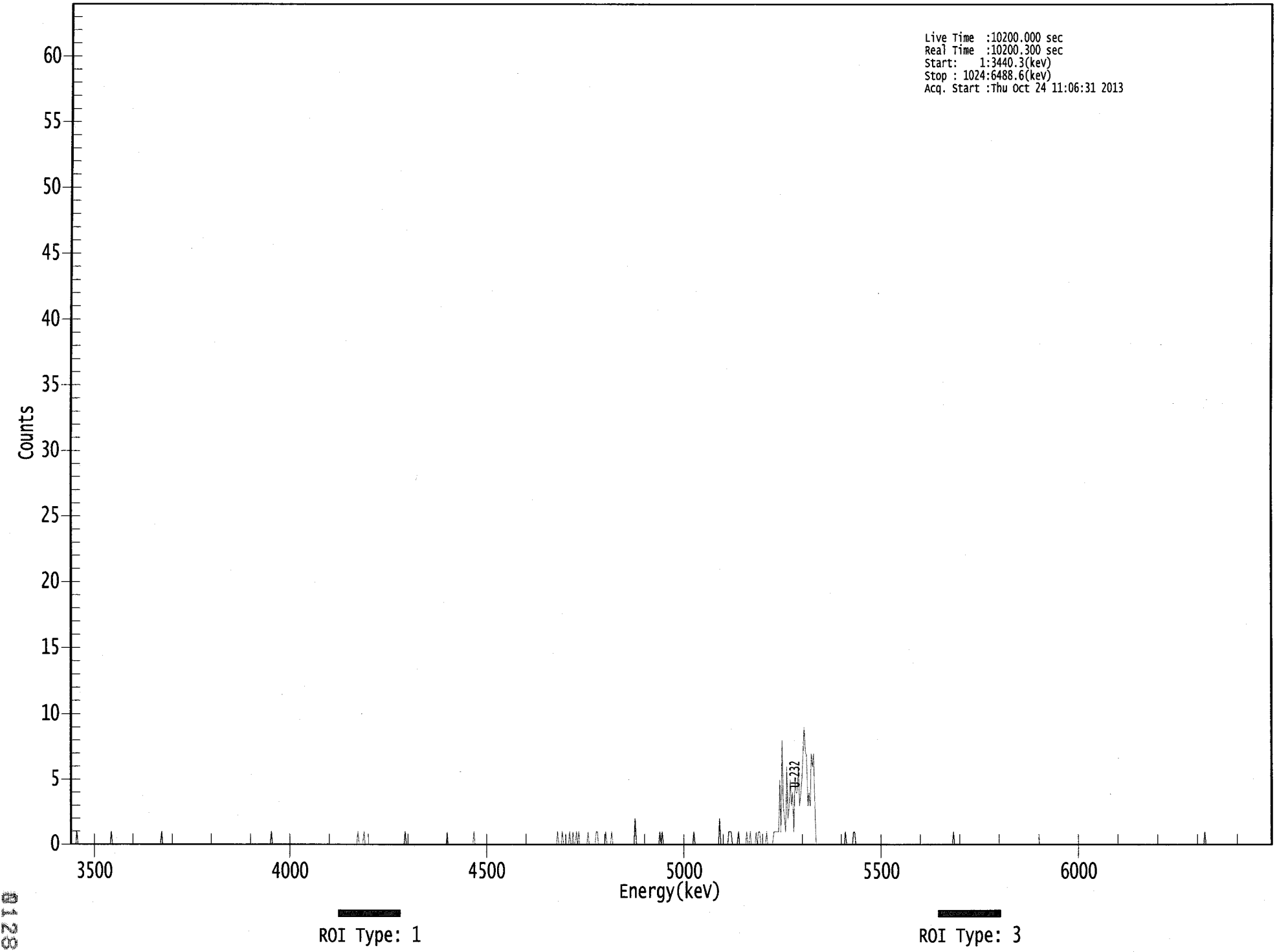
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.998	5302.50*	1.03E+001 +/- 1.73E+000	4.39E-001 +/- 7.38E-002
U-234	0.998	4761.50*	7.43E-001 +/- 4.71E-001	3.33E-001 +/- 5.59E-002
U-235	0.983	4385.50*	1.72E-001 +/- 2.93E-001	5.15E-001 +/- 8.66E-002
U-238	1.000	4184.40*	1.27E-001 +/- 1.95E-001	2.90E-001 +/- 4.86E-002

AG
10/24/13

0000071879.CNF



8128

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 07

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	1	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	1	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	1	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	1	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	1	0
249:	0	0	0	1	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	1	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	1	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	1	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 07

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	1	0	0	0	1	0	0	0
425:	0	0	1	0	0	1	0	0
433:	1	0	1	0	0	0	0	0
441:	0	0	1	0	0	0	0	0
449:	0	1	1	0	0	0	0	0
457:	0	1	0	0	0	0	1	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	2	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	1
505:	0	1	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	1	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	2	0	0	0	0	0
561:	0	0	1	1	1	0	0	0
569:	0	0	1	0	0	0	0	0
577:	0	1	0	0	1	0	0	0
585:	0	1	0	1	1	0	0	0
593:	0	0	1	0	0	0	0	0
601:	1	1	1	1	1	5	1	8
609:	3	2	1	6	2	3	5	3
617:	4	1	5	4	4	6	3	4
625:	5	7	9	7	7	3	4	3
633:	7	6	7	3	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	1	0	0
665:	0	0	0	0	1	1	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	1	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 07

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	1	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

KB 10/24/13

Sample Description: WLL20131008K1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 08
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_044
Chamber Serial Number: 04026481B
Detector Serial Number: 84168
Env. Background: System Bkgd 70375
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:34 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.604 mL
Effective Efficiency: 0.1333 +/- 0.0089
Counting Efficiency: 0.1920 +/- 0.0033 on 8/11/2013 2:17:37 PM
Chem. Recovery Factor: 0.6943 +/- 0.0477

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.280	258.49	12.20	0.51	0.00E+000	20.8
U-234		4.731	27.83	37.29	0.17	0.00E+000	11.1
U-235		4.420	4.00	109.57	0.00	0.00E+000	3.0
U-238		4.152	15.00	52.27	0.00	0.00E+000	4.4

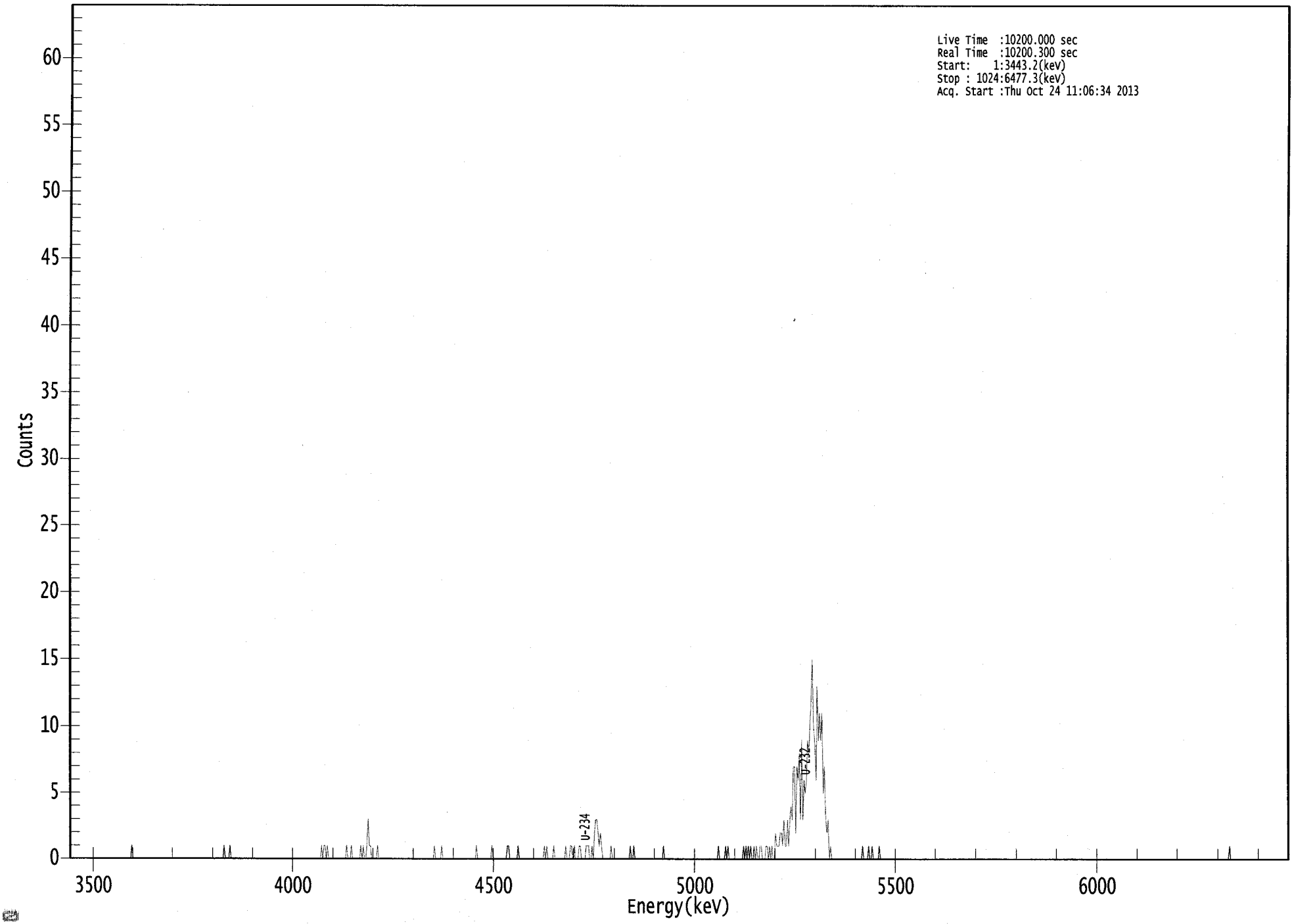
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.996	5302.50*	1.03E+001 +/- 1.34E+000	2.09E-001 +/- 2.72E-002
U-234	0.993	4761.50*	1.11E+000 +/- 4.38E-001	1.66E-001 +/- 2.16E-002
U-235	0.992	4385.50*	1.97E-001 +/- 2.17E-001	2.95E-001 +/- 3.83E-002
U-238	0.993	4184.40*	5.95E-001 +/- 3.20E-001	2.38E-001 +/- 3.09E-002

AG
10/24/13

0000071880.CNF



****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 08

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	1	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	1	0	0	0	0	1
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	1	0	1	1
217:	0	1	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	1	0	0	0	1	0	0
241:	0	0	0	0	0	1	0	1
249:	0	0	1	3	1	1	0	0
257:	0	0	0	1	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	1	0	0	0	0
313:	0	1	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	1	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	1	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	1	1	0	0	0	0	0	0

Sample Title: 08

Channel								
377:	0	1	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	1
401:	0	1	0	0	0	0	0	1
409:	0	0	0	0	0	0	0	0
417:	0	1	0	0	0	1	1	0
425:	1	0	0	0	1	1	0	0
433:	0	0	1	1	1	0	0	1
441:	0	2	3	3	2	1	2	1
449:	0	0	0	0	0	0	0	1
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	1
473:	0	0	1	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	1	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	1	0	0	0	0	0	1
553:	0	1	0	0	0	0	0	0
561:	0	0	0	0	0	0	1	0
569:	1	0	1	0	1	0	0	1
577:	0	1	0	0	1	1	0	0
585:	0	1	1	0	1	0	1	0
593:	0	2	1	1	1	2	2	1
601:	3	1	1	3	1	3	4	3
609:	7	7	2	7	6	8	3	9
617:	3	6	5	6	9	8	10	12
625:	15	10	9	6	13	9	11	9
633:	11	5	7	3	2	3	0	1
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	1	0	0	0	0	1
673:	0	0	1	0	0	0	0	0
681:	1	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 08

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	1	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

WB 10/24/13

Apex-Alpha™

Sample Description: WLL201310008K2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 09
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_045
Chamber Serial Number: 04026482A
Detector Serial Number: 91131
Env. Background: System Bkgd 70376
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:36 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.604 mL
Effective Efficiency: 0.1323 +/- 0.0088
Counting Efficiency: 0.1909 +/- 0.0033 on 7/20/2013 2:31:26 PM
Chem. Recovery Factor: 0.6930 +/- 0.0477

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.274	256.49	12.25	0.51	0.00E+000	11.9
U-234		4.745	21.15	43.61	0.85	0.00E+000	4.5
U-235		4.472	1.49	190.02	0.51	0.00E+000	3.0
U-238		4.155	13.83	53.08	0.17	0.00E+000	3.0

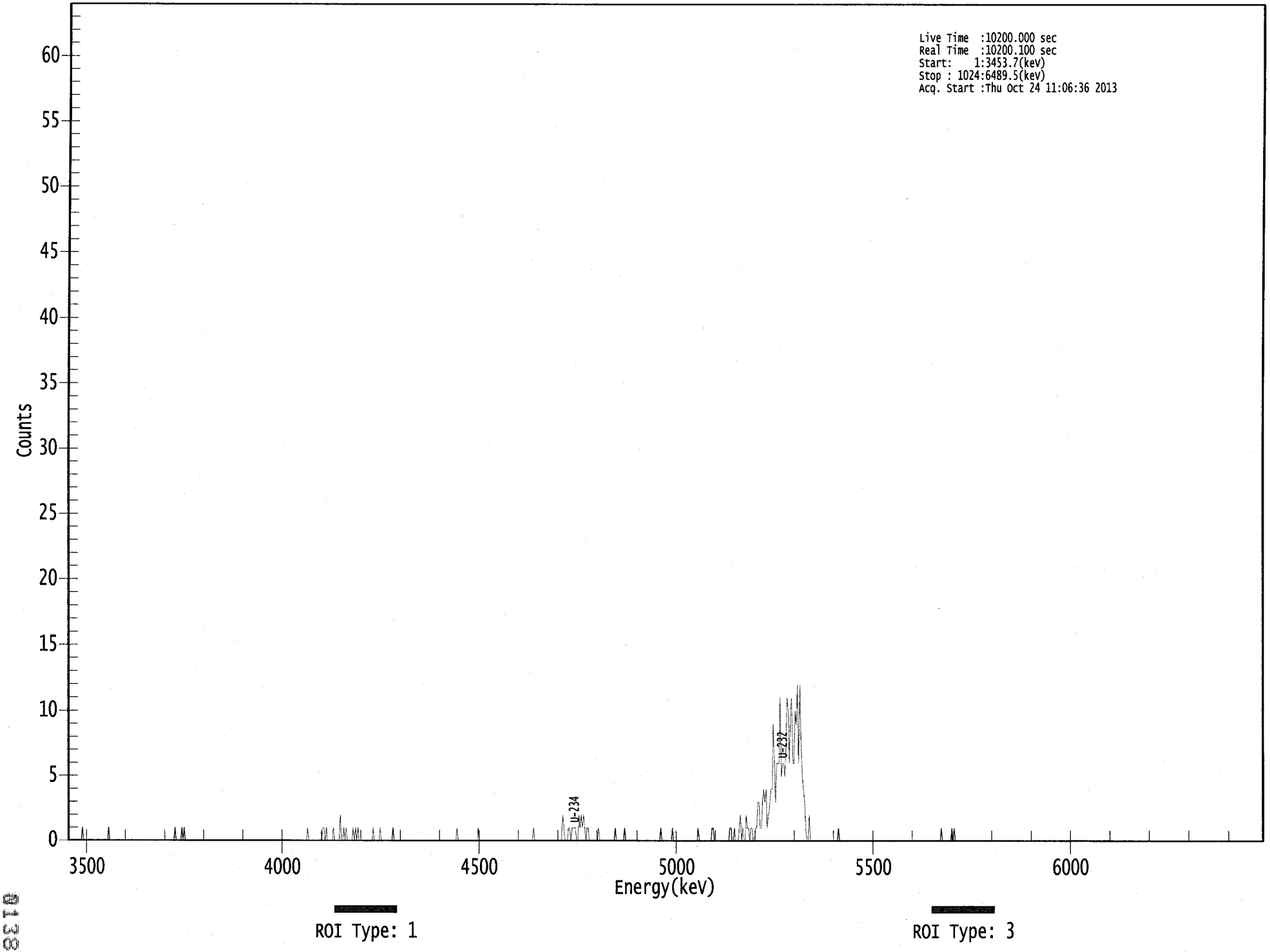
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.994	5302.50*	1.03E+001 +/- 1.34E+000	2.11E-001 +/- 2.75E-002
U-234	0.998	4761.50*	8.49E-001 +/- 3.86E-001	2.40E-001 +/- 3.14E-002
U-235	0.949	4385.50*	7.38E-002 +/- 1.41E-001	2.60E-001 +/- 3.39E-002
U-238	0.994	4184.40*	5.53E-001 +/- 3.02E-001	1.67E-001 +/- 2.18E-002

AG 10/24/13

0000071871.CNF



9138

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 09

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	1	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	1	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	1	0	0	0
97:	0	0	1	0	1	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	1	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	1	1	0	1	0
225:	0	0	0	0	1	0	0	0
233:	0	0	2	0	0	1	0	1
241:	0	0	0	0	0	1	0	1
249:	0	1	0	0	0	0	0	0
257:	0	0	0	0	0	0	1	0
265:	0	0	0	0	1	0	0	0
273:	0	0	0	0	0	0	0	1
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	1	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	1	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 09

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	1
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	2	1	0	0	0	1	1	0
433:	1	1	1	1	0	0	2	1
441:	2	1	2	1	0	1	1	0
449:	0	0	0	0	0	0	0	1
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	1	0	0
473:	0	0	0	0	0	1	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	1	0	0	0
513:	0	0	0	0	0	0	1	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	1	0	0	0
545:	0	0	0	0	0	0	0	0
553:	1	1	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	1
569:	1	0	0	1	0	0	0	1
577:	2	0	1	0	0	2	1	1
585:	0	1	1	0	0	1	1	3
593:	3	1	1	3	4	3	4	1
601:	2	3	4	4	9	6	3	6
609:	6	6	11	5	6	6	5	7
617:	11	10	6	10	11	6	6	10
625:	9	12	6	12	8	5	4	3
633:	1	0	0	2	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	1	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	1	0	0	0
753:	0	0	0	0	0	1	0	1
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 09

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KCB 10/24/13

Apex-Alpha™

Sample Description: WLL20131009L1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 10
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_046
Chamber Serial Number: 04026482B
Detector Serial Number: 58762
Env. Background: System Bkgd 70377
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/9/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:38 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.604 mL
Effective Efficiency: 0.1850 +/- 0.0107
Counting Efficiency: 0.1789 +/- 0.0031 on 12/16/2012 5:49:23 PM
Chem. Recovery Factor: 1.0336 +/- 0.0622

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.270	358.83	10.35	0.17	0.00E+000	20.8
U-234		4.725	35.83	32.83	0.17	0.00E+000	4.5
U-235		4.389	4.83	91.00	0.17	0.00E+000	3.0
U-238		4.136	41.66	30.51	0.34	0.00E+000	6.0

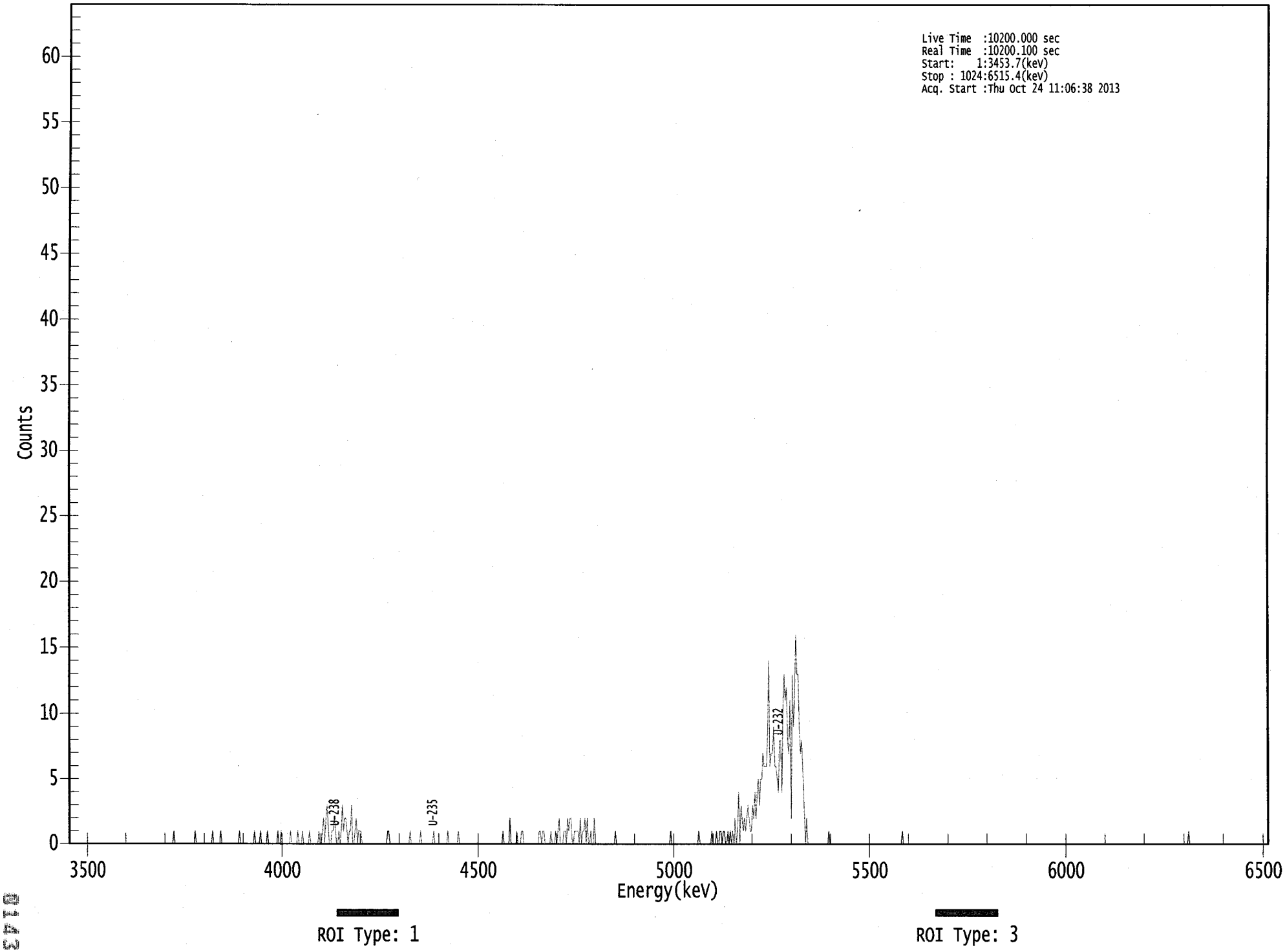
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.992	5302.50*	1.03E+001 +/- 1.16E+000	1.20E-001 +/- 1.35E-002
U-234	0.991	4761.50*	1.03E+000 +/- 3.57E-001	1.20E-001 +/- 1.35E-002
U-235	1.000	4385.50*	1.71E-001 +/- 1.57E-001	1.48E-001 +/- 1.67E-002
U-238	0.983	4184.40*	1.19E+000 +/- 3.87E-001	1.37E-001 +/- 1.54E-002

AG
10/24/13

0000071872.CNF



0143

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 10

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	1	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	1	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	1	0	0	0	0
129:	0	0	1	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	1	0	0	0	0	0
153:	0	0	0	0	0	0	0	1
161:	0	0	0	0	1	0	0	0
169:	0	0	1	0	0	0	0	0
177:	0	0	0	1	0	0	1	0
185:	0	0	0	0	0	0	1	0
193:	0	0	0	0	1	0	0	0
201:	1	0	0	0	0	0	1	0
209:	0	0	0	0	0	0	1	0
217:	0	1	2	0	2	3	1	0
225:	0	1	1	2	1	0	0	1
233:	0	1	3	1	2	2	1	0
241:	1	1	3	0	0	1	2	0
249:	1	1	1	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	1	1	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	1	0	0	0
297:	0	0	0	0	0	1	0	0
305:	0	0	0	0	0	0	0	0
313:	1	0	0	0	0	0	0	0
321:	0	0	0	0	1	0	0	0
329:	0	0	0	0	0	1	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	1	0	0	0	0

Sample Title: 10

Channel								
377:	0	2	0	0	0	0	0	1
385:	0	0	0	1	1	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	1	1	0	1	1	0
409:	0	0	0	0	1	0	0	0
417:	1	0	1	2	0	0	0	1
425:	1	0	2	1	2	2	0	0
433:	1	1	1	1	0	2	0	1
441:	1	2	0	2	0	0	1	0
449:	0	2	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	1	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	1	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	1	0	0	0	0	0
545:	0	0	0	0	0	1	0	0
553:	0	1	0	0	1	1	0	1
561:	1	0	0	1	0	1	0	1
569:	0	2	0	1	4	0	3	2
577:	1	2	1	2	3	2	1	1
585:	3	2	4	2	4	5	3	5
593:	5	7	6	6	6	8	14	6
601:	7	7	9	6	6	5	4	8
609:	8	4	10	13	11	12	8	7
617:	11	2	13	9	11	16	13	13
625:	9	7	8	5	3	0	2	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	1	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	1	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 10

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	1	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

ICB 10/24/13

Apex-Alpha™

Sample Description: WLL201310009L2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-UU
Sample Identification: 11
Sample Geometry: Shelf 2
Procedure Description: U iso

Detector Name: Alpha_047
Chamber Serial Number: 02030596A
Detector Serial Number: 91086
Env. Background: System Bkgd 70378
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/9/2013 10:18:15 AM
Acquisition Date/Time: 10/24/2013 11:06:41 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
Tracer Quantity: 0.604 mL
Effective Efficiency: 0.1543 +/- 0.0096
Counting Efficiency: 0.1822 +/- 0.0032 on 12/16/2012 5:49:21 PM
Chem. Recovery Factor: 0.8469 +/- 0.0548

Peak Match Tolerance: 0.150 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
U-232	T	5.277	299.15	11.35	0.85	0.00E+000	4.6
U-234		4.739	9.00	68.87	0.00	0.00E+000	2.9
U-235		4.321	2.00	169.74	0.00	0.00E+000	2.9
U-238		4.129	1.83	152.56	0.17	0.00E+000	2.9

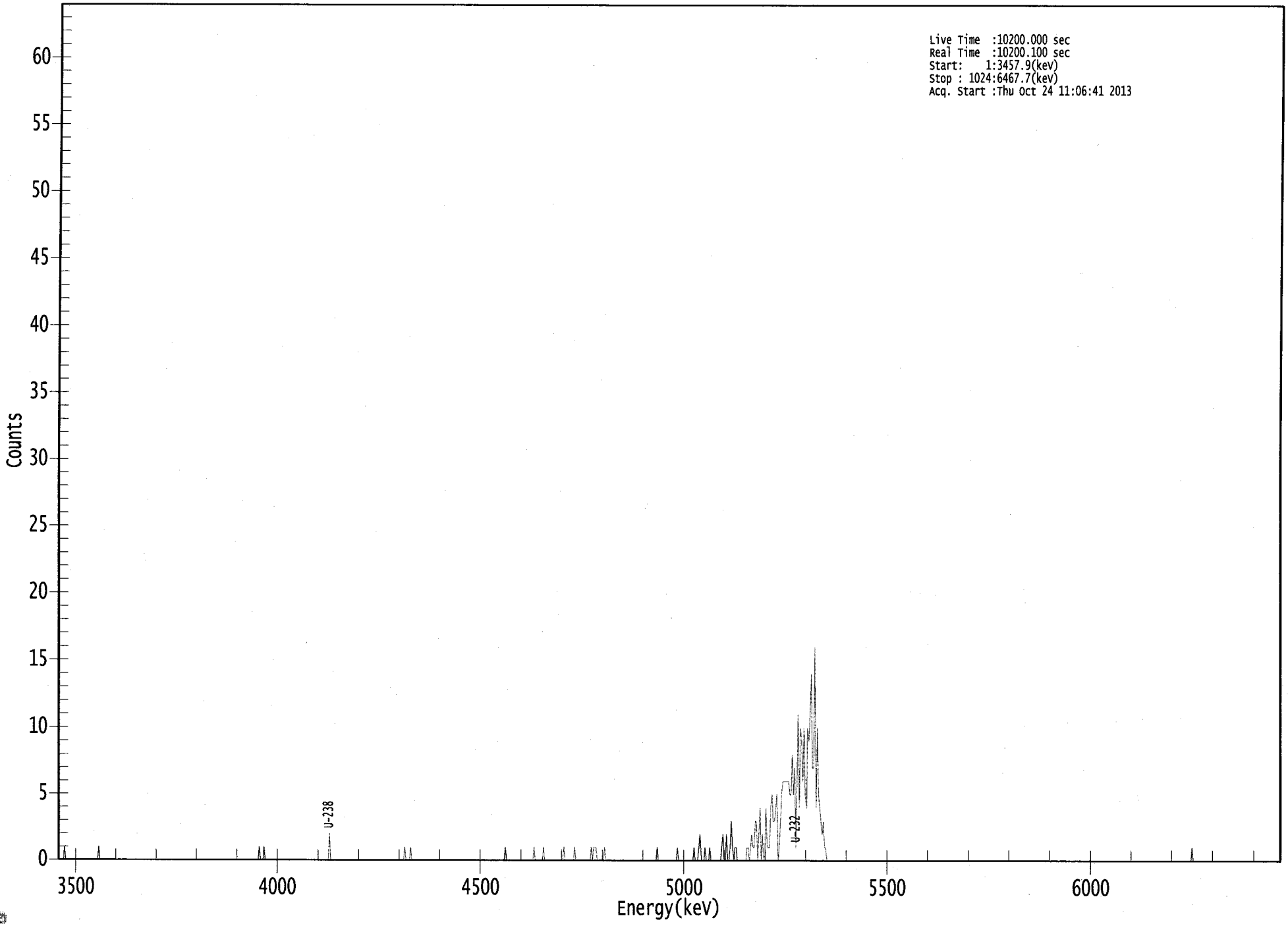
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.995	5302.50*	1.03E+001 +/- 1.26E+000	2.06E-001 +/- 2.52E-002
U-234	0.996	4761.50*	3.10E-001 +/- 2.17E-001	2.06E-001 +/- 2.52E-002
U-235	0.971	4385.50*	8.49E-002 +/- 1.45E-001	2.55E-001 +/- 3.11E-002
U-238	0.978	4184.40*	6.27E-002 +/- 9.60E-002	1.43E-001 +/- 1.75E-002

AG
10/24/13

0000071881.CNF



[redacted]

ROI Type: 1

[redacted]

ROI Type: 3

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 11

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	1	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	1	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	1	0	0	0	1	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	2	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	1	0	0	0	0
297:	1	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	1

Sample Title: 11

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	1
401:	0	0	0	0	0	0	0	1
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	1	0	0	0	0	0	0	0
433:	0	1	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	1
449:	0	1	1	1	0	0	0	0
457:	0	0	1	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	1	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	1
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	1	0	0
537:	0	1	2	0	0	0	1	0
545:	0	0	1	0	0	0	0	0
553:	0	0	0	0	1	2	0	0
561:	2	0	0	1	3	1	0	1
569:	1	0	0	0	0	0	0	0
577:	0	1	1	0	1	2	1	1
585:	3	3	0	2	4	0	2	0
593:	0	4	1	1	1	4	5	3
601:	3	4	5	0	1	3	5	6
609:	6	6	6	6	6	5	5	8
617:	5	7	1	6	11	4	10	9
625:	6	10	5	4	10	9	11	14
633:	7	7	16	4	10	5	4	3
641:	2	3	1	1	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 11

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	1	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

10/24/2013 5:24:28 AM

Apex-Alpha™

QA SUMMARY REPORT

Review Of QA Results - Pulser Check

Date : 10/24/2013
Time : 5:24:28 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_001	21f	ALL	Not Done	
Alpha_002	21f	ALL	Not Done	
Alpha_003	21f	ALL	Passed	10/24/2013 5:07:41 AM
Alpha_004	21f	ALL	Passed	10/24/2013 5:07:42 AM
Alpha_005	21f	ALL	Not Done	
Alpha_006	21f	ALL	Not Done	
Alpha_007	21f	ALL	Not Done	
Alpha_008	21f	ALL	Not Done	
Alpha_009	21f	ALL	Not Done	
Alpha_010	21f	ALL	Passed	10/24/2013 5:07:42 AM
Alpha_011	21f	ALL	Passed	10/24/2013 5:07:43 AM
Alpha_012	21f	ALL	Passed	10/24/2013 5:07:44 AM
Alpha_013	21f	ALL	Passed	10/24/2013 5:07:45 AM
Alpha_014	21f	ALL	Passed	10/24/2013 5:07:46 AM
Alpha_015	21f	Peak Energy	Action	10/24/2013 5:07:47 AM
Alpha_016	21f	ALL	Not Done	
Alpha_017	AIM730	ALL	Not Done	
Alpha_018	AIM730	ALL	Not Done	
Alpha_019	AIM730	ALL	Passed	10/24/2013 5:07:47 AM
Alpha_020	AIM730	ALL	Not Done	
Alpha_021	AIM730	ALL	Not Done	
Alpha_022	AIM730	ALL	Passed	10/24/2013 5:07:48 AM
Alpha_023	AIM730	ALL	Not Done	
Alpha_024	AIM730	ALL	Passed	10/24/2013 5:07:49 AM
Alpha_025	AIM730	ALL	Passed	10/24/2013 5:07:50 AM
Alpha_026	AIM730	ALL	Not Done	
Alpha_027	AIM730	ALL	Passed	10/24/2013 5:07:51 AM
Alpha_028	AIM730	ALL	Not Done	
Alpha_029	AIM730	ALL	Passed	10/24/2013 5:07:51 AM
Alpha_030	AIM730	ALL	Not Done	
Alpha_031	AIM730	ALL	Passed	10/17/2013 6:40:27 AM
Alpha_032	AIM730	ALL	Not Done	
Alpha_033	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:53 AM
Alpha_034	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:54 AM
Alpha_035	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:56 AM
Alpha_036	Alpha Analyst100DC	ALL	Not Done	
Alpha_037	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:57 AM
Alpha_038	Alpha Analyst100DC	Peak Energy	Action	10/18/2013 6:33:11 AM
Alpha_039	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:59 AM
Alpha_040	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:00 AM
Alpha_041	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:02 AM
Alpha_042	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:04 AM

Review of QA Results - Pulser Check

10/24/2013 5:24:28 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_043	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:06 AM
Alpha_044	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:07 AM
Alpha_045	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:09 AM
Alpha_046	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:10 AM
Alpha_047	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:12 AM
Alpha_048	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:14 AM

APPROVED BY: C

APPROVAL DATE: 10/24/13

****
***** L I B R A R Y L I S T I N G R E P O R T *****
****

Nuclide Library Title: Uranium

Nuclide Library Description: U-232,-234,-235,-238

Nuclide Name	Half-Life (Seconds)	Energy (keV)	Energy Uncert. (keV)	Yield (%)	Yield Uncert.(Abs.+-)
U-232	2.174E+009	5302.500*	0.000	99.8000	0.0000
U-234	7.731E+012	4761.500*	0.000	99.8000	0.0000
U-235	2.221E+016	4385.500*	0.000	80.9000	0.0000
U-238	1.410E+017	4184.400*	0.000	100.2300	0.0000

* = key line

TOTALS: 4 Nuclides 4 Energy Lines

SECTION IX

ANALYTICAL DATA (ISOTOPIC THORIUM)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

13-10043
ThISO
Run 1

Work Order	13-10043
Analysis Code	ThISO
Run	1
Date Received	10/10/2013
Lab Deadline	10/31/2013
Client	Missouri Dept. of Natural Resources
Project	C310163001
Report Level	4
Activity Units	pCi
Aliquot Units	l
Matrix	WA
Method	EML Th-01 Modified
Instrument Type	Alpha Spectroscopy
Radiometric Tracer	Th-229
Radiometric Sol#	Th-18a
Tracer Act (dpm/g)	22.466
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/10/13 00:00	1.0000E+00
02	MBL	BLANK		10/10/13 00:00	1.0000E+00
03	DUP	WLL201310008E2	47	10/08/13 11:15	5.0000E-01
04	TRG	WLL20131008E1	53	10/08/13 11:15	5.0000E-01
05	DO	WLL201310008E2	47	10/08/13 11:15	5.0000E-01
06	TRG	WLL20131008F1	56	10/08/13 12:10	5.0000E-01
07	TRG	WLL20131008F2	52	10/08/13 12:10	5.0000E-01
08	TRG	WLL20131008K1	49	10/08/13 16:05	5.0000E-01
09	TRG	WLL201310008K2	45	10/08/13 16:05	5.0000E-01
10	TRG	WLL20131009L1	48	10/09/13 10:55	5.0000E-01
11	TRG	WLL201310009L2	57	10/09/13 10:55	5.0000E-01

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
ThISO
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	0.4757	10.7		0.00								
02	MBL	0.2376	5.3		0.00								
03	DUP	0.2350	5.3		0.00								
04	TRG	0.2369	5.3		0.00								
05	DO	0.2342	5.3		0.00								
06	TRG	0.2341	5.3		0.00								
07	TRG	0.2354	5.3		0.00								
08	TRG	0.2346	5.3		0.00								
09	TRG	0.2340	5.3		0.00								
10	TRG	0.2334	5.2		0.00								
11	TRG	0.2358	5.3		0.00								

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
ThISO
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			10/18/13 08:17	JWOLFE				
02	MBL			10/18/13 08:17	JWOLFE				
03	DUP			10/18/13 08:17	JWOLFE				
04	TRG			10/18/13 08:17	JWOLFE				
05	DO			10/18/13 08:17	JWOLFE				
06	TRG			10/18/13 08:17	JWOLFE				
07	TRG			10/18/13 08:17	JWOLFE				
08	TRG			10/18/13 08:17	JWOLFE				
09	TRG			10/18/13 08:17	JWOLFE				
10	TRG			10/18/13 08:17	JWOLFE				
11	TRG			10/18/13 08:17	JWOLFE				

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run: 1
Analysis Code: ThISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	TH-228	LCS	LCS	pCi/l	5.37E+00	8.28E-01	1.03E-01	4.87E+00	110.10	OK		OK	
02	TH-228	MBL	BLANK	pCi/l	3.23E-02	9.40E-02	1.85E-01					OK	OK
03	TH-228	DUP	WLL201310008E2	pCi/l	1.09E-01	1.43E-01	2.32E-01				NA	OK	
04	TH-228	TRG	WLL20131008E1	pCi/l	6.26E-01	3.04E-01	2.26E-01					OK	
05	TH-228	DO	WLL201310008E2	pCi/l	4.86E-02	1.05E-01	2.08E-01					OK	
06	TH-228	TRG	WLL20131008F1	pCi/l	2.70E-02	1.37E-01	2.90E-01					OK	
07	TH-228	TRG	WLL20131008F2	pCi/l	-1.31E-02	1.42E-01	3.27E-01					OK	
08	TH-228	TRG	WLL20131008K1	pCi/l	1.98E-02	8.26E-02	2.12E-01					OK	
09	TH-228	TRG	WLL201310008K2	pCi/l	1.95E-01	1.70E-01	1.65E-01					OK	
10	TH-228	TRG	WLL20131009L1	pCi/l	1.58E+00	4.85E-01	1.88E-01					OK	
11	TH-228	TRG	WLL201310009L2	pCi/l	1.49E-01	1.96E-01	3.18E-01					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run: 1
Analysis Code: ThISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	TH-228	LCS	10/10/13 00:00	1.00E+00	114.82	0.00	0.00			
02	TH-228	MBL	10/10/13 00:00	1.00E+00	74.01	0.00	0.00			
03	TH-228	DUP	10/08/13 11:15	5.00E-01	103.33	0.00	0.00			
04	TH-228	TRG	10/08/13 11:15	5.00E-01	85.22	0.00	0.00			
05	TH-228	DO	10/08/13 11:15	5.00E-01	73.53	0.00	0.00			
06	TH-228	TRG	10/08/13 12:10	5.00E-01	98.33	0.00	0.00			
07	TH-228	TRG	10/08/13 12:10	5.00E-01	98.12	0.00	0.00			
08	TH-228	TRG	10/08/13 16:05	5.00E-01	90.28	0.00	0.00			
09	TH-228	TRG	10/08/13 16:05	5.00E-01	94.30	0.00	0.00			
10	TH-228	TRG	10/09/13 10:55	5.00E-01	128.31	0.00	0.00			
11	TH-228	TRG	10/09/13 10:55	5.00E-01	93.26	0.00	0.00			

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run	Analysis Code	Eberline Services Work Order	Client
1	ThISO	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	TH-228	LCS	10/24/13 11:04		A_Spec	Alpha_003	170.02	4.06 E+02	1.20 E-02	17.5
02	TH-228	MBL	10/24/13 11:04		A_Spec	Alpha_004	170.02	1.75 E+00	2.50 E-02	19.4
03	TH-228	DUP	10/24/13 11:04		A_Spec	Alpha_010	170.02	4.11 E+00	1.70 E-02	19.7
04	TH-228	TRG	10/24/13 11:04		A_Spec	Alpha_011	170.02	2.03 E+01	1.00 E-02	20.5
05	TH-228	DO	10/24/13 11:04		A_Spec	Alpha_012	170	1.32 E+00	4.00 E-03	19.9
06	TH-228	TRG	10/24/13 11:04		A_Spec	Alpha_013	170	9.20 E-01	2.40 E-02	18.7
07	TH-228	TRG	10/24/13 11:04		A_Spec	Alpha_014	170	-4.40 E-01	3.20 E-02	18.5
08	TH-228	TRG	10/24/13 11:04		A_Spec	Alpha_015	170	4.90 E-01	3.00 E-03	14.8
09	TH-228	TRG	10/24/13 11:04		A_Spec	Alpha_019	170	5.66 E+00	2.00 E-03	16.6
10	TH-228	TRG	10/24/13 11:04		A_Spec	Alpha_022	170	5.76 E+01	8.00 E-03	15.3
11	TH-228	TRG	10/24/13 11:04		A_Spec	Alpha_024	170	4.43 E+00	2.10 E-02	17.1

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run: 1
Analysis Code: ThISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	TH-230	LCS	LCS	pCi/l	6.03E+00	9.08E-01	7.47E-02	5.46E+00	110.37	OK		OK	
02	TH-230	MBL	BLANK	pCi/l	3.56E-01	1.84E-01	1.58E-01					OK	OK
03	TH-230	DUP	WLL201310008E2	pCi/l	6.45E-02	1.06E-01	1.86E-01				NA	OK	
04	TH-230	TRG	WLL20131008E1	pCi/l	8.15E-01	3.38E-01	1.27E-01					OK	
05	TH-230	DO	WLL201310008E2	pCi/l	1.69E-01	1.63E-01	1.74E-01					OK	
06	TH-230	TRG	WLL20131008F1	pCi/l	4.91E-01	2.55E-01	1.82E-01					OK	
07	TH-230	TRG	WLL20131008F2	pCi/l	4.49E-01	2.50E-01	2.15E-01					OK	
08	TH-230	TRG	WLL20131008K1	pCi/l	1.13E-01	1.37E-01	1.66E-01					OK	
09	TH-230	TRG	WLL201310008K2	pCi/l	1.98E-01	1.67E-01	1.42E-01					OK	
10	TH-230	TRG	WLL20131009L1	pCi/l	2.30E+00	6.14E-01	1.70E-01					OK	
11	TH-230	TRG	WLL201310009L2	pCi/l	4.48E-01	2.67E-01	2.37E-01					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run	Analysis Code	Eberline Services Work Order	Client
1	ThISO	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	TH-230	LCS	10/10/13 00:00	1.00E+00	114.82	0.00	0.00			
02	TH-230	MBL	10/10/13 00:00	1.00E+00	74.01	0.00	0.00			
03	TH-230	DUP	10/08/13 11:15	5.00E-01	103.33	0.00	0.00			
04	TH-230	TRG	10/08/13 11:15	5.00E-01	85.22	0.00	0.00			
05	TH-230	DO	10/08/13 11:15	5.00E-01	73.53	0.00	0.00			
06	TH-230	TRG	10/08/13 12:10	5.00E-01	98.33	0.00	0.00			
07	TH-230	TRG	10/08/13 12:10	5.00E-01	98.12	0.00	0.00			
08	TH-230	TRG	10/08/13 16:05	5.00E-01	90.28	0.00	0.00			
09	TH-230	TRG	10/08/13 16:05	5.00E-01	94.30	0.00	0.00			
10	TH-230	TRG	10/09/13 10:55	5.00E-01	128.31	0.00	0.00			
11	TH-230	TRG	10/09/13 10:55	5.00E-01	93.26	0.00	0.00			

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run	Analysis Code	Eberline Services Work Order	Client
1	ThISO	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	TH-230	LCS	10/24/13 11:04		A_Spec	Alpha_003	170.02	4.55 E+02	4.00 E-03	17.5
02	TH-230	MBL	10/24/13 11:04		A_Spec	Alpha_004	170.02	1.93 E+01	1.60 E-02	19.4
03	TH-230	DUP	10/24/13 11:04		A_Spec	Alpha_010	170.02	2.47 E+00	9.00 E-03	19.7
04	TH-230	TRG	10/24/13 11:04		A_Spec	Alpha_011	170.02	2.68 E+01	1.00 E-03	20.5
05	TH-230	DO	10/24/13 11:04		A_Spec	Alpha_012	170	4.66 E+00	2.00 E-03	19.9
06	TH-230	TRG	10/24/13 11:04		A_Spec	Alpha_013	170	1.70 E+01	6.00 E-03	18.7
07	TH-230	TRG	10/24/13 11:04		A_Spec	Alpha_014	170	1.53 E+01	1.00 E-02	18.5
08	TH-230	TRG	10/24/13 11:04		A_Spec	Alpha_015	170	2.83 E+00	1.00 E-03	14.8
09	TH-230	TRG	10/24/13 11:04		A_Spec	Alpha_019	170	5.83 E+00	1.00 E-03	16.6
10	TH-230	TRG	10/24/13 11:04		A_Spec	Alpha_022	170	8.50 E+01	6.00 E-03	15.3
11	TH-230	TRG	10/24/13 11:04		A_Spec	Alpha_024	170	1.35 E+01	9.00 E-03	17.1

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run: 1
Analysis Code: ThISO
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	TH-232	LCS	LCS	pCi/l	5.62E+00	8.58E-01	6.32E-02	4.87E+00	115.37	OK		OK	
02	TH-232	MBL	BLANK	pCi/l	3.65E-02	6.48E-02	1.16E-01					OK	OK
03	TH-232	DUP	WLL201310008E2	pCi/l	3.39E-02	9.28E-02	1.91E-01				NA	OK	
04	TH-232	TRG	WLL20131008E1	pCi/l	6.57E-01	3.00E-01	1.45E-01					OK	
05	TH-232	DO	WLL201310008E2	pCi/l	6.63E-02	1.02E-01	1.51E-01					OK	
06	TH-232	TRG	WLL20131008F1	pCi/l	9.57E-02	1.16E-01	1.63E-01					OK	
07	TH-232	TRG	WLL20131008F2	pCi/l	6.73E-02	1.19E-01	2.15E-01					OK	
08	TH-232	TRG	WLL20131008K1	pCi/l	-6.75E-03	7.90E-02	1.66E-01					OK	
09	TH-232	TRG	WLL201310008K2	pCi/l	3.39E-02	9.41E-02	2.03E-01					OK	
10	TH-232	TRG	WLL20131009L1	pCi/l	1.62E+00	4.88E-01	1.62E-01					OK	
11	TH-232	TRG	WLL201310009L2	pCi/l	1.82E-01	1.64E-01	1.74E-01					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Client	Eberline Services Work Order	Analysis Code	Run
Missouri Dept. of Natural Resources	13-10043	ThISO	1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	TH-232	LCS	10/10/13 00:00	1.00E+00	114.82	0.00	0.00			
02	TH-232	MBL	10/10/13 00:00	1.00E+00	74.01	0.00	0.00			
03	TH-232	DUP	10/08/13 11:15	5.00E-01	103.33	0.00	0.00			
04	TH-232	TRG	10/08/13 11:15	5.00E-01	85.22	0.00	0.00			
05	TH-232	DO	10/08/13 11:15	5.00E-01	73.53	0.00	0.00			
06	TH-232	TRG	10/08/13 12:10	5.00E-01	98.33	0.00	0.00			
07	TH-232	TRG	10/08/13 12:10	5.00E-01	98.12	0.00	0.00			
08	TH-232	TRG	10/08/13 16:05	5.00E-01	90.28	0.00	0.00			
09	TH-232	TRG	10/08/13 16:05	5.00E-01	94.30	0.00	0.00			
10	TH-232	TRG	10/09/13 10:55	5.00E-01	128.31	0.00	0.00			
11	TH-232	TRG	10/09/13 10:55	5.00E-01	93.26	0.00	0.00			

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Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-ThISO-1

Run	Analysis Code	Eberline Services Work Order	Client
1	ThISO	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	TH-232	LCS	10/24/13 11:04		A_Spec	Alpha_003	170.02	4.26 E+02	2.00 E-03	17.5
02	TH-232	MBL	10/24/13 11:04		A_Spec	Alpha_004	170.02	1.98 E+00	6.00 E-03	19.4
03	TH-232	DUP	10/24/13 11:04		A_Spec	Alpha_010	170.02	1.30 E+00	1.00 E-02	19.7
04	TH-232	TRG	10/24/13 11:04		A_Spec	Alpha_011	170.02	2.17 E+01	2.00 E-03	20.5
05	TH-232	DO	10/24/13 11:04		A_Spec	Alpha_012	170	1.83 E+00	1.00 E-03	19.9
06	TH-232	TRG	10/24/13 11:04		A_Spec	Alpha_013	170	3.32 E+00	4.00 E-03	18.7
07	TH-232	TRG	10/24/13 11:04		A_Spec	Alpha_014	170	2.30 E+00	1.00 E-02	18.5
08	TH-232	TRG	10/24/13 11:04		A_Spec	Alpha_015	170	-1.70 E-01	1.00 E-03	14.8
09	TH-232	TRG	10/24/13 11:04		A_Spec	Alpha_019	170	1.00 E+00	0.00 E+00	16.6
10	TH-232	TRG	10/24/13 11:04		A_Spec	Alpha_022	170	6.00 E+01	0.00 E+00	15.3
11	TH-232	TRG	10/24/13 11:04		A_Spec	Alpha_024	170	5.49 E+00	3.00 E-03	17.1

Count Room Report
Client: Missouri Dept. of Natural

13-10043-ThISO-1 (pCi/l) in WA
Tracer ID: Th-18a

2 15

5-15

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	10/10/13 00:00	1.0000	0.4757	10.6871		0.00		
02	MBL	BLANK	10/10/13 00:00	1.0000	0.2376	5.3379		0.00		
03	DUP	WLL201310008E2	10/08/13 11:15	0.5000	0.2350	5.2795		0.00		
04	TRG	WLL20131008E1	10/08/13 11:15	0.5000	0.2369	5.3222		0.00		
05	DO	WLL201310008E2	10/08/13 11:15	0.5000	0.2342	5.2615		0.00		
06	TRG	WLL20131008F1	10/08/13 12:10	0.5000	0.2341	5.2593		0.00		
07	TRG	WLL20131008F2	10/08/13 12:10	0.5000	0.2354	5.2885		0.00		
08	TRG	WLL20131008K1	10/08/13 16:05	0.5000	0.2346	5.2705		0.00		
09	TRG	WLL201310008K2	10/08/13 16:05	0.5000	0.2340	5.2570		0.00		
10	TRG	WLL20131009L1	10/09/13 10:55	0.5000	0.2334	5.2436		0.00		
11	TRG	WLL201310009L2	10/09/13 10:55	0.5000	0.2358	5.2975		0.00		

x24

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Eberline Services
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 10/18/2013 8:17 AM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
13-10043	1	ThISO	10/18/2013 8:16	JWOLFE	JW	

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estimate	Known pCi	Error Estimate	Added pCi	Error Estimate
Th-228	Th-8b	103.560	10/18/2013	0.100	0.1045				4.87	0.175	0.00	0.000	0.00	0.000	0.00	0.000
Th-230	Th-1b	23.525	10/18/2013	0.500	0.5153				5.46	0.147	0.00	0.000	0.00	0.000	0.00	0.000
Th-232	Th-8b	103.560	10/18/2013	0.100	0.1045				4.87	0.175	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	Th-229	Th-18a	22.466	10/18/2013	0.4757	0.2200
02	Th-229	Th-18a	22.466	10/18/2013	0.2376	0.2200
03	Th-229	Th-18a	22.466	10/18/2013	0.2350	0.2200
04	Th-229	Th-18a	22.466	10/18/2013	0.2369	0.2200
05	Th-229	Th-18a	22.466	10/18/2013	0.2342	0.2200
06	Th-229	Th-18a	22.466	10/18/2013	0.2341	0.2200
07	Th-229	Th-18a	22.466	10/18/2013	0.2354	0.2200
08	Th-229	Th-18a	22.466	10/18/2013	0.2346	0.2200
09	Th-229	Th-18a	22.466	10/18/2013	0.2340	0.2200
10	Th-229	Th-18a	22.466	10/18/2013	0.2334	0.2200
11	Th-229	Th-18a	22.466	10/18/2013	0.2358	0.2200

Balance Printer Tapes

Tracer

0.4757 g
0.2376 g
-0.2350 g
-0.2369 g
-0.2342 g
-0.2341 g
-0.2354 g
-0.2346 g
-0.2340 g
-0.2334 g
-0.2358 g

LCS

0.5153 g
0.1045 g

Matrix Spike

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
13-10043	1	ThISO	liters	10/31/2013	JWOLFE

Lab Fraction	Missouri Dept. of Natural Resources Client ID	Sample Type	Muffle Data Ratio Post/Pre	Dilution Data No of Dils	Dil Factor	Ratio	Aliquot Data Aliquot	Net Equiv	MS Aliquot Data Aliquot	Net Equiv	H-3 Solids Only Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	WLL201310008E2	DUP					5.0000E-01	5.0000E-01				
04	WLL20131008E1	TRG					5.0000E-01	5.0000E-01				
05	WLL201310008E2	DO					5.0000E-01	5.0000E-01				
06	WLL20131008F1	TRG					5.0000E-01	5.0000E-01				
07	WLL20131008F2	TRG					5.0000E-01	5.0000E-01				
08	WLL20131008K1	TRG					5.0000E-01	5.0000E-01				
09	WLL201310008K2	TRG					5.0000E-01	5.0000E-01				
10	WLL20131009L1	TRG					5.0000E-01	5.0000E-01				
11	WLL201310009L2	TRG					5.0000E-01	5.0000E-01				

Comments	

Technician: JWolfe Date: 10/18/13

ICB 10/27/13

Apex-Alpha™

Sample Description: SPIKE
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 01
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_003
Chamber Serial Number:
Detector Serial Number: 3
Env. Background: System Bkgd 70352
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Sample Date/Time: 10/24/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:18 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.476 mL
Effective Efficiency: 0.2005 +/- 0.0122
Counting Efficiency: 0.1746 +/- 0.0033 on 12/15/2012 11:26:47 AM
Chem. Recovery Factor: 1.1482 +/- 0.0732

Control Certificate Name: NatTh_Th-8
Chem. Recov. of Control: TH-232 1.153734 +/- 0.096275
Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.801	20.96	45.18	2.04	0.00E+000	4.5
TH-228		5.378	405.96	9.76	2.04	0.00E+000	34.5
TH-229	T	4.879	364.32	10.28	0.68	0.00E+000	30.9
TH-230		4.640	455.32	9.19	0.68	0.00E+000	40.1
TH-232		3.964	425.66	9.50	0.34	0.00E+000	15.2

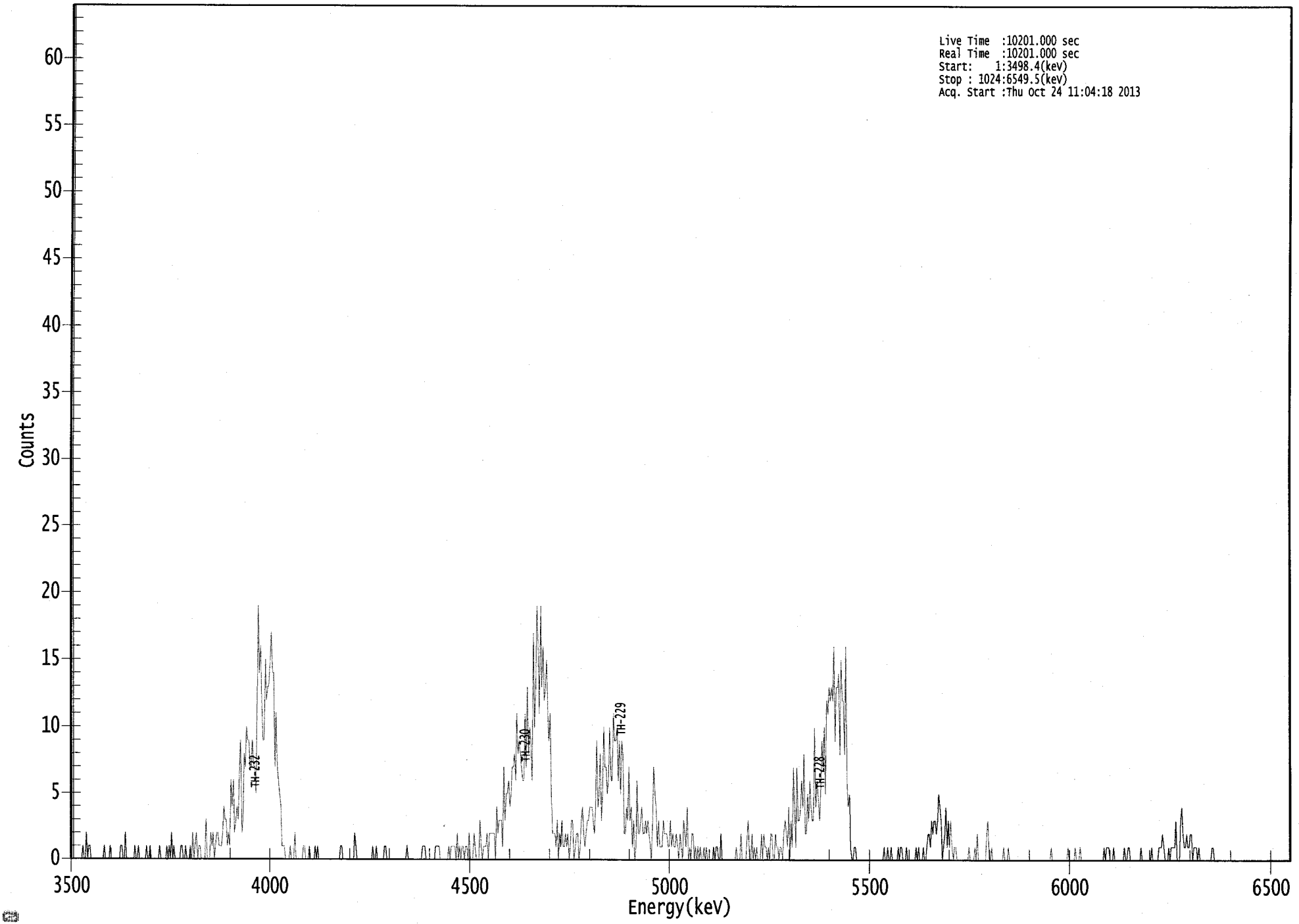
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.987	5850.00*	2.84E-001 +/- 1.33E-001	1.06E-001 +/- 1.26E-002
TH-228	0.997	5400.00*	5.37E+000 +/- 8.28E-001	1.03E-001 +/- 1.23E-002
TH-229	1.000	4872.00*	4.84E+000 +/- 5.78E-001	7.49E-002 +/- 8.94E-003
TH-230	0.995	4672.00*	6.03E+000 +/- 9.08E-001	7.47E-002 +/- 8.92E-003
TH-232	0.994	3997.00*	5.62E+000 +/- 8.58E-001	6.32E-002 +/- 7.54E-003

AG
10/24/13

0000071861.CNF



8172

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 01

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	1	0	0	2	0	1
17:	1	0	0	0	0	0	0	0
25:	0	0	0	0	1	0	0	0
33:	0	1	0	0	0	0	0	0
41:	0	0	1	1	0	0	2	0
49:	0	0	0	0	0	0	1	0
57:	0	1	0	0	0	0	0	0
65:	1	0	0	1	0	0	0	0
73:	0	0	0	1	0	0	0	0
81:	0	1	0	1	0	2	0	1
89:	0	0	0	0	0	1	1	0
97:	0	1	0	0	0	1	0	2
105:	0	1	2	0	1	1	0	0
113:	0	0	3	0	0	0	2	1
121:	2	0	1	2	2	1	1	1
129:	2	4	3	3	1	2	1	6
137:	4	6	2	3	4	3	7	9
145:	2	3	8	7	10	9	9	7
153:	7	9	7	7	5	11	19	14
161:	16	12	9	9	15	12	13	13
169:	15	17	14	14	7	11	7	6
177:	5	4	1	1	1	0	0	0
185:	0	1	0	0	0	2	0	0
193:	0	0	0	0	1	1	0	0
201:	0	1	0	0	0	0	1	0
209:	1	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	1	1	0	0	0
233:	0	0	0	0	0	0	0	2
241:	1	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	1	0
257:	0	1	0	0	0	0	0	0
265:	1	1	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	1	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	1	1	1	0	0	0	0	0
305:	0	0	0	1	1	1	1	0
313:	0	0	0	0	0	0	1	0
321:	1	1	1	1	0	2	0	1
329:	0	1	1	0	1	1	0	2
337:	0	0	0	2	1	0	0	0
345:	3	1	0	1	1	1	2	0
353:	2	2	2	2	2	0	4	2
361:	3	3	3	1	7	3	5	5

369:	6	4	5	7	7	8	6	11

Sample Title: 01

Channel								
377:	8	9	8	7	6	6	11	7
385:	13	8	10	9	6	17	10	13
393:	19	15	11	19	13	16	12	13
401:	15	11	9	11	5	2	2	2
409:	1	3	0	2	1	3	1	1
417:	2	1	2	0	1	3	3	0
425:	1	2	2	0	1	3	4	2
433:	1	2	3	3	4	4	4	3
441:	2	4	9	4	5	8	3	5
449:	10	7	7	5	6	10	6	6
457:	11	9	9	10	6	9	5	9
465:	8	2	2	4	3	7	3	4
473:	1	3	0	1	6	2	2	3
481:	4	2	2	3	2	3	2	1
489:	0	3	7	5	4	1	3	1
497:	1	1	3	2	2	2	1	1
505:	3	1	2	1	1	2	1	0
513:	2	1	0	3	2	1	4	0
521:	1	0	2	2	0	1	0	1
529:	0	1	0	0	1	0	1	0
537:	0	0	0	0	1	0	1	1
545:	0	0	2	0	0	0	0	0
553:	0	0	0	0	0	0	0	1
561:	0	0	0	2	0	0	0	0
569:	2	3	0	0	2	0	1	0
577:	1	0	0	0	2	0	2	1
585:	1	0	1	0	2	2	0	0
593:	2	1	1	0	1	1	0	2
601:	3	2	1	4	0	3	1	7
609:	4	1	7	3	3	4	6	4
617:	8	2	2	5	3	6	4	3
625:	3	10	4	6	5	3	5	9
633:	7	10	5	12	11	13	12	13
641:	12	16	9	13	13	14	8	15
649:	12	12	8	16	6	4	5	1
657:	0	0	1	1	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	1	0	0	1	0
689:	0	1	0	0	0	0	0	1
697:	0	1	1	0	0	0	1	0
705:	0	0	0	0	0	0	1	0
713:	1	0	0	0	1	0	0	1
721:	2	2	1	3	2	3	3	2
729:	3	5	4	3	0	1	2	4
737:	1	3	1	3	1	0	1	1
745:	0	0	0	0	0	0	0	0
753:	0	0	1	0	0	0	0	1
761:	0	2	0	0	0	0	0	0
769:	0	2	3	0	0	1	0	0
777:	0	0	0	0	0	0	0	1
785:	0	0	0	1	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 01

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	1
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	1	0	0
841:	0	0	0	1	0	0	0	1
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	1	0	1	1	1
873:	0	0	0	1	0	0	0	0
881:	0	0	0	0	1	0	0	1
889:	1	0	0	0	0	0	0	0
897:	0	0	1	0	0	0	0	0
905:	0	0	0	1	0	0	0	0
913:	0	1	1	1	2	1	0	0
921:	0	1	0	1	1	1	1	3
929:	0	0	0	3	4	2	1	1
937:	2	1	1	2	2	0	1	1
945:	1	0	1	0	0	0	0	0
953:	0	0	0	0	0	1	1	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

ICB 10/24/13

Apex-Alpha™

Sample Description: BLANK
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 02
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_004
Chamber Serial Number:
Detector Serial Number: 4
Env. Background: System Bkgd 70353
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Sample Date/Time: 10/24/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:19 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.238 mL
Effective Efficiency: 0.1436 +/- 0.0134
Counting Efficiency: 0.1940 +/- 0.0036 on 12/15/2012 11:26:46 AM
Chem. Recovery Factor: 0.7401 +/- 0.0703

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.779	8.98	69.62	1.02	0.00E+000	2.9
TH-228		5.373	1.75	290.46	4.25	0.00E+000	2.9
TH-229	T	4.845	130.32	17.22	0.68	0.00E+000	4.9
TH-230		4.625	19.28	48.18	2.72	0.00E+000	2.9
TH-232		3.942	1.98	176.35	1.02	0.00E+000	2.9

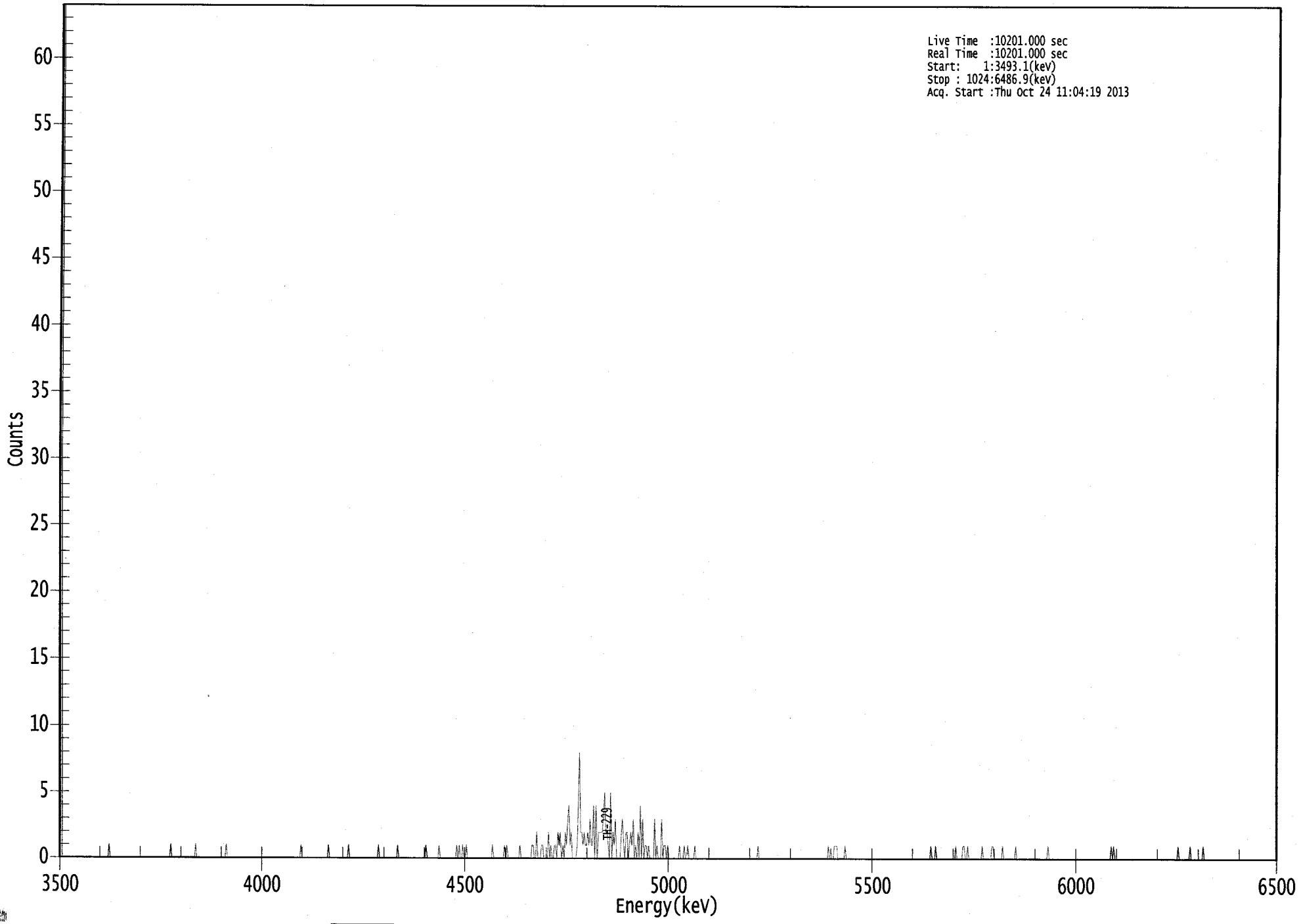
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.974	5850.00*	1.70E-001 +/- 1.22E-001	1.19E-001 +/- 2.18E-002
TH-228	0.996	5400.00*	3.23E-002 +/- 9.40E-002	1.85E-001 +/- 3.39E-002
TH-229	0.996	4872.00*	2.42E+000 +/- 4.41E-001	1.05E-001 +/- 1.91E-002
TH-230	0.988	4672.00*	3.56E-001 +/- 1.84E-001	1.58E-001 +/- 2.89E-002
TH-232	0.984	3997.00*	3.65E-002 +/- 6.48E-002	1.16E-001 +/- 2.12E-002

AG 10/24/13

0000071862.CNF



ROI Type: 1

ROI Type: 3

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 02

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	1	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	1	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	1	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	1	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	1	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	1	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	1	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	1	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	1	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	1	0	0
313:	0	0	0	0	0	0	0	0
321:	1	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	1
337:	0	1	0	0	1	0	0	1
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	1	0	0

369:	0	0	0	0	0	0	0	1

Sample Title: 02

Channel								
377:	0	1	0	0	0	0	0	0
385:	0	0	0	0	1	0	0	0
393:	0	0	0	0	0	0	1	1
401:	0	0	2	0	0	0	1	1
409:	0	0	0	0	2	0	1	0
417:	0	1	1	0	2	1	2	0
425:	1	0	2	1	3	4	1	2
433:	0	0	0	0	1	4	8	2
441:	2	1	2	1	1	2	1	3
449:	1	1	4	0	4	0	2	2
457:	2	2	3	5	2	2	1	0
465:	5	0	2	1	3	0	0	0
473:	0	2	3	1	0	2	2	0
481:	1	2	1	3	0	1	0	2
489:	0	4	0	3	0	1	1	0
497:	1	0	0	0	0	3	0	1
505:	0	0	0	3	0	1	1	0
513:	1	0	0	0	0	0	0	0
521:	0	0	1	0	0	0	1	0
529:	0	1	0	0	0	0	0	1
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	1	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	1
649:	0	0	0	0	1	1	1	0
657:	0	0	0	0	0	1	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	1	0	0
737:	0	1	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	1	0	0	0	0	0
761:	1	1	0	0	1	0	0	0
769:	0	0	0	0	0	0	0	0
777:	1	0	0	0	0	0	0	0
785:	1	1	0	0	0	0	0	0
793:	0	1	0	0	0	0	0	0

801:	0	0	0	0	1	0	0	0

Sample Title: 02

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	1
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	1	0	1	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	1	0	0	0
945:	0	0	0	0	0	0	1	0
953:	0	0	0	0	0	0	0	0
961:	0	1	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

Sample Description: WLL201310008E2-DUP
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 03
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_010
Chamber Serial Number:
Detector Serial Number: 10
Env. Background: System Bkgd 70354
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:11 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.235 mL
Effective Efficiency: 0.2033 +/- 0.0164
Counting Efficiency: 0.1967 +/- 0.0036 on 12/15/2012 11:26:40 AM
Chem. Recovery Factor: 1.0333 +/- 0.0856

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.827	2.13	191.23	1.87	0.00E+000	2.9
TH-228		5.310	4.11	130.53	2.89	0.00E+000	2.9
TH-229	T	4.882	182.45	14.63	2.55	0.00E+000	4.3
TH-230		4.552	2.47	163.79	1.53	0.00E+000	2.9
TH-232		3.962	1.30	273.47	1.70	0.00E+000	2.9

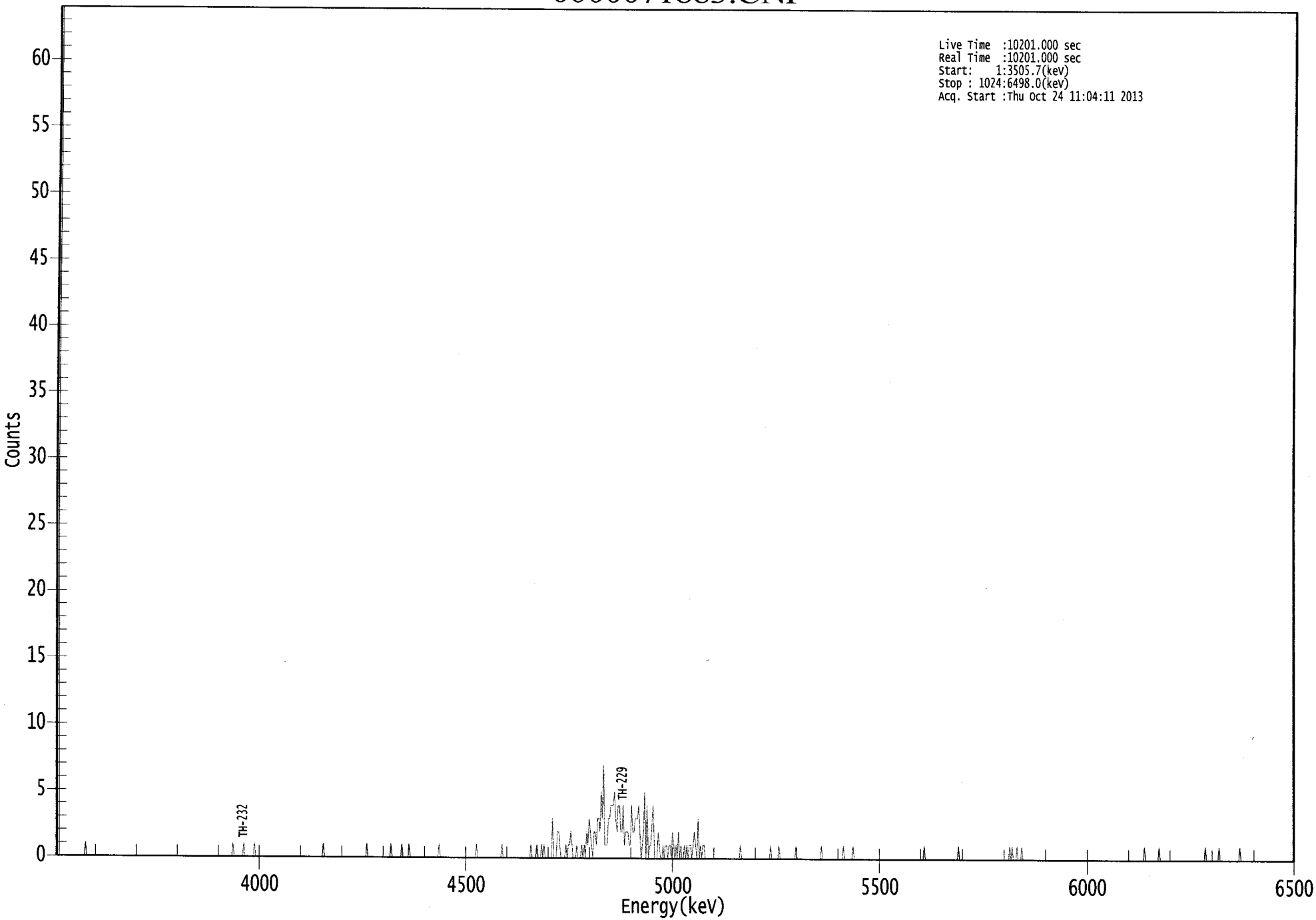
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.997	5850.00*	5.70E-002 +/- 1.09E-001	2.03E-001 +/- 3.21E-002
TH-228	0.958	5400.00*	1.09E-001 +/- 1.43E-001	2.32E-001 +/- 3.68E-002
TH-229	1.000	4872.00*	4.78E+000 +/- 7.57E-001	2.20E-001 +/- 3.48E-002
TH-230	0.928	4672.00*	6.45E-002 +/- 1.06E-001	1.86E-001 +/- 2.94E-002
TH-232	0.994	3997.00*	3.39E-002 +/- 9.28E-002	1.91E-001 +/- 3.03E-002

AG
10/24/13

0000071883.CNF



ROI Type: 1

0182

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 03

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	1	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	1	0	0	0	0
153:	0	0	0	0	1	0	0	0
161:	0	0	0	0	0	1	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	1	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	1	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	1	0
281:	0	0	0	0	0	0	0	1
289:	0	0	0	0	0	1	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	1	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	1	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	1	0	0	0	0	0

Sample Title: 03

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	1	0	0	0	0	1
401:	0	0	0	1	0	1	0	0
409:	0	0	0	0	3	0	0	0
417:	2	2	1	0	0	0	0	1
425:	0	1	1	2	1	0	0	0
433:	1	0	0	0	1	0	1	0
441:	2	1	3	2	1	0	2	2
449:	1	3	3	2	5	3	7	1
457:	1	1	3	3	4	4	4	5
465:	3	2	4	4	2	2	4	1
473:	2	2	2	1	1	4	2	2
481:	3	3	3	4	2	0	1	2
489:	5	0	4	0	1	1	3	4
497:	0	0	0	2	1	0	0	1
505:	0	1	1	0	1	1	0	2
513:	1	0	1	0	2	0	1	0
521:	0	1	0	1	0	1	1	0
529:	1	2	1	0	3	0	1	0
537:	1	1	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	1
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	1	0	0	0	0	0	0	1
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	1	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	1	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	1	0	0	0
657:	0	0	0	0	1	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	1
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	1	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	1	0	1
793:	0	0	0	1	0	0	0	1

801:	0	0	0	0	0	0	0	0

Sample Title: 03

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	1	0	0	0
905:	0	0	0	0	0	0	0	0
913:	1	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	1	0
953:	0	0	0	0	0	0	0	0
961:	0	1	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	1	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

ICB 10/24/13

Apex-Alpha™

Sample Description: WLL20131008E1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 04
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_011
Chamber Serial Number:
Detector Serial Number: 11
Env. Background: System Bkgd 70355
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:12 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.237 mL
Effective Efficiency: 0.1748 +/- 0.0150
Counting Efficiency: 0.2051 +/- 0.0035 on 7/20/2013 2:50:46 PM
Chem. Recovery Factor: 0.8522 +/- 0.0744

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.866	5.64	93.45	1.36	0.00E+000	2.6
TH-228		5.350	20.30	45.58	1.70	0.00E+000	2.6
TH-229	T	4.871	158.15	15.63	0.85	0.00E+000	4.2
TH-230		4.643	26.83	37.98	0.17	0.00E+000	2.6
TH-232		3.948	21.66	42.50	0.34	0.00E+000	2.6

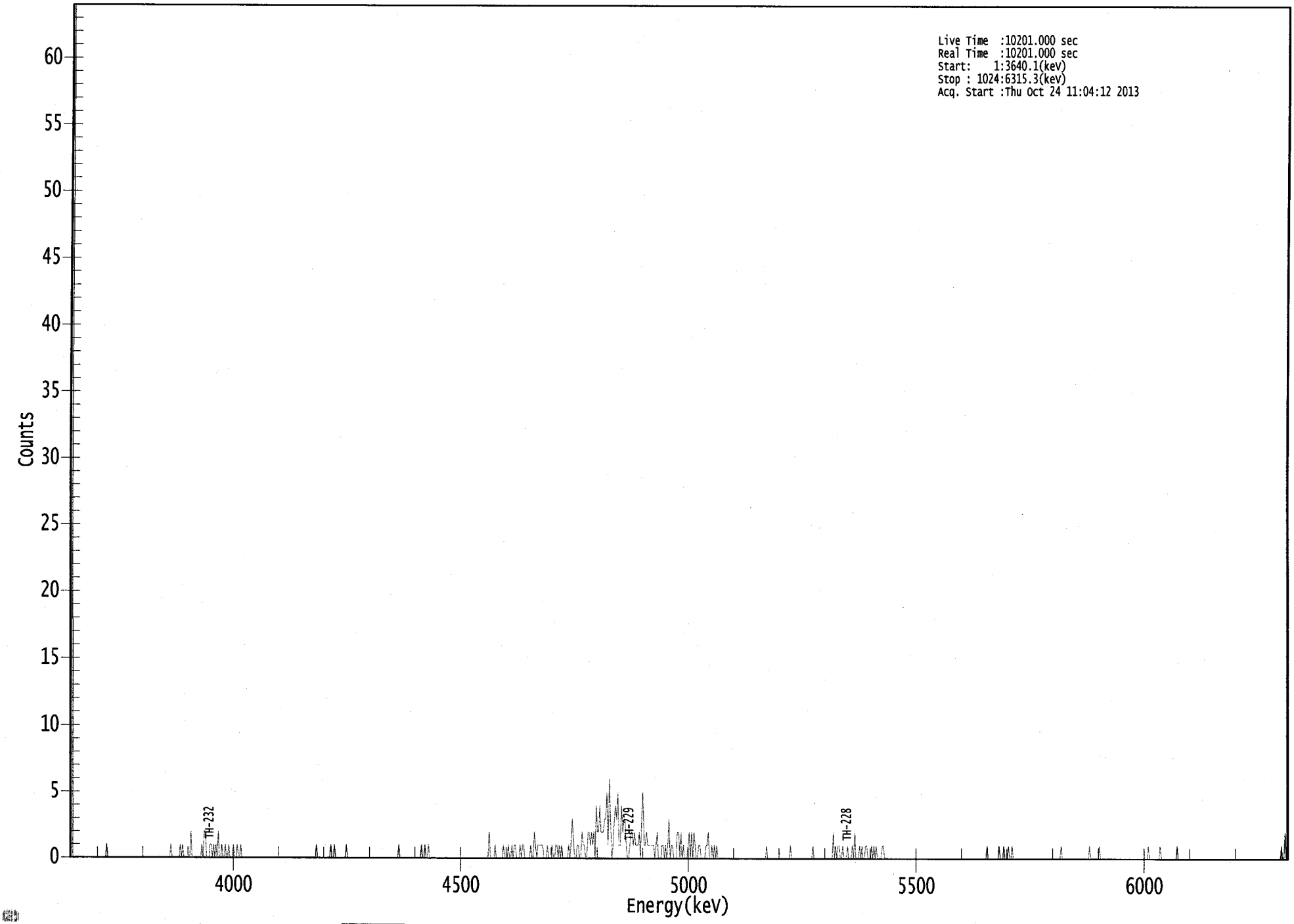
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.999	5850.00*	1.76E-001 +/- 1.67E-001	2.13E-001 +/- 3.58E-002
TH-228	0.987	5400.00*	6.26E-001 +/- 3.04E-001	2.26E-001 +/- 3.80E-002
TH-229	1.000	4872.00*	4.82E+000 +/- 8.08E-001	1.82E-001 +/- 3.06E-002
TH-230	0.996	4672.00*	8.15E-001 +/- 3.38E-001	1.27E-001 +/- 2.13E-002
TH-232	0.987	3997.00*	6.57E-001 +/- 3.00E-001	1.45E-001 +/- 2.43E-002

AG 10/24/13

0000071856.CNF



9187

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 04

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	1
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	1	0	0
89:	0	0	0	0	0	1	0	1
97:	0	0	0	0	0	0	2	0
105:	0	0	0	0	0	0	0	1
113:	0	2	2	0	0	0	1	1
121:	0	1	0	1	0	2	0	0
129:	1	0	0	1	0	0	1	0
137:	0	0	1	0	0	1	0	0
145:	1	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	1	0	0	0	0	0	0	0
217:	0	0	0	0	1	0	0	1
225:	0	0	0	0	0	0	0	0
233:	0	1	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	1	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	1	0	0	1	0	0	1	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	2	0	0	0	0	1	0
361:	0	0	0	0	0	1	0	0

369:	0	1	0	0	1	0	1	1

Sample Title: 04

Channel								
377:	0	0	0	1	0	1	1	0
385:	0	0	0	0	1	0	0	2
393:	1	0	1	1	1	1	1	0
401:	0	0	1	0	0	0	1	0
409:	0	1	1	0	1	0	1	0
417:	0	0	0	0	1	0	1	3
425:	1	0	0	1	1	0	0	2
433:	1	1	0	0	2	2	1	2
441:	1	2	0	4	2	2	4	2
449:	2	2	3	3	5	1	6	3
457:	0	1	3	4	3	5	1	1
465:	4	2	3	3	1	0	0	1
473:	2	2	1	2	1	1	1	2
481:	0	3	5	1	1	2	1	1
489:	1	1	1	1	0	1	2	0
497:	0	0	1	1	0	1	0	1
505:	3	0	1	1	0	0	0	2
513:	2	0	2	0	1	0	0	0
521:	1	2	0	2	0	2	1	0
529:	0	1	1	0	0	0	0	1
537:	1	2	0	0	1	0	1	0
545:	1	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	1	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	1	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	1	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	2	0	1	0	1	1
649:	0	0	1	0	0	0	1	0
657:	0	0	1	0	2	0	0	0
665:	1	0	1	0	0	1	1	0
673:	0	0	1	0	1	0	1	0
681:	0	0	0	1	1	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	1	0	0	0	0
777:	0	0	0	0	0	1	0	0
785:	0	1	0	0	0	1	0	0
793:	1	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 04

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	1	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	1	0	0	0	0	0	0
865:	0	1	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	1	0	0	0	0	0
913:	0	0	0	0	1	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	1	0	0	2	0	0	0

KB 10/24/13

Apex-Alpha™

Sample Description: WLL201310008E2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 05
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_012
Chamber Serial Number:
Detector Serial Number: 12
Env. Background: System Bkgd 70356
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:14 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.234 mL
Effective Efficiency: 0.1463 +/- 0.0136
Counting Efficiency: 0.1989 +/- 0.0034 on 12/11/2011 2:21:56 PM
Chem. Recovery Factor: 0.7353 +/- 0.0694

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.773	3.66	107.87	0.34	0.00E+000	3.0
TH-228		5.339	1.32	215.97	0.68	0.00E+000	3.0
TH-229	T	4.857	130.83	17.15	0.17	0.00E+000	4.2
TH-230		4.697	4.66	94.59	0.34	0.00E+000	3.0
TH-232		3.955	1.83	152.56	0.17	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.970	5850.00*	1.36E-001 +/- 1.49E-001	1.78E-001 +/- 3.24E-002
TH-228	0.981	5400.00*	4.86E-002 +/- 1.05E-001	2.08E-001 +/- 3.78E-002
TH-229	0.999	4872.00*	4.76E+000 +/- 8.66E-001	1.52E-001 +/- 2.76E-002
TH-230	0.997	4672.00*	1.69E-001 +/- 1.63E-001	1.74E-001 +/- 3.16E-002
TH-232	0.991	3997.00*	6.63E-002 +/- 1.02E-001	1.51E-001 +/- 2.75E-002

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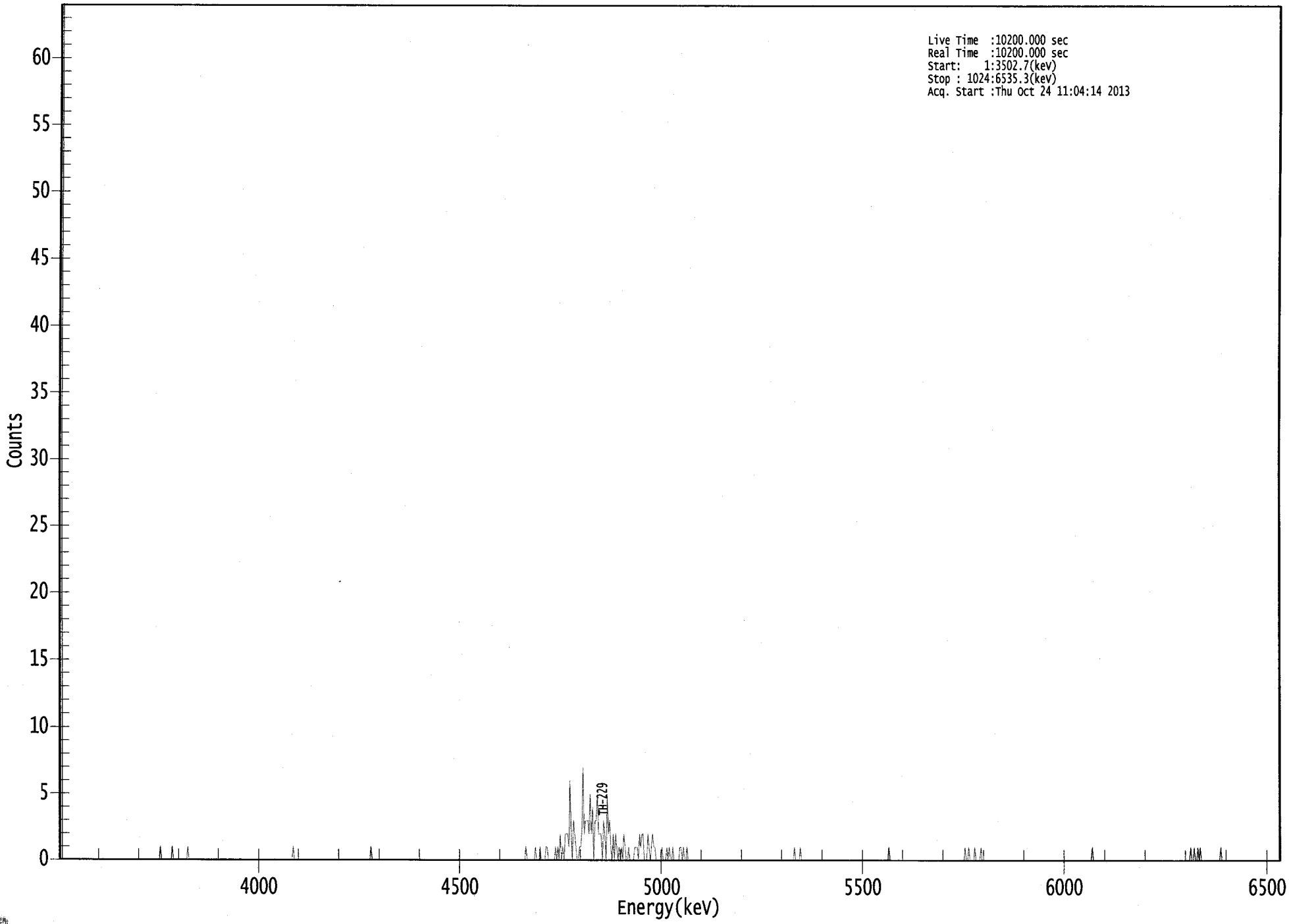
0000071857.CNF



ROI Type: 1

ROI Type: 3

0192

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 05

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	1	0	0
89:	0	0	0	0	0	0	0	1
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	1	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	1	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	1	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 05

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	1	0	0	0	0	0	0	0
401:	1	0	0	0	1	0	0	0
409:	0	1	1	0	0	0	0	0
417:	0	1	0	1	0	2	0	1
425:	0	2	2	2	1	6	2	0
433:	3	2	1	0	0	1	1	2
441:	7	2	3	3	3	2	5	2
449:	4	0	3	3	5	2	2	2
457:	0	3	2	0	5	2	3	1
465:	0	2	0	2	1	0	1	0
473:	1	0	2	1	0	0	1	0
481:	0	0	0	1	1	1	0	2
489:	1	2	2	0	0	0	2	1
497:	0	1	2	1	1	0	0	0
505:	0	0	1	0	0	0	1	0
513:	1	0	0	1	0	0	0	0
521:	0	1	1	0	1	0	0	1
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	1	0	0	0	0	1	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	1	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	1	0	0	1	0	0	0	0
769:	1	0	0	0	0	1	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 05

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	1	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	1	0	0	1
953:	0	0	1	0	1	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	1	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

ICB 10/24/13

Sample Description: WLL20131008F1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 06
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_013
Chamber Serial Number:
Detector Serial Number: 13
Env. Background: System Bkgd 70357
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:15 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.234 mL
Effective Efficiency: 0.1838 +/- 0.0155
Counting Efficiency: 0.1869 +/- 0.0035 on 12/15/2012 11:26:45 AM
Chem. Recovery Factor: 0.9833 +/- 0.0849

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.828	5.30	99.84	1.70	0.00E+000	2.8
TH-228		5.352	0.92	508.35	4.08	0.00E+000	2.8
TH-229	T	4.862	164.30	15.38	1.70	0.00E+000	4.5
TH-230		4.617	16.98	49.21	1.02	0.00E+000	2.8
TH-232		3.933	3.32	119.77	0.68	0.00E+000	2.8

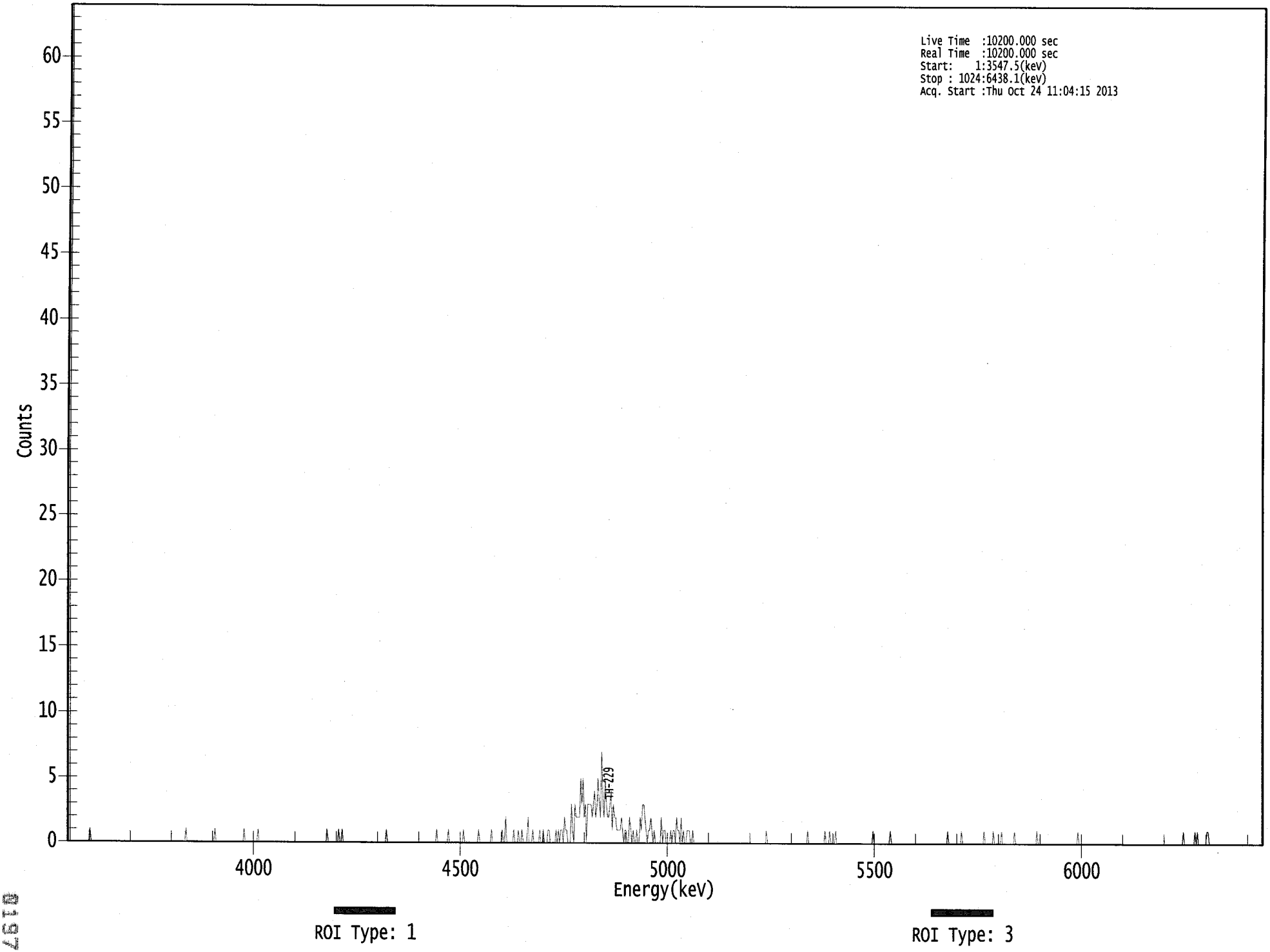
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.998	5850.00*	1.57E-001 +/- 1.59E-001	2.18E-001 +/- 3.60E-002
TH-228	0.988	5400.00*	2.70E-002 +/- 1.37E-001	2.90E-001 +/- 4.80E-002
TH-229	0.999	4872.00*	4.76E+000 +/- 7.87E-001	2.13E-001 +/- 3.52E-002
TH-230	0.984	4672.00*	4.91E-001 +/- 2.55E-001	1.82E-001 +/- 3.01E-002
TH-232	0.979	3997.00*	9.57E-002 +/- 1.16E-001	1.63E-001 +/- 2.69E-002

AG 10/24/13

0000071858.CNF



8187

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 06

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	1	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	1	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	1
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	1	0	0	0	0	0	0	0
161:	0	0	0	0	1	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	1
225:	0	0	0	0	0	0	0	0
233:	0	1	0	0	1	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	1	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	1	0	0
321:	0	0	0	0	0	0	0	1
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	1	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	1	0	0	0	0	0	0
361:	0	0	0	0	1	0	0	0

369:	0	0	0	0	0	1	0	0

Sample Title: 06

Channel								
377:	2	0	0	0	0	0	0	1
385:	0	0	0	1	0	0	1	0
393:	0	0	0	2	0	0	0	1
401:	0	0	0	0	0	1	0	0
409:	1	0	0	0	1	1	0	0
417:	0	0	0	1	0	1	0	1
425:	1	0	2	1	1	0	0	0
433:	3	1	0	3	2	2	2	2
441:	5	3	5	2	3	0	3	3
449:	3	3	2	3	4	2	3	5
457:	3	2	7	3	2	5	3	2
465:	2	3	4	1	3	2	2	1
473:	1	1	1	2	1	0	1	1
481:	0	0	2	1	0	1	0	0
489:	1	0	0	2	1	3	3	2
497:	1	0	1	1	2	1	0	1
505:	0	0	0	0	0	2	0	1
513:	1	0	0	0	0	1	0	1
521:	1	0	2	1	1	0	2	0
529:	1	0	0	1	1	1	0	0
537:	1	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	1
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	1	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	1	0	0	0	1	0	0
657:	0	0	1	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	1	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	1	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	1	0	0	0	0	0
761:	0	0	0	0	0	0	1	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	1	0	0	0	0	0	0
793:	0	1	0	0	0	0	0	0

801:	1	0	0	0	0	0	0	0

Sample Title: 06

Channel								
809:	0	0	0	1	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	1	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	1	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	1	0	0	0	0
961:	0	0	0	0	0	1	0	1
969:	0	0	0	0	0	0	0	1
977:	1	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

ICB 10/24/13

Apex-Alpha™

Sample Description: WLL20131008F2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 07
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_014
Chamber Serial Number:
Detector Serial Number: 14
Env. Background: System Bkgd 70358
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:16 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.235 mL
Effective Efficiency: 0.1811 +/- 0.0153
Counting Efficiency: 0.1846 +/- 0.0034 on 12/15/2012 11:26:44 AM
Chem. Recovery Factor: 0.9812 +/- 0.0850

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.864	0.94	443.31	3.06	0.00E+000	2.9
TH-228		5.328	-0.44	1084.2	5.44	0.00E+000	2.9
TH-229	T	4.861	162.81	15.43	1.19	0.00E+000	4.6
TH-230		4.657	15.30	53.27	1.70	0.00E+000	2.9
TH-232		3.977	2.30	176.48	1.70	0.00E+000	2.9

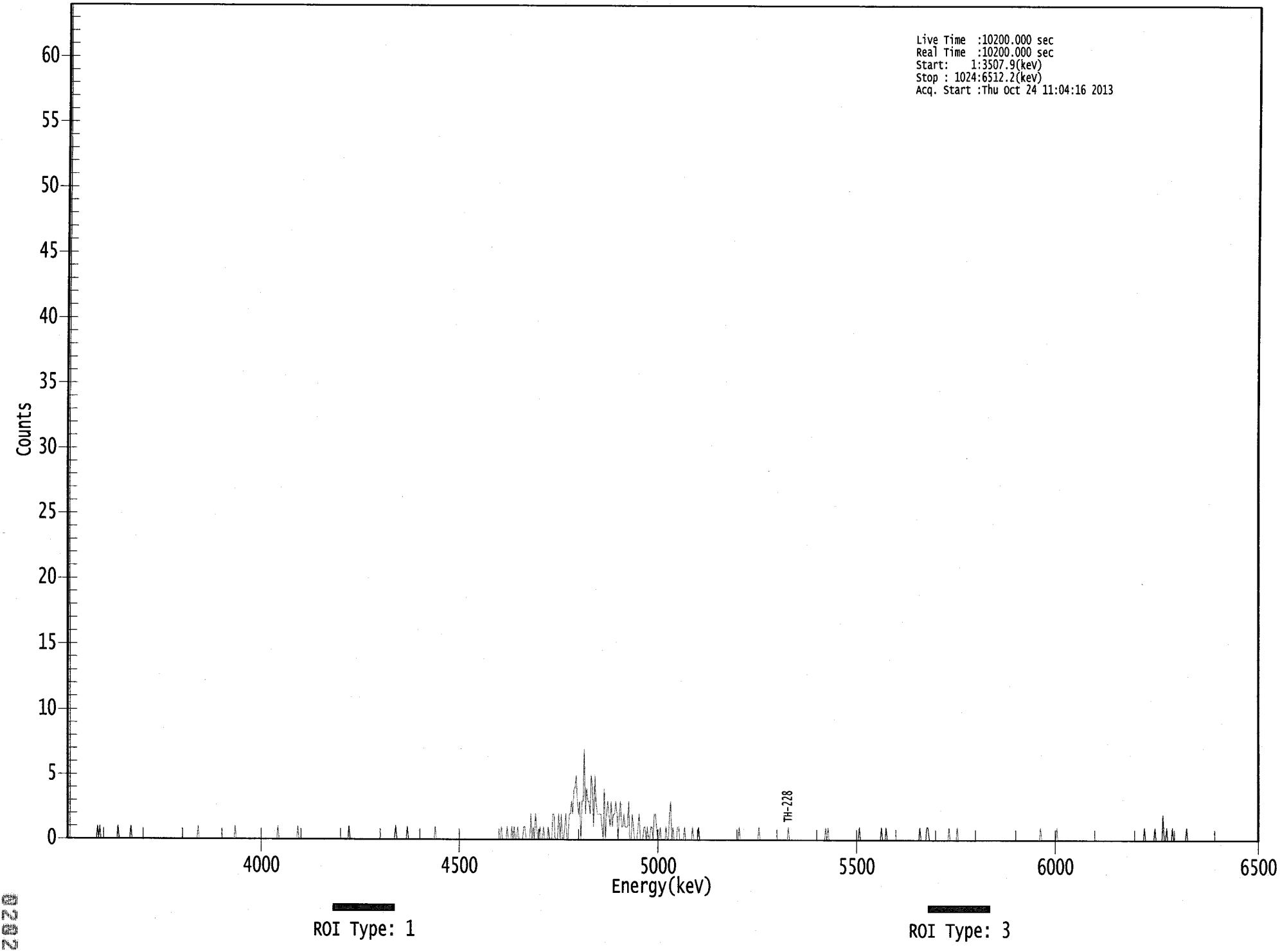
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.999	5850.00*	2.83E-002 +/- 1.25E-001	2.68E-001 +/- 4.45E-002
TH-228	0.973	5400.00*	-1.31E-002 +/- 1.42E-001	3.27E-001 +/- 5.43E-002
TH-229	0.999	4872.00*	4.79E+000 +/- 7.94E-001	1.94E-001 +/- 3.21E-002
TH-230	0.999	4672.00*	4.49E-001 +/- 2.50E-001	2.15E-001 +/- 3.57E-002
TH-232	0.998	3997.00*	6.73E-002 +/- 1.19E-001	2.15E-001 +/- 3.56E-002

AG 10/24/13

0000071859.CNF



02820

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 07

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	1	0	1	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	1	0	0	0
49:	0	0	0	0	0	0	0	1
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	1	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	1	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	1	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	1
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	1	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	1	0	0	0	0
289:	0	0	0	0	0	1	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	1	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	1	0

Sample Title: 07

Channel								
377:	0	0	0	1	0	0	0	1
385:	0	1	0	0	1	0	0	0
393:	0	1	1	0	0	0	0	2
401:	0	1	0	2	1	0	0	1
409:	0	0	1	0	0	0	1	0
417:	0	0	2	2	0	0	0	2
425:	0	2	0	0	1	2	0	0
433:	2	2	3	2	4	4	5	3
441:	2	3	0	3	3	7	2	4
449:	3	3	2	5	4	1	5	3
457:	2	2	2	2	1	0	4	0
465:	2	3	2	1	3	1	2	2
473:	3	2	0	2	3	1	1	2
481:	1	1	1	3	0	0	2	1
489:	0	0	0	1	2	0	0	0
497:	1	1	0	1	0	0	1	1
505:	0	2	2	1	0	0	1	0
513:	0	0	0	1	0	0	2	3
521:	0	1	0	0	0	1	1	0
529:	0	0	0	1	0	0	0	0
537:	0	0	1	0	0	0	0	1
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	1	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	1	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	1	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	1	0	1	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	1	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	1	0	0	0
705:	1	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	1	0	0
737:	0	0	0	1	1	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	1	0
761:	0	0	0	0	0	1	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 07

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	1	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	1	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	1	0	0
929:	0	0	0	0	0	0	1	0
937:	0	0	0	0	0	2	0	0
945:	1	0	0	0	0	1	0	0
953:	0	0	0	0	0	0	0	0
961:	0	1	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

ICB 10/24/13

Sample Description: WLL20131008K1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 08
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_015
Chamber Serial Number:
Detector Serial Number: 15
Env. Background: System Bkgd 70359
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:17 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.235 mL
Effective Efficiency: 0.1334 +/- 0.0129
Counting Efficiency: 0.1477 +/- 0.0027 on 7/20/2013 6:27:27 PM
Chem. Recovery Factor: 0.9028 +/- 0.0889

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.769	4.00	109.57	0.00	0.00E+000	3.0
TH-228		5.419	0.49	416.98	0.51	0.00E+000	3.0
TH-229	T	4.855	119.49	17.98	0.51	0.00E+000	7.0
TH-230		4.687	2.83	120.53	0.17	0.00E+000	3.0
TH-232		3.950	-0.17	1169.4	0.17	0.00E+000	0.0

T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.966	5850.00*	1.63E-001 +/- 1.82E-001	2.45E-001 +/- 4.64E-002
TH-228	0.998	5400.00*	1.98E-002 +/- 8.26E-002	2.12E-001 +/- 4.02E-002
TH-229	0.999	4872.00*	4.77E+000 +/- 9.05E-001	2.10E-001 +/- 3.98E-002
TH-230	0.999	4672.00*	1.13E-001 +/- 1.37E-001	1.66E-001 +/- 3.15E-002
TH-232	0.988	3997.00*	-6.75E-003 +/- 7.90E-002	1.66E-001 +/- 3.15E-002

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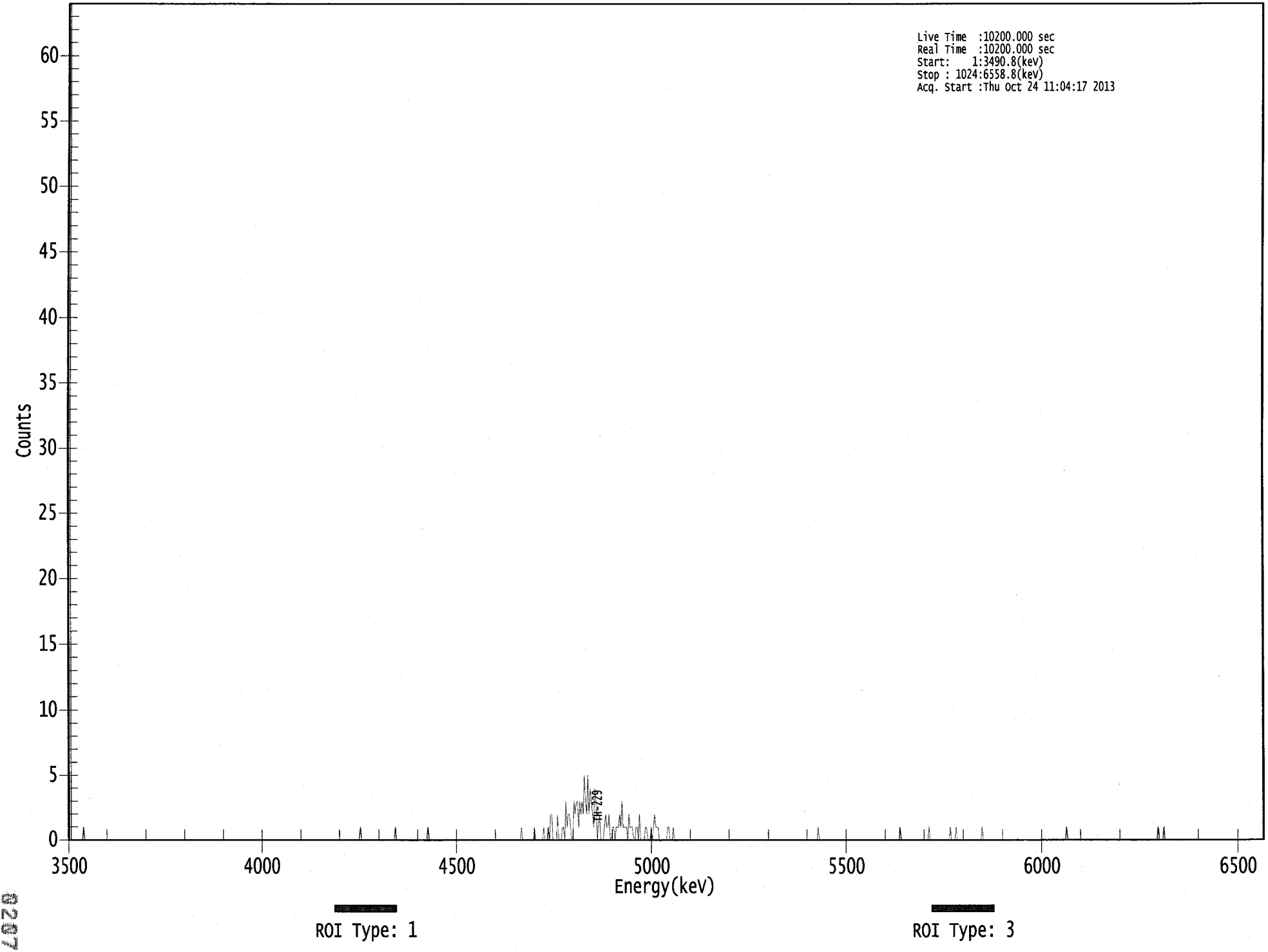
10/24/13

0000071860.CNF



02997

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 08

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	1	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	1	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	1	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	1	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 08

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	1	0	0
393:	0	0	0	0	0	0	0	0
401:	1	0	0	0	0	0	0	0
409:	1	0	0	0	1	0	2	2
417:	0	0	0	0	2	0	0	0
425:	1	1	0	3	1	2	2	1
433:	0	0	3	2	3	3	1	3
441:	2	3	2	5	3	2	5	2
449:	4	3	2	1	4	3	0	1
457:	2	0	0	0	1	2	1	1
465:	2	0	0	1	1	0	1	1
473:	1	2	1	3	1	1	1	1
481:	0	2	1	1	1	0	0	1
489:	1	0	2	0	0	0	0	1
497:	1	0	0	0	1	0	1	2
505:	1	1	1	0	0	0	0	0
513:	0	0	1	1	0	0	0	1
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	1	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	1	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	1	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	1	0	0	0
761:	0	1	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	1
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 08

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	1
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	1	0	0
937:	0	0	1	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB
10/24/13

Apex-Alpha™

Sample Description: WLL201310008K2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 09
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_019
Chamber Serial Number:
Detector Serial Number: 19
Env. Background: System Bkgd 70360
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/8/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:40 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.234 mL
Effective Efficiency: 0.1565 +/- 0.0141
Counting Efficiency: 0.1659 +/- 0.0029 on 2/17/2013 10:45:23 AM
Chem. Recovery Factor: 0.9430 +/- 0.0866

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.782	2.81	142.98	1.19	0.00E+000	6.7
TH-228		5.366	5.66	85.23	0.34	0.00E+000	3.3
TH-229	T	4.877	139.83	16.59	0.17	0.00E+000	8.9
TH-230		4.624	5.83	82.55	0.17	0.00E+000	3.3
TH-232		3.962	1.00	277.19	0.00	0.00E+000	3.3

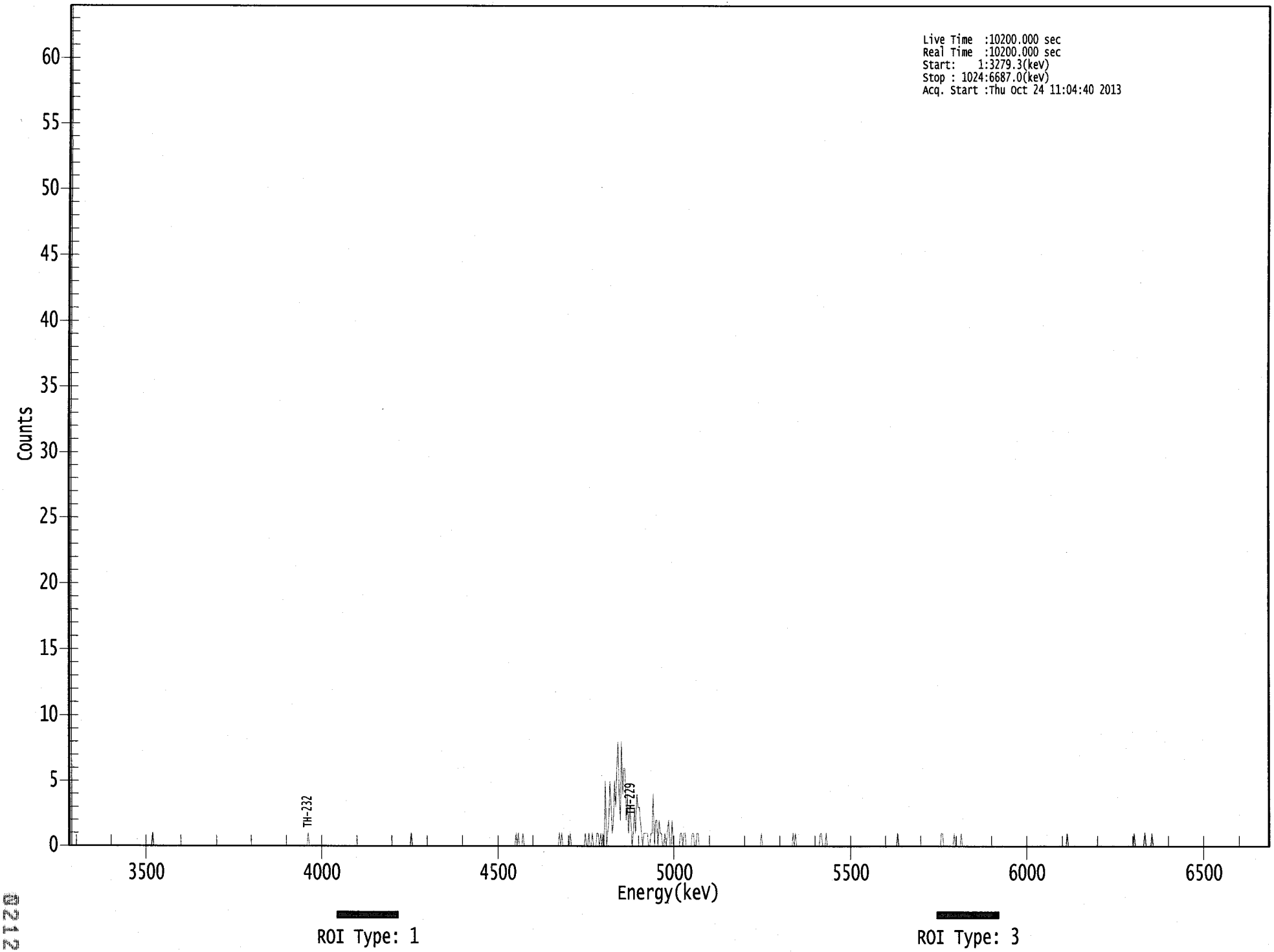
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.976	5850.00*	9.77E-002 +/- 1.41E-001	2.29E-001 +/- 4.05E-002
TH-228	0.994	5400.00*	1.95E-001 +/- 1.70E-001	1.65E-001 +/- 2.91E-002
TH-229	1.000	4872.00*	4.76E+000 +/- 8.41E-001	1.42E-001 +/- 2.51E-002
TH-230	0.988	4672.00*	1.98E-001 +/- 1.67E-001	1.42E-001 +/- 2.50E-002
TH-232	0.994	3997.00*	3.39E-002 +/- 9.41E-002	2.03E-001 +/- 3.59E-002

AG
10/24/13

0000071863.CNF



0212

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 09

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	1	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	1	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	1	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 09

Channel								
377:	0	0	0	0	0	0	1	0
385:	1	0	0	0	1	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	1	0	1	0	0
425:	0	0	0	0	1	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	1	0	0	1	0	0	1
449:	0	0	0	1	1	0	1	0
457:	1	0	5	0	1	2	5	3
465:	1	2	5	3	6	8	4	2
473:	8	4	6	6	2	4	1	3
481:	2	0	1	3	1	4	3	3
489:	2	1	0	1	1	1	1	0
497:	0	1	1	4	0	2	2	0
505:	2	1	1	0	0	1	0	1
513:	2	0	0	2	0	0	0	0
521:	0	0	1	1	0	1	1	0
529:	0	0	0	0	1	1	0	0
537:	1	1	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	1
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	1	0	1	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	1	1	0	0	0	1	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	1	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	1	1	0	0	0	0	0	0
753:	0	0	0	1	0	0	0	0
761:	0	1	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 09

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	1	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	1	0	0	0
913:	0	0	0	0	0	1	0	0
921:	0	0	0	1	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB
10/24/13

Apex-Alpha™

Sample Description: WLL20131009L1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 10
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_022
Chamber Serial Number:
Detector Serial Number: 22
Env. Background: System Bkgd 70361
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/9/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:41 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.233 mL
Effective Efficiency: 0.1965 +/- 0.0161
Counting Efficiency: 0.1531 +/- 0.0029 on 12/15/2012 1:57:26 PM
Chem. Recovery Factor: 1.2831 +/- 0.1079

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.919	8.15	72.72	0.85	0.00E+000	6.2
TH-228		5.386	57.64	26.17	1.36	0.00E+000	3.6
TH-229	T	4.904	175.15	14.85	0.85	0.00E+000	4.9
TH-230		4.651	84.98	21.41	1.02	0.00E+000	9.6
TH-232		3.990	60.00	25.51	0.00	0.00E+000	18.7

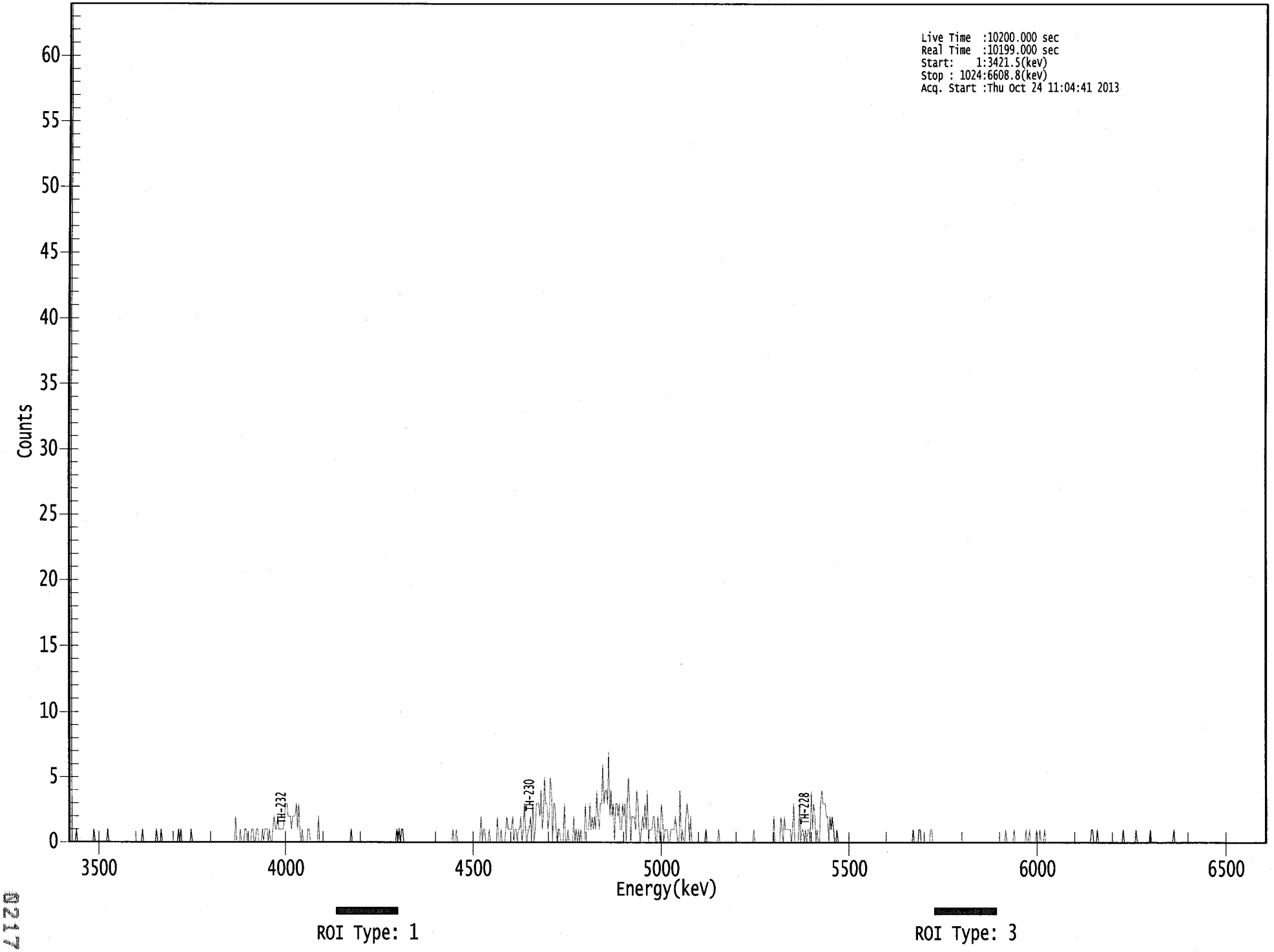
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.976	5850.00*	2.26E-001 +/- 1.68E-001	1.66E-001 +/- 2.66E-002
TH-228	0.999	5400.00*	1.58E+000 +/- 4.85E-001	1.88E-001 +/- 3.01E-002
TH-229	0.995	4872.00*	4.75E+000 +/- 7.62E-001	1.62E-001 +/- 2.60E-002
TH-230	0.998	4672.00*	2.30E+000 +/- 6.14E-001	1.70E-001 +/- 2.73E-002
TH-232	1.000	3997.00*	1.62E+000 +/- 4.88E-001	1.62E-001 +/- 2.59E-002

AG
10/24/13

0000071864.CNF



0217

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 10

Elapsed Live time: 10200
Elapsed Real Time: 10199

Channel								
1:	10199	10200	0	0	0	0	1	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	1	0	0
25:	0	0	0	0	0	0	0	0
33:	0	1	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	1
65:	0	0	0	0	0	0	0	0
73:	0	0	0	1	0	0	0	1
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	1	0
97:	1	0	0	0	0	0	0	0
105:	0	1	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	2
145:	0	0	0	1	0	0	0	1
153:	1	0	0	0	0	1	1	0
161:	0	1	1	0	0	0	1	0
169:	1	1	1	0	1	0	0	1
177:	2	1	1	2	1	1	1	1
185:	1	2	3	3	2	2	2	1
193:	2	2	2	3	1	3	1	0
201:	1	0	0	0	0	1	1	0
209:	0	0	0	0	0	0	2	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	1	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	1	0	1	0	1	1	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	1	0	0	1	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	2	0	1	1	0	0	0
361:	1	0	0	0	0	0	0	2

369:	0	0	1	0	0	0	1	2

Sample Title: 10

Channel								
377:	1	1	1	1	2	0	1	1
385:	0	1	1	2	0	1	3	1
393:	0	1	1	2	0	3	0	1
401:	3	3	3	2	4	1	2	5
409:	3	3	1	2	5	4	0	3
417:	3	1	0	1	1	0	0	0
425:	3	0	0	1	0	0	0	0
433:	2	0	1	0	1	0	1	0
441:	0	0	3	1	1	1	3	1
449:	2	1	2	1	4	2	1	3
457:	3	6	3	4	4	3	7	2
465:	4	2	3	0	3	3	2	3
473:	1	1	3	2	3	0	3	5
481:	3	0	2	2	2	1	4	3
489:	1	0	1	2	1	3	1	4
497:	0	1	1	1	2	2	0	0
505:	2	1	0	3	2	0	1	1
513:	1	0	0	1	1	1	1	2
521:	1	0	0	4	0	1	0	0
529:	2	3	2	0	2	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	1	0	0	0	0	0	0
553:	0	0	0	0	1	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	1	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	2	0	0	0	0
609:	0	2	1	0	2	1	1	1
617:	1	1	0	1	3	0	0	0
625:	0	3	0	1	1	0	1	0
633:	1	1	0	4	1	3	2	0
641:	1	0	0	3	4	3	3	3
649:	2	2	0	2	1	2	1	0
657:	0	1	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	1	0	0	0	0	1
729:	1	0	0	0	0	0	0	0
737:	0	1	1	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	1	0	0	0	0	0	0

Sample Title: 10

Channel								
809:	1	0	0	0	0	0	0	0
817:	0	0	1	0	0	1	0	0
825:	0	0	0	1	0	0	1	0
833:	0	0	1	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	1	1	0	0	0	1
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	1	0	0
905:	0	0	0	0	0	0	0	0
913:	1	0	0	0	0	0	0	0
921:	0	0	0	0	1	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	1	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB
10/24/13

Apex-Alpha™

Sample Description: WLL201310009L2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000718
Batch Identification: 1310043A-TH
Sample Identification: 11
Sample Geometry: Shelf 2
Procedure Description: Th iso

Detector Name: Alpha_024
Chamber Serial Number:
Detector Serial Number: 24
Env. Background: System Bkgd 70362
Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
Sample Date/Time: 10/9/2013 10:32:46 AM
Acquisition Date/Time: 10/24/2013 11:04:42 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_TH-18A
Tracer Quantity: 0.236 mL
Effective Efficiency: 0.1595 +/- 0.0143
Counting Efficiency: 0.1710 +/- 0.0032 on 12/15/2012 2:02:15 PM
Chem. Recovery Factor: 0.9326 +/- 0.0852

Peak Match Tolerance: 0.175 MeV

PEAK AREA REPORT

Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227		5.864	0.30	988.36	1.70	0.00E+000	3.1
TH-228		5.312	4.43	129.80	3.57	0.00E+000	3.1
TH-229	T	4.857	143.64	16.44	1.36	0.00E+000	6.2
TH-230		4.673	13.47	56.84	1.53	0.00E+000	5.4
TH-232		3.914	5.49	88.08	0.51	0.00E+000	3.1

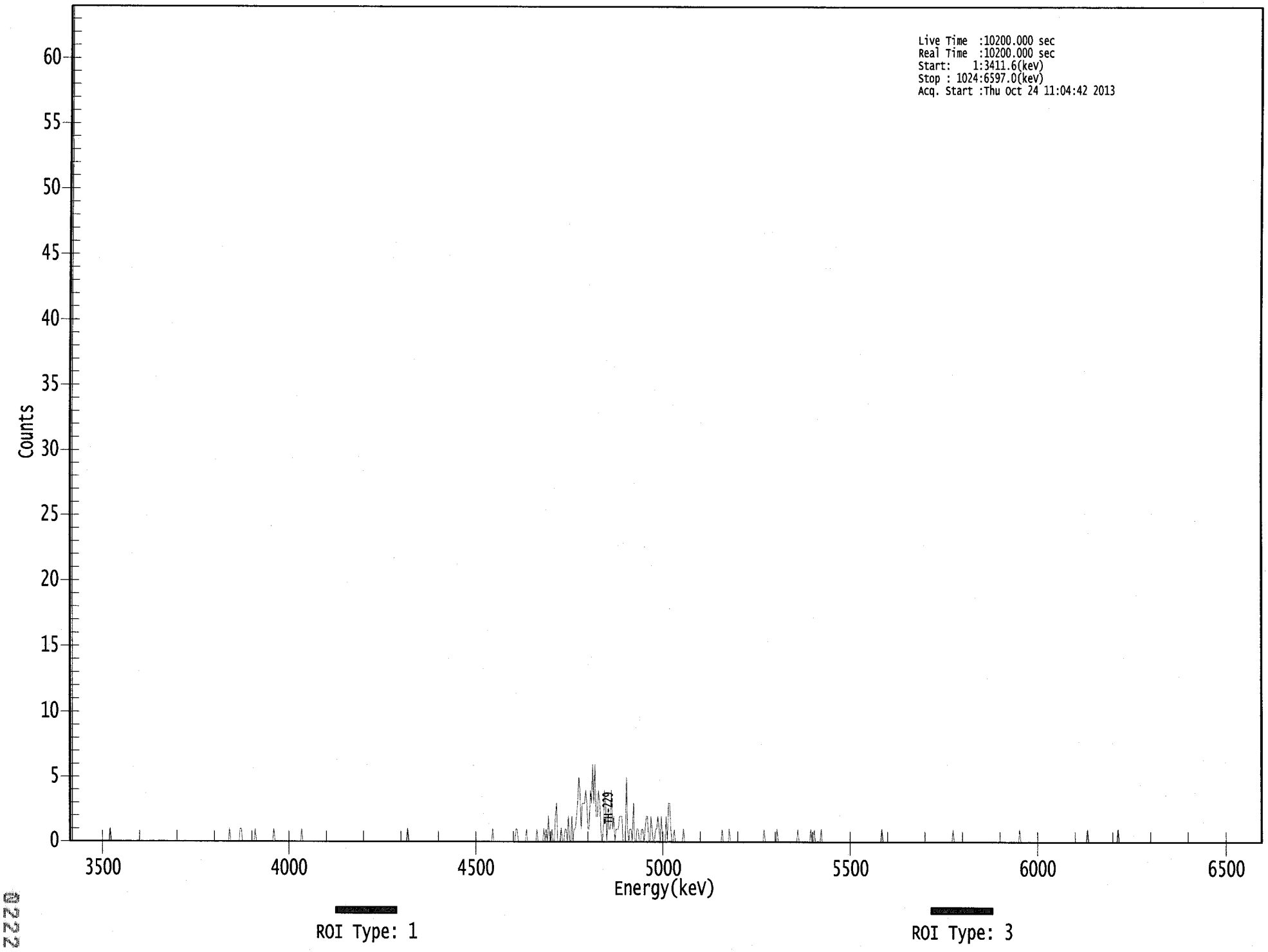
T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.999	5850.00*	1.02E-002 +/- 1.01E-001	2.51E-001 +/- 4.39E-002
TH-228	0.960	5400.00*	1.49E-001 +/- 1.96E-001	3.18E-001 +/- 5.58E-002
TH-229	0.999	4872.00*	4.80E+000 +/- 8.41E-001	2.29E-001 +/- 4.01E-002
TH-230	1.000	4672.00*	4.48E-001 +/- 2.67E-001	2.37E-001 +/- 4.15E-002
TH-232	0.965	3997.00*	1.82E-001 +/- 1.64E-001	1.74E-001 +/- 3.06E-002

AG
10/24/13

0000071865.CNF



02222

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 11

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	1	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	1	0	0	0	0	0
145:	0	0	0	1	1	0	0	0
153:	0	0	0	0	0	0	0	0
161:	1	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	1	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	1	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	1	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	1	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 11

Channel								
377:	0	0	0	0	0	0	0	0
385:	1	1	0	0	0	0	0	0
393:	0	1	0	0	0	0	0	0
401:	0	0	1	0	0	0	0	0
409:	1	0	1	0	2	0	0	1
417:	0	0	2	3	0	0	0	1
425:	0	0	1	1	0	2	0	0
433:	2	0	1	1	2	3	5	4
441:	1	3	3	3	4	3	1	1
449:	4	3	6	3	6	2	2	4
457:	3	1	0	1	4	3	0	2
465:	1	1	4	1	2	0	1	1
473:	1	2	2	2	0	0	0	5
481:	1	0	1	1	0	3	0	0
489:	1	1	0	0	1	1	0	1
497:	2	2	0	0	2	1	0	0
505:	1	1	2	1	0	2	0	0
513:	0	2	0	3	3	1	0	0
521:	1	0	0	0	0	0	0	0
529:	1	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	1	0	0	0	0	0	1
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	1	0	0
601:	0	0	0	0	0	0	0	0
609:	1	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	1	0	0	0	0	0
633:	0	0	0	0	0	1	0	0
641:	1	0	0	0	0	0	1	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	1	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	1
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 11

Channel								
809:	0	0	0	0	0	0	0	0
817:	1	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	1	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	1	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

10/24/2013 5:24:28 AM

Apex-Alpha™

QA SUMMARY REPORT

Review Of QA Results - Pulser Check

Date : 10/24/2013
Time : 5:24:28 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_001	21f	ALL	Not Done	
Alpha_002	21f	ALL	Not Done	
Alpha_003	21f	ALL	Passed	10/24/2013 5:07:41 AM
Alpha_004	21f	ALL	Passed	10/24/2013 5:07:42 AM
Alpha_005	21f	ALL	Not Done	
Alpha_006	21f	ALL	Not Done	
Alpha_007	21f	ALL	Not Done	
Alpha_008	21f	ALL	Not Done	
Alpha_009	21f	ALL	Not Done	
Alpha_010	21f	ALL	Passed	10/24/2013 5:07:42 AM
Alpha_011	21f	ALL	Passed	10/24/2013 5:07:43 AM
Alpha_012	21f	ALL	Passed	10/24/2013 5:07:44 AM
Alpha_013	21f	ALL	Passed	10/24/2013 5:07:45 AM
Alpha_014	21f	ALL	Passed	10/24/2013 5:07:46 AM
Alpha_015	21f	Peak Energy	Action	10/24/2013 5:07:47 AM
Alpha_016	21f	ALL	Not Done	
Alpha_017	AIM730	ALL	Not Done	
Alpha_018	AIM730	ALL	Not Done	
Alpha_019	AIM730	ALL	Passed	10/24/2013 5:07:47 AM
Alpha_020	AIM730	ALL	Not Done	
Alpha_021	AIM730	ALL	Not Done	
Alpha_022	AIM730	ALL	Passed	10/24/2013 5:07:48 AM
Alpha_023	AIM730	ALL	Not Done	
Alpha_024	AIM730	ALL	Passed	10/24/2013 5:07:49 AM
Alpha_025	AIM730	ALL	Passed	10/24/2013 5:07:50 AM
Alpha_026	AIM730	ALL	Not Done	
Alpha_027	AIM730	ALL	Passed	10/24/2013 5:07:51 AM
Alpha_028	AIM730	ALL	Not Done	
Alpha_029	AIM730	ALL	Passed	10/24/2013 5:07:51 AM
Alpha_030	AIM730	ALL	Not Done	
Alpha_031	AIM730	ALL	Passed	10/17/2013 6:40:27 AM
Alpha_032	AIM730	ALL	Not Done	
Alpha_033	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:53 AM
Alpha_034	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:54 AM
Alpha_035	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:56 AM
Alpha_036	Alpha Analyst100DC	ALL	Not Done	
Alpha_037	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:57 AM
Alpha_038	Alpha Analyst100DC	Peak Energy	Action	10/18/2013 6:33:11 AM
Alpha_039	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:07:59 AM
Alpha_040	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:00 AM
Alpha_041	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:02 AM
Alpha_042	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:04 AM

Review of QA Results - Pulser Check

10/24/2013 5:24:28 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_043	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:06 AM
Alpha_044	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:07 AM
Alpha_045	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:09 AM
Alpha_046	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:10 AM
Alpha_047	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:12 AM
Alpha_048	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:14 AM

APPROVED BY: C

APPROVAL DATE: 10/24/13

****
***** L I B R A R Y L I S T I N G R E P O R T *****
****

Nuclide Library Title: Thorium

Nuclide Library Description: Th-227,-228,-229,-230,-232

Nuclide Name	Half-Life (Seconds)	Energy (keV)	Energy Uncert. (keV)	Yield (%)	Yield Uncert.(Abs.+-)
TH-227	6.873E+008	5850.000*	0.000	97.5000	0.0000
TH-228	6.034E+007	5400.000*	0.000	99.9400	0.0000
TH-229	2.487E+011	4872.000*	0.000	99.5200	0.0000
TH-230	2.379E+012	4672.000*	0.000	99.8200	0.0000
TH-232	4.434E+017	3997.000*	0.000	100.0000	0.0000

* = key line

TOTALS: 5 Nuclides 5 Energy Lines

SECTION X

ANALYTICAL DATA (RADIUM-226)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

13-10043
Ra226
Run 1

Work Order	13-10043
Analysis Code	Ra226
Run	1
Date Received	10/10/2013
Lab Deadline	10/31/2013
Client	Missouri Dept. of Natural Resources
Project	C310163001
Report Level	4
Activity Units	pCi
Aliquot Units	l
Matrix	WA
Method	EPA 903.0 Modified
Instrument Type	Alpha Spectroscopy
Radiometric Tracer	Ba-133
Radiometric Sol#	Ba-6a
Tracer Act (dpm/g)	977.397
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/10/13 00:00	1.0000E+00
02	MBL	BLANK		10/10/13 00:00	1.0000E+00
03	DUP	WLL20131008E1	53	10/08/13 11:15	1.0000E+00
04	DO	WLL20131008E1	53	10/08/13 11:15	1.0000E+00
05	TRG	WLL201310008E2	47	10/08/13 11:15	1.0000E+00
06	TRG	WLL20131008F1	56	10/08/13 12:10	1.0000E+00
07	TRG	WLL20131008F2	52	10/08/13 12:10	1.0000E+00
08	TRG	WLL20131008K1	49	10/08/13 16:05	1.0000E+00
09	TRG	WLL201310008K2	45	10/08/13 16:05	1.0000E+00
10	TRG	WLL20131009L1	48	10/09/13 10:55	1.0000E+00
11	TRG	WLL201310009L2	57	10/09/13 10:55	1.0000E+00

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
Ra226
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	0.9163	895.6	374.7	92.88		0.0234	0.0305	0.0071		92.88	2.53	1.00
02	MBL	0.9108	890.2	366.0	91.27		0.0236	0.0301	0.0065		91.27	2.34	1.00
03	DUP	0.9081	887.6	267.1	66.81		0.0233	0.0299	0.0066		66.81	2.37	1.00
04	DO	0.9055	885.0	325.2	81.57		0.0233	0.0301	0.0068		81.57	2.44	1.00
05	TRG	0.9052	884.7	406.6	102.02		0.0238	0.0314	0.0076		102.02	2.66	1.00
06	TRG	0.9049	884.4	365.6	91.77		0.0233	0.0316	0.0083		91.77	2.84	1.00
07	TRG	0.9040	883.6	373.3	93.79		0.0236	0.0317	0.0081		93.79	2.79	1.00
08	TRG	0.9063	885.8	359.7	90.15		0.0234	0.0318	0.0084		90.15	2.87	1.00
09	TRG	0.9040	883.6	342.1	85.95		0.0236	0.0322	0.0086		85.95	2.91	1.00
10	TRG	0.9046	884.2	148.3	37.24		0.0232	0.0281	0.0049		37.24	1.66	1.00
11	TRG	0.9074	886.9	236.5	59.20		0.0235	0.0302	0.0067		59.20	2.40	1.00

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
Ra226
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
02	MBL			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
03	DUP			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
04	DO			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
05	TRG			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
06	TRG			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
07	TRG			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
08	TRG			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
09	TRG			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
10	TRG			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		
11	TRG			10/18/13 08:05	JWOLFE	10/24/13 07:38	TSMITH		

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-Ra226-1

Run: 1
Analysis Code: Ra226
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-226	LCS	LCS	pCi/l	1.06E+01	1.36E+00	2.47E-01	1.03E+01	103.46	OK		OK	
02	RA-226	MBL	BLANK	pCi/l	-1.02E-01	8.86E-02	3.41E-01					OK	OK
03	RA-226	DUP	WLL20131008E1	pCi/l	5.72E+00	1.06E+00	3.82E-01				NA	OK	
04	RA-226	DO	WLL20131008E1	pCi/l	5.04E+00	8.84E-01	2.03E-01					OK	
05	RA-226	TRG	WLL201310008E2	pCi/l	3.18E+00	6.68E-01	1.69E-01					OK	
06	RA-226	TRG	WLL20131008F1	pCi/l	2.42E+01	2.21E+00	3.22E-01					OK	
07	RA-226	TRG	WLL20131008F2	pCi/l	2.36E+01	2.15E+00	3.74E-01					OK	
08	RA-226	TRG	WLL20131008K1	pCi/l	1.29E+00	5.39E-01	2.73E-01					OK	
09	RA-226	TRG	WLL201310008K2	pCi/l	1.18E+00	4.99E-01	2.26E-01					OK	
10	RA-226	TRG	WLL20131009L1	pCi/l	2.22E+00	8.35E-01	5.08E-01					OK	
11	RA-226	TRG	WLL201310009L2	pCi/l	1.61E+00	6.59E-01	5.15E-01					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-Ra226-1

Run: 1
Analysis Code: Ra226
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	RA-226	LCS	10/10/13 00:00	1.00E+00	92.88	0.00	92.88		10/24/2013 7:38	
02	RA-226	MBL	10/10/13 00:00	1.00E+00	91.27	0.00	91.27		10/24/2013 7:38	
03	RA-226	DUP	10/08/13 11:15	1.00E+00	66.81	0.00	66.81		10/24/2013 7:38	
04	RA-226	DO	10/08/13 11:15	1.00E+00	81.57	0.00	81.57		10/24/2013 7:38	
05	RA-226	TRG	10/08/13 11:15	1.00E+00	100.00	0.00	102.02		10/24/2013 7:38	
06	RA-226	TRG	10/08/13 12:10	1.00E+00	91.77	0.00	91.77		10/24/2013 7:38	
07	RA-226	TRG	10/08/13 12:10	1.00E+00	93.79	0.00	93.79		10/24/2013 7:38	
08	RA-226	TRG	10/08/13 16:05	1.00E+00	90.15	0.00	90.15		10/24/2013 7:38	
09	RA-226	TRG	10/08/13 16:05	1.00E+00	85.95	0.00	85.95		10/24/2013 7:38	
10	RA-226	TRG	10/09/13 10:55	1.00E+00	37.24	0.00	37.24		10/24/2013 7:38	
11	RA-226	TRG	10/09/13 10:55	1.00E+00	59.20	0.00	59.20		10/24/2013 7:38	

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-Ra226-1

Run	Analysis Code	Eberline Services Work Order	Client
1	Ra226	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-226	LCS	10/25/13 05:56		A_Spec	Alpha_003	170	2.57 E+02	5.00 E-03	17.5
02	RA-226	MBL	10/25/13 05:56		A_Spec	Alpha_004	170.02	-2.91 E+00	2.30 E-02	19.4
03	RA-226	DUP	10/25/13 05:56		A_Spec	Alpha_010	170	1.20 E+02	1.30 E-02	19.7
04	RA-226	DO	10/25/13 05:56		A_Spec	Alpha_011	170	1.30 E+02	3.00 E-03	20.5
05	RA-226	TRG	10/25/13 05:56		A_Spec	Alpha_012	170.02	8.97 E+01	2.00 E-03	19.9
06	RA-226	TRG	10/25/13 05:56		A_Spec	Alpha_013	170	5.52 E+02	1.00 E-02	18.7
07	RA-226	TRG	10/25/13 05:56		A_Spec	Alpha_014	170.02	5.53 E+02	1.70 E-02	18.5
08	RA-226	TRG	10/25/13 05:56		A_Spec	Alpha_015	170	2.27 E+01	2.00 E-03	14.8
09	RA-226	TRG	10/25/13 05:56		A_Spec	Alpha_019	170.02	2.18 E+01	1.00 E-03	16.6
10	RA-226	TRG	10/25/13 05:56		A_Spec	Alpha_022	170	2.88 E+01	7.00 E-03	15.3
11	RA-226	TRG	10/25/13 05:56		A_Spec	Alpha_024	170	2.56 E+01	1.40 E-02	17.1

Count Room Report
Client: Missouri Dept. of Natural

13-10043-Ra226-1 (pCi/l) in WA
Tracer ID: Ba-6a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	10/10/13 00:00	1.0000	0.9163	895.5889	374.7000	92.88	2.53	1.00
02	MBL	BLANK	10/10/13 00:00	1.0000	0.9108	890.2132	366.0000	91.27	2.34	1.00
03	DUP	WLL20131008E1	10/08/13 11:15	1.0000	0.9081	887.5742	267.1000	66.81	2.37	1.00
04	DO	WLL20131008E1	10/08/13 11:15	1.0000	0.9055	885.0330	325.2000	81.57	2.44	1.00
05	TRG	WLL201310008E2	10/08/13 11:15	1.0000	0.9052	884.7398	406.6000	102.02	2.66	1.00
06	TRG	WLL20131008F1	10/08/13 12:10	1.0000	0.9049	884.4465	365.6000	91.77	2.84	1.00
07	TRG	WLL20131008F2	10/08/13 12:10	1.0000	0.9040	883.5669	373.3000	93.79	2.79	1.00
08	TRG	WLL20131008K1	10/08/13 16:05	1.0000	0.9063	885.8149	359.7000	90.15	2.87	1.00
09	TRG	WLL201310008K2	10/08/13 16:05	1.0000	0.9040	883.5669	342.1000	85.95	2.91	1.00
10	TRG	WLL20131009L1	10/09/13 10:55	1.0000	0.9046	884.1533	148.3000	37.24	1.66	1.00
11	TRG	WLL201310009L2	10/09/13 10:55	1.0000	0.9074	886.8900	236.5000	59.20	2.40	1.00

3
0556
15
19
24

0236

Eberline Services
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 10/18/2013 8:05 AM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
13-10043	1	Ra226	10/18/2013 8:04	JWOLFE	JW	

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estimate	Known pCi	Error Estimate	Added pCi	Error Estimate
Ra-226	Ra-5b	44.062	10/18/2013	0.500	0.5176				10.27	0.473	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	Ba-133	Ba-6a	977.397	10/18/2013	0.9163	1.0400
02	Ba-133	Ba-6a	977.397	10/18/2013	0.9108	1.0400
03	Ba-133	Ba-6a	977.397	10/18/2013	0.9081	1.0400
04	Ba-133	Ba-6a	977.397	10/18/2013	0.9055	1.0400
05	Ba-133	Ba-6a	977.397	10/18/2013	0.9052	1.0400
06	Ba-133	Ba-6a	977.397	10/18/2013	0.9049	1.0400
07	Ba-133	Ba-6a	977.397	10/18/2013	0.9040	1.0400
08	Ba-133	Ba-6a	977.397	10/18/2013	0.9063	1.0400
09	Ba-133	Ba-6a	977.397	10/18/2013	0.9040	1.0400
10	Ba-133	Ba-6a	977.397	10/18/2013	0.9046	1.0400
11	Ba-133	Ba-6a	977.397	10/18/2013	0.9074	1.0400

Balance Printer Tapes

Tracer

0.9163 g
0.9108 g
-0.9081 g
-0.9055 g
-0.9052 g
-0.9049 g
-0.9040 g
-0.9063 g
-0.9040 g
-0.9046 g
-0.9074 g

LCS

0.5176 g
0.5127 g

Matrix Spike

Version 2.0 08/99

7127

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
13-10043	1	Ra226	liters	10/31/2013	JWOLFE

Lab Fraction	Missouri Dept. of Natural Resources Client ID	Sample Type	Muffle Data Ratio Post/Pre	Dilution Data No of Dils	Dil Factor	Ratio	Aliquot Data Aliquot	Net Equiv	MS Aliquot Data Aliquot	Net Equiv	H-3 Solids Only Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	WLL20131008E1	DUP					1.0000E+00	1.0000E+00				
04	WLL20131008E1	DO					1.0000E+00	1.0000E+00				
05	WLL201310008E2	TRG					1.0000E+00	1.0000E+00				
06	WLL20131008F1	TRG					1.0000E+00	1.0000E+00				
07	WLL20131008F2	TRG					1.0000E+00	1.0000E+00				
08	WLL20131008K1	TRG					1.0000E+00	1.0000E+00				
09	WLL201310008K2	TRG					1.0000E+00	1.0000E+00				
10	WLL20131009L1	TRG					1.0000E+00	1.0000E+00				
11	WLL201310009L2	TRG					1.0000E+00	1.0000E+00				

Comments	

Technician: JWolfe Date: 10/18/13

0238

Eberline Services - Oak Ridge
Version 1.0 9/1999

Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
13-10043	1	Ra226			TSMITH

TRetec Fraction	Missouri Dept. of Natural Resources Client ID	Sample Type	Carrier Data: Carrier Added (ml)	Filter Data: Filter Tare (g)	Filter Final (g)	Filter Net (g)	Gravimetric: % Recovery
01	LCS	LCS		0.0234	0.0305	0.0071	
02	BLANK	MBL		0.0236	0.0301	0.0065	
03	DUP	DUP		0.0233	0.0299	0.0066	
04	WLL20131008E1	DO		0.0233	0.0301	0.0068	
05	WLL201310008E2	TRG		0.0238	0.0314	0.0076	
06	WLL20131008F1	TRG		0.0233	0.0316	0.0083	
07	WLL20131008F2	TRG		0.0236	0.0317	0.0081	
08	WLL20131008K1	TRG		0.0234	0.0318	0.0084	
09	WLL201310008K2	TRG		0.0236	0.0322	0.0086	
10	WLL20131009L1	TRG		0.0232	0.0281	0.0049	
11	WLL201310009L2	TRG		0.0235	0.0302	0.0067	

Technician: [illegible] Date: 10 / 24 / 13

Apex-Alpha™

C
10/25/13

Sample Description: SPIKE
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000720
Batch Identification: 1310043A-RA
Sample Identification: 01
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_003
Chamber Serial Number:
Detector Serial Number: 3
Env. Background: System Bkgd 70352
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.530E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/25/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:19 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9288 +/- 0.0000
Counting Efficiency: 0.1746 +/- 0.0033 on 12/15/2012 11:26:47 AM
Effective Efficiency: 0.1622 +/- 0.0030

Control Certificate Name: Ra226_Ra-5b
Chem. Recov. of Control: RA-226 0.408900 +/- 0.029353
Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.525	469.77	9.08	3.23	0.00E+000	10.5
RA-226	4.655	257.15	12.25	0.85	0.00E+000	6.1

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.967	5685.50*	2.04E+001 +/- 2.00E+000	3.96E-001 +/- 1.45E-002
RA-226	0.978	4785.00*	1.06E+001 +/- 1.36E+000	2.47E-001 +/- 9.06E-003

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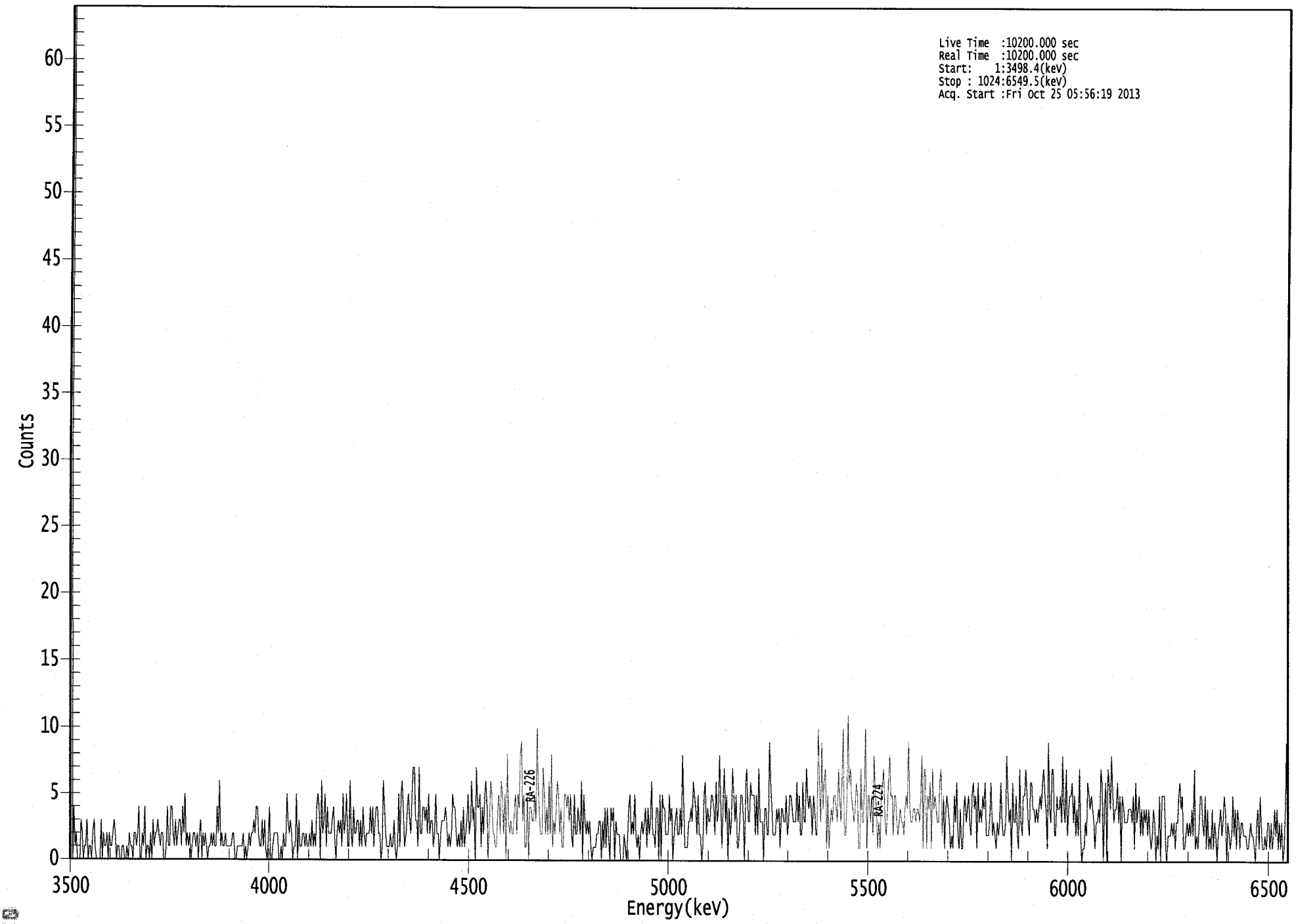
10/25/13

0000072006.CNF



ROI Type: 1

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 01

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	4	1	2	0	0
9:	0	3	2	0	1	1	3	0
17:	1	1	0	2	3	1	0	0
25:	0	0	3	0	2	1	1	2
33:	0	2	1	1	2	3	2	0
41:	1	1	0	0	1	1	0	0
49:	1	0	2	1	1	0	2	2
57:	1	2	4	0	0	2	1	4
65:	0	1	1	0	2	0	3	1
73:	2	2	3	2	1	2	2	0
81:	0	1	4	1	1	4	4	2
89:	1	3	1	2	3	3	1	4
97:	2	5	1	2	1	2	0	1
105:	2	2	1	2	0	2	3	0
113:	2	1	2	1	0	1	1	2
121:	1	2	1	1	4	2	6	1
129:	2	1	1	2	1	1	1	1
137:	1	2	2	0	0	1	1	1
145:	1	1	2	0	1	0	1	2
153:	1	2	2	3	2	4	4	2
161:	1	1	3	1	3	1	0	1
169:	4	0	0	1	2	2	2	2
177:	0	0	1	0	2	1	1	5
185:	3	2	3	2	0	1	1	5
193:	0	3	1	1	2	2	1	2
201:	1	1	2	1	3	1	2	1
209:	4	5	4	0	6	2	3	5
217:	1	4	2	2	2	3	4	2
225:	0	2	3	2	3	1	5	2
233:	3	5	1	1	6	2	1	4
241:	2	2	3	3	1	3	1	4
249:	2	1	2	2	2	4	2	4
257:	1	3	4	4	2	2	0	1
265:	6	4	2	1	1	1	2	1
273:	1	3	1	0	1	5	1	5
281:	6	3	1	2	4	5	3	2
289:	5	7	7	3	3	1	7	2
297:	2	4	4	3	4	2	5	2
305:	3	3	1	2	5	2	2	0
313:	2	3	3	3	4	3	1	2
321:	1	2	5	4	4	2	1	2
329:	1	3	1	4	1	2	3	5
337:	2	3	6	3	4	0	7	4
345:	4	5	1	4	2	5	6	4
353:	0	3	6	5	2	2	1	1
361:	4	5	2	6	5	2	5	0

369:	8	3	2	3	2	2	4	5

Sample Title: 01

Channel								
377:	2	5	4	8	9	3	5	1
385:	1	5	0	4	4	3	3	5
393:	3	10	6	3	2	2	7	5
401:	2	4	2	6	2	8	1	3
409:	2	4	6	5	2	4	1	1
417:	5	5	4	5	3	5	2	1
425:	5	2	2	4	3	2	6	0
433:	5	3	2	3	2	3	1	0
441:	1	1	1	2	2	3	3	0
449:	3	1	4	1	4	2	0	4
457:	3	4	0	3	2	2	2	0
465:	0	0	2	1	0	2	4	5
473:	2	3	2	5	2	1	2	0
481:	2	3	2	3	4	1	4	2
489:	3	6	2	2	1	4	4	0
497:	5	0	5	4	4	2	2	2
505:	5	3	4	0	2	3	4	2
513:	2	4	2	8	4	1	1	1
521:	3	3	4	3	6	5	4	2
529:	5	2	2	0	1	5	6	2
537:	4	3	3	5	5	4	2	6
545:	3	4	8	4	1	5	7	3
553:	5	0	4	2	3	7	5	3
561:	5	1	1	3	5	5	3	0
569:	6	7	3	3	6	5	5	5
577:	2	5	2	7	3	3	3	0
585:	4	4	2	2	9	6	4	2
593:	2	2	4	3	4	1	4	4
601:	3	3	5	2	3	5	5	4
609:	3	3	3	6	3	5	2	2
617:	6	3	3	7	5	4	5	4
625:	2	5	4	2	2	10	6	3
633:	9	4	6	7	1	5	1	3
641:	4	3	5	5	4	3	7	5
649:	3	6	10	2	2	4	11	6
657:	7	5	4	3	4	6	5	1
665:	1	7	3	3	6	10	1	5
673:	5	3	5	2	8	5	4	1
681:	3	1	5	6	7	3	2	4
689:	6	8	5	5	2	5	5	3
697:	2	3	4	3	3	2	4	5
705:	4	9	4	3	3	4	4	3
713:	4	4	3	5	8	1	7	7
721:	1	5	4	6	1	7	4	5
729:	4	3	3	6	7	2	5	1
737:	4	5	4	3	1	2	1	5
745:	3	6	2	1	4	1	1	4
753:	5	3	4	5	3	2	5	6
761:	4	5	1	6	3	4	3	5
769:	4	6	2	2	2	4	6	2
777:	3	2	1	3	2	3	6	3
785:	2	2	3	8	5	3	4	0
793:	6	3	3	5	2	1	7	3

801:	2	5	5	7	5	3	2	6

Sample Title: 01

Channel								
809:	6	4	4	3	4	3	4	5
817:	4	6	7	5	4	1	9	4
825:	3	7	7	2	2	5	4	4
833:	5	3	8	4	3	7	2	4
841:	5	5	6	3	5	2	4	2
849:	7	2	0	1	1	3	2	6
857:	5	4	5	4	3	1	3	3
865:	4	3	7	6	0	4	6	0
873:	7	6	4	8	5	3	4	4
881:	6	3	5	0	5	4	3	3
889:	3	4	4	4	3	5	1	6
897:	3	4	5	2	4	2	4	3
905:	4	2	4	2	1	2	4	3
913:	0	2	1	5	0	5	5	5
921:	1	0	2	2	2	3	2	3
929:	1	3	3	5	6	4	5	1
937:	1	2	3	2	3	2	4	2
945:	7	1	2	1	3	5	5	3
953:	2	5	1	4	1	2	1	4
961:	1	3	2	0	2	3	4	2
969:	3	5	4	0	3	2	1	2
977:	5	2	4	1	4	3	1	3
985:	3	2	2	2	1	1	2	3
993:	2	2	1	0	3	4	1	5
1001:	2	1	1	2	1	3	3	1
1009:	3	1	2	4	2	4	1	3
1017:	1	3	0	1	4	9	0	1

Apex-Alpha™

C 10/25/13

Sample Description: BLANK
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 02
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_004
Chamber Serial Number:
Detector Serial Number: 4
Env. Background: System Bkgd 70353
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.340E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/25/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:20 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9127 +/- 0.0000
Counting Efficiency: 0.1940 +/- 0.0036 on 12/15/2012 11:26:46 AM
Effective Efficiency: 0.1771 +/- 0.0033

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.650	-2.40	102.58	3.40	0.00E+000	2.9
RA-226	4.494	-2.91	86.89	3.91	0.00E+000	2.9

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.998	5685.50*	-8.84E-002 +/- 9.07E-002	3.41E-001 +/- 1.23E-002
RA-226	0.895	4785.00*	-1.02E-001 +/- 8.86E-002	3.41E-001 +/- 1.23E-002

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10/25/13

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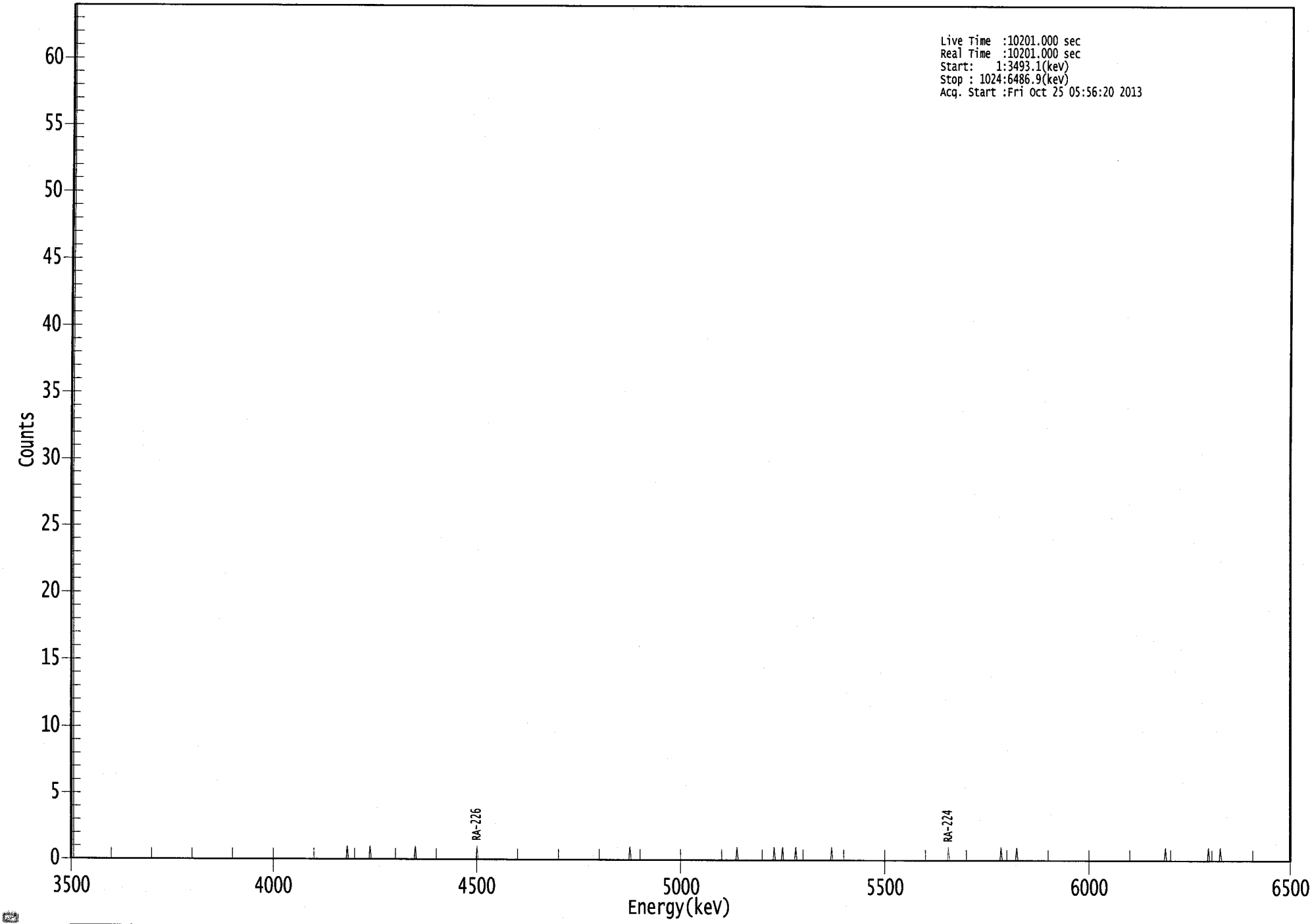

ROI Type: 1

0246

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 02

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	1	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	1	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	1	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	1	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 02

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	1	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	1	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	1
593:	0	0	0	0	0	0	1	0
601:	0	0	0	0	0	0	0	0
609:	0	1	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	1
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	1	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	1	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	1	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 02

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	1	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	1	0	0	0	0	0
961:	0	0	0	0	1	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

C 10/25/13

Sample Description: WLL20131008E1-DUP
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 03
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_010
Chamber Serial Number:
Detector Serial Number: 10
Env. Background: System Bkgd 70354
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.370E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:22 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.6681 +/- 0.0000
Counting Efficiency: 0.1967 +/- 0.0036 on 12/15/2012 11:26:40 AM
Effective Efficiency: 0.1314 +/- 0.0024

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.512	27.77	39.64	3.23	0.00E+000	2.9
RA-226	4.591	119.79	18.10	2.21	0.00E+000	3.7

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.961	5685.50*	1.40E+000 +/- 5.59E-001	4.60E-001 +/- 1.65E-002
RA-226	0.952	4785.00*	5.72E+000 +/- 1.06E+000	3.82E-001 +/- 1.37E-002

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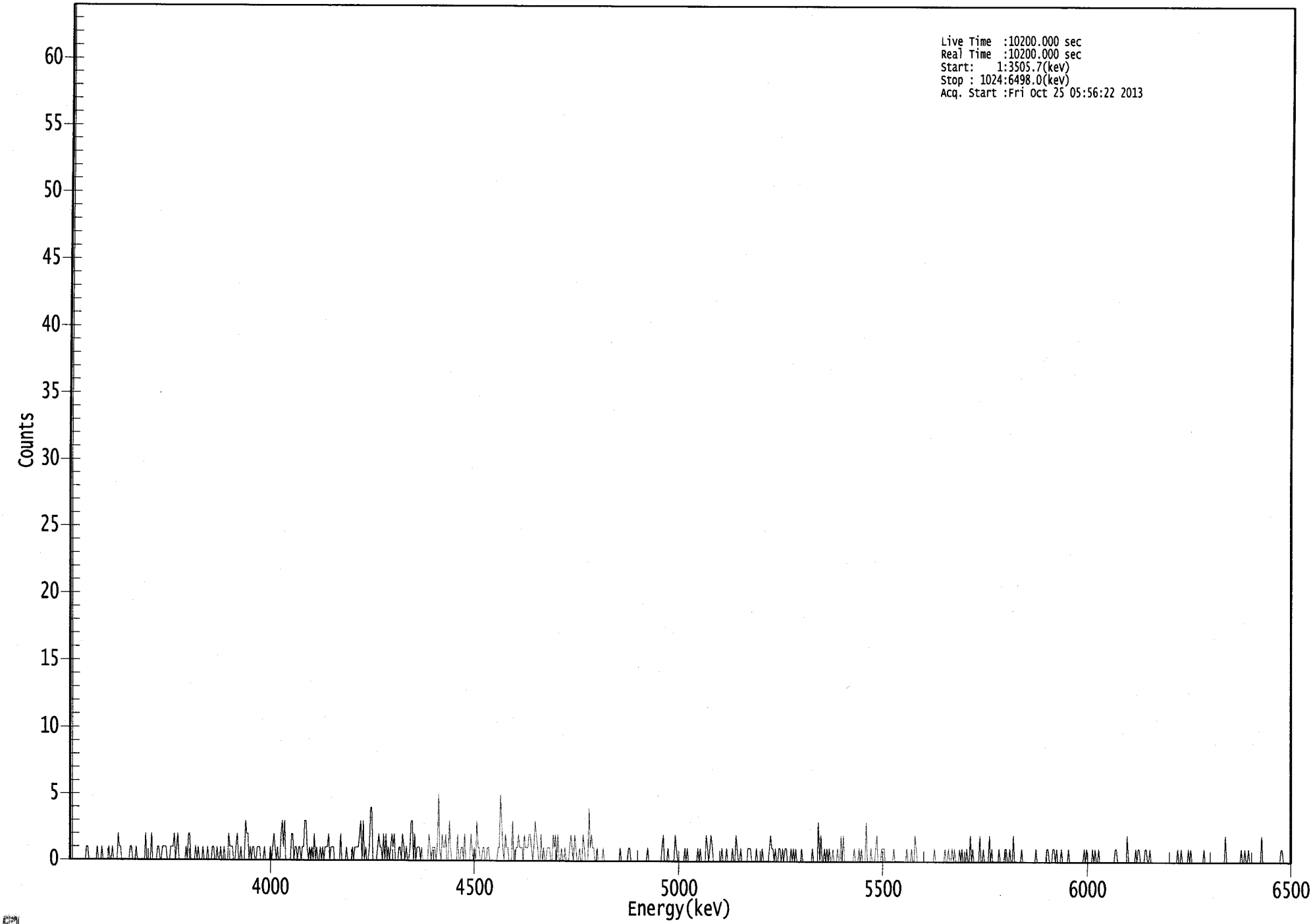
0000071991.CNF



****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 03

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	1	1
17:	0	0	0	0	0	0	0	1
25:	0	0	0	1	0	0	0	0
33:	0	1	0	0	1	0	0	0
41:	0	2	1	1	0	0	0	0
49:	0	0	0	1	1	0	0	0
57:	1	0	0	0	0	0	0	0
65:	2	0	0	0	0	2	0	0
73:	0	0	1	1	0	0	1	1
81:	1	1	0	0	0	1	1	1
89:	2	0	1	2	0	0	0	0
97:	0	0	1	0	2	2	0	0
105:	0	0	1	0	1	0	0	0
113:	1	0	0	0	1	0	0	0
121:	1	1	0	0	1	0	0	1
129:	0	0	1	0	0	0	2	1
137:	1	1	0	0	1	2	0	0
145:	1	0	0	0	3	2	2	0
153:	1	0	1	1	0	0	1	1
161:	1	0	0	0	1	0	0	0
169:	0	1	0	1	2	1	0	1
177:	0	0	2	3	1	3	0	0
185:	0	0	0	2	2	0	1	1
193:	0	1	1	0	1	1	3	3
201:	1	0	1	0	1	0	2	0
209:	1	0	0	1	0	1	0	1
217:	1	1	2	0	1	1	1	0
225:	0	0	0	0	2	0	0	0
233:	0	1	0	0	0	0	1	0
241:	1	1	1	1	2	3	0	3
249:	0	1	0	0	1	4	4	0
257:	0	0	0	1	2	1	1	0
265:	2	0	2	0	1	0	1	2
273:	1	2	0	0	0	1	1	0
281:	2	1	0	1	0	0	1	3
289:	3	0	2	0	1	1	1	0
297:	1	0	0	0	0	0	2	1
305:	0	1	1	1	0	1	5	1
313:	0	2	1	1	2	0	0	3
321:	1	0	0	0	0	0	2	0
329:	0	1	1	0	2	0	0	0
337:	0	2	1	0	1	0	3	1
345:	1	0	0	1	1	0	0	1
353:	1	0	0	0	0	0	0	0
361:	1	1	5	3	1	0	2	1

369:	1	0	0	0	3	0	0	1

Sample Title: 03

Channel								
377:	1	2	1	1	1	0	2	1
385:	1	1	2	2	1	0	1	3
393:	2	1	0	0	2	0	1	0
401:	0	1	1	1	0	0	2	1
409:	2	0	2	0	0	1	0	0
417:	1	0	0	0	1	2	1	0
425:	2	1	0	0	1	0	0	2
433:	1	0	0	0	4	1	2	1
441:	1	0	0	1	0	0	0	0
449:	1	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	1	0
465:	0	0	0	0	0	1	1	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	1	0	0
489:	0	0	0	0	0	0	0	0
497:	0	1	2	0	0	0	1	0
505:	0	0	0	0	2	1	0	0
513:	0	0	0	0	1	0	1	0
521:	0	0	0	0	0	0	0	1
529:	0	1	0	0	0	0	2	1
537:	0	1	2	1	0	0	0	0
545:	0	0	0	1	0	0	0	1
553:	0	0	0	0	1	0	0	2
561:	1	0	0	1	0	0	0	0
569:	0	1	1	1	0	0	0	0
577:	1	0	0	0	0	1	0	0
585:	0	0	0	1	2	1	1	0
593:	1	0	0	1	1	0	1	0
601:	1	1	0	0	0	1	0	1
609:	0	1	0	0	0	0	1	0
617:	0	0	0	0	0	0	0	1
625:	0	0	0	0	3	0	2	0
633:	0	1	0	1	0	1	0	0
641:	1	0	0	0	1	0	0	2
649:	0	2	0	0	0	0	0	0
657:	0	0	1	0	0	0	1	0
665:	1	0	0	0	3	0	0	0
673:	1	0	0	0	1	2	0	0
681:	0	1	1	1	0	0	0	0
689:	0	0	0	1	0	0	0	0
697:	0	0	0	0	0	0	1	0
705:	0	0	1	0	0	2	1	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	1	0	0
729:	0	0	0	0	0	0	1	0
737:	0	1	0	0	1	0	1	0
745:	0	0	1	0	1	0	0	0
753:	1	0	0	2	0	1	0	0
761:	0	0	0	2	0	0	1	0
769:	0	0	0	2	0	1	0	0
777:	0	0	0	1	0	0	0	0
785:	1	1	0	0	1	0	0	2
793:	0	0	0	0	0	0	1	0

801:	0	0	0	0	0	0	0	0

Sample Title: 03

Channel								
809:	0	0	1	0	0	0	0	0
817:	0	0	0	1	1	0	0	0
825:	1	1	0	1	0	0	0	1
833:	0	0	0	0	0	1	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	1	0	1	0	0	0
857:	0	1	0	1	0	0	1	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	1	1	0	0
881:	0	0	0	0	0	0	2	0
889:	0	0	0	0	0	1	0	1
897:	1	0	0	0	0	1	1	0
905:	0	1	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	1	0	0	1	0	0	0	0
937:	0	1	0	1	0	0	0	0
945:	0	0	0	0	0	0	1	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	2	0	0	0	0	0	0	0
977:	0	0	0	0	0	1	0	0
985:	1	0	0	1	0	0	0	0
993:	0	0	0	0	0	0	2	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	1	1
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

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10/25

Sample Description: WLL20131008E1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 04
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_011
Chamber Serial Number:
Detector Serial Number: 11
Env. Background: System Bkgd 70355
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.440E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:23 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8157 +/- 0.0000
Counting Efficiency: 0.2051 +/- 0.0035 on 7/20/2013 2:50:46 PM
Effective Efficiency: 0.1673 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.543	34.30	34.42	1.70	0.00E+000	2.6
RA-226	4.570	130.49	17.20	0.51	0.00E+000	4.6

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.974	5685.50*	1.40E+000 +/- 4.85E-001	3.00E-001 +/- 1.02E-002
RA-226	0.941	4785.00*	5.04E+000 +/- 8.84E-001	2.03E-001 +/- 6.86E-003

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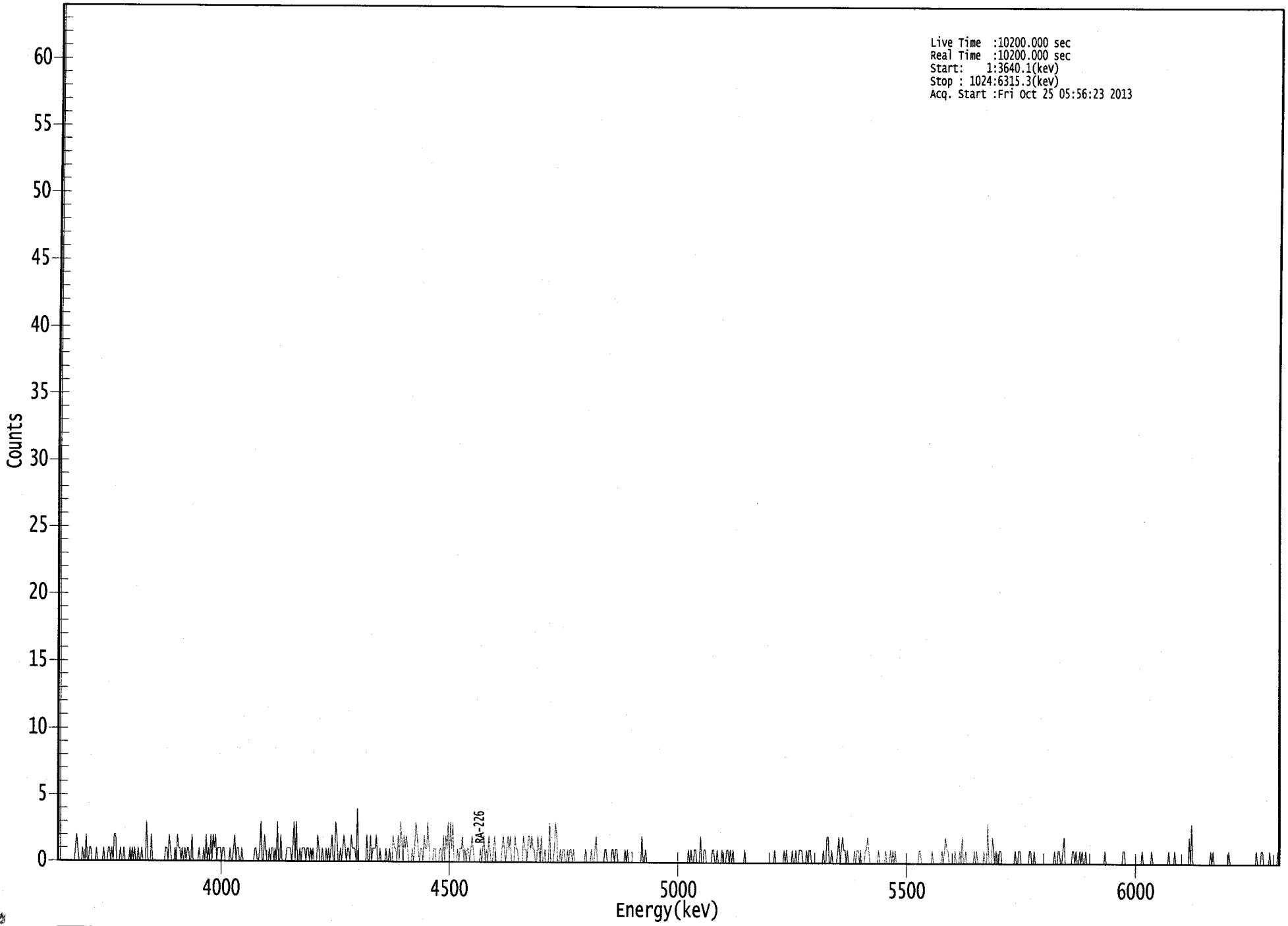
0000071994.CNF



ROI Type: 1

0256

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 04

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	1
17:	2	1	0	0	0	1	0	0
25:	2	0	0	1	1	0	0	0
33:	0	1	0	0	0	0	0	1
41:	0	0	0	1	1	0	1	0
49:	2	2	0	0	0	1	0	0
57:	1	0	0	0	0	1	0	1
65:	0	1	0	0	1	0	0	1
73:	0	0	0	3	0	0	0	2
81:	0	0	0	0	0	0	0	0
89:	0	0	0	1	1	0	2	1
97:	0	0	0	1	0	2	1	1
105:	0	1	0	1	0	1	1	0
113:	0	2	0	0	0	0	0	1
121:	0	0	0	1	0	2	0	1
129:	0	2	0	2	1	2	0	1
137:	1	1	0	1	1	0	0	0
145:	0	1	0	0	1	2	0	1
153:	1	0	0	1	0	0	0	0
161:	0	0	0	0	0	0	1	1
169:	0	0	1	3	0	0	2	1
177:	0	0	1	0	1	1	0	1
185:	0	3	0	0	2	0	0	0
193:	0	1	1	1	1	0	1	3
201:	0	3	0	0	1	0	1	1
209:	1	0	1	1	0	1	0	1
217:	0	0	0	2	1	0	0	1
225:	0	0	1	0	1	0	1	2
233:	0	0	3	2	0	0	1	0
241:	1	2	1	0	1	1	0	2
249:	1	1	1	0	4	0	0	0
257:	0	0	0	0	2	0	0	2
265:	0	1	1	1	2	0	0	1
273:	0	0	0	0	1	0	0	1
281:	0	0	2	1	1	0	2	0
289:	3	2	0	2	1	2	1	0
297:	0	0	1	0	1	3	2	1
305:	0	1	1	0	2	1	1	3
313:	1	0	0	0	1	1	0	0
321:	0	1	1	0	2	0	2	1
329:	3	0	3	1	3	0	0	0
337:	1	0	1	1	2	0	1	0
345:	1	1	0	1	2	1	0	0
353:	0	0	0	1	0	1	2	0
361:	1	0	2	1	0	0	1	2

369:	0	0	0	0	0	1	2	1

Sample Title: 04

Channel								
377:	0	1	2	1	2	0	0	0
385:	2	1	1	0	0	0	0	2
393:	1	1	0	2	2	1	2	1
401:	1	0	0	2	1	0	2	0
409:	0	1	0	0	0	3	0	0
417:	0	1	3	2	0	0	1	0
425:	1	1	0	0	1	0	1	1
433:	0	1	0	0	0	0	0	0
441:	0	0	0	1	0	0	0	0
449:	1	0	0	1	2	0	0	0
457:	0	0	0	1	1	0	0	0
465:	0	1	1	0	1	1	0	0
473:	0	0	0	0	1	0	1	0
481:	0	0	0	0	0	0	0	0
489:	0	0	2	0	0	1	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	1	0	1	0	0	1	1
537:	0	0	0	2	0	0	1	1
545:	0	0	0	0	0	1	1	0
553:	0	1	0	0	0	1	0	0
561:	0	1	1	0	1	0	1	0
569:	0	0	0	0	0	0	0	0
577:	1	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	1	0	0	0	0	0	0
609:	0	1	0	1	0	0	0	0
617:	1	0	0	1	0	0	1	1
625:	1	0	0	0	1	0	1	1
633:	0	0	0	0	0	0	0	0
641:	0	0	1	0	0	2	2	0
649:	0	1	0	0	0	0	1	2
657:	0	1	2	1	1	0	1	0
665:	0	0	0	0	1	0	1	1
673:	0	1	0	0	0	1	1	2
681:	1	0	0	0	0	0	0	0
689:	1	0	0	0	0	0	1	0
697:	0	0	1	0	1	0	1	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	1	1	0	0	0	0
729:	0	0	0	0	0	1	0	0
737:	0	0	0	0	0	1	0	1
745:	2	1	1	0	0	0	0	0
753:	1	0	0	0	1	0	2	0
761:	0	1	0	0	0	0	0	0
769:	1	0	1	0	0	0	0	0
777:	1	0	0	3	0	0	0	2
785:	1	0	1	0	0	1	1	0
793:	0	0	0	0	0	0	0	0

801:	0	0	1	0	0	1	1	0

Sample Title: 04

Channel								
809:	0	0	0	0	0	0	1	1
817:	0	0	1	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	1	0	0	1	1
841:	0	0	1	2	0	0	0	0
849:	0	0	1	1	0	1	0	0
857:	1	0	1	0	0	1	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	1	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	1	1	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	1	0	0	0
913:	0	0	0	0	1	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	1	0	0	0	0	1
937:	0	0	0	0	0	0	0	0
945:	0	0	0	2	0	3	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	1	0	1
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	1	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	1	0	0	0	1
1009:	1	0	0	0	0	0	1	0
1017:	0	0	0	0	0	1	0	0

Apex-Alpha™

C 10/25

Sample Description: WLL20130008E2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 05
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_012
Chamber Serial Number:
Detector Serial Number: 12
Env. Background: System Bkgd 70356
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.660E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:24 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1989 +/- 0.0034 on 12/11/2011 2:21:56 PM
Effective Efficiency: 0.1989 +/- 0.0034

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

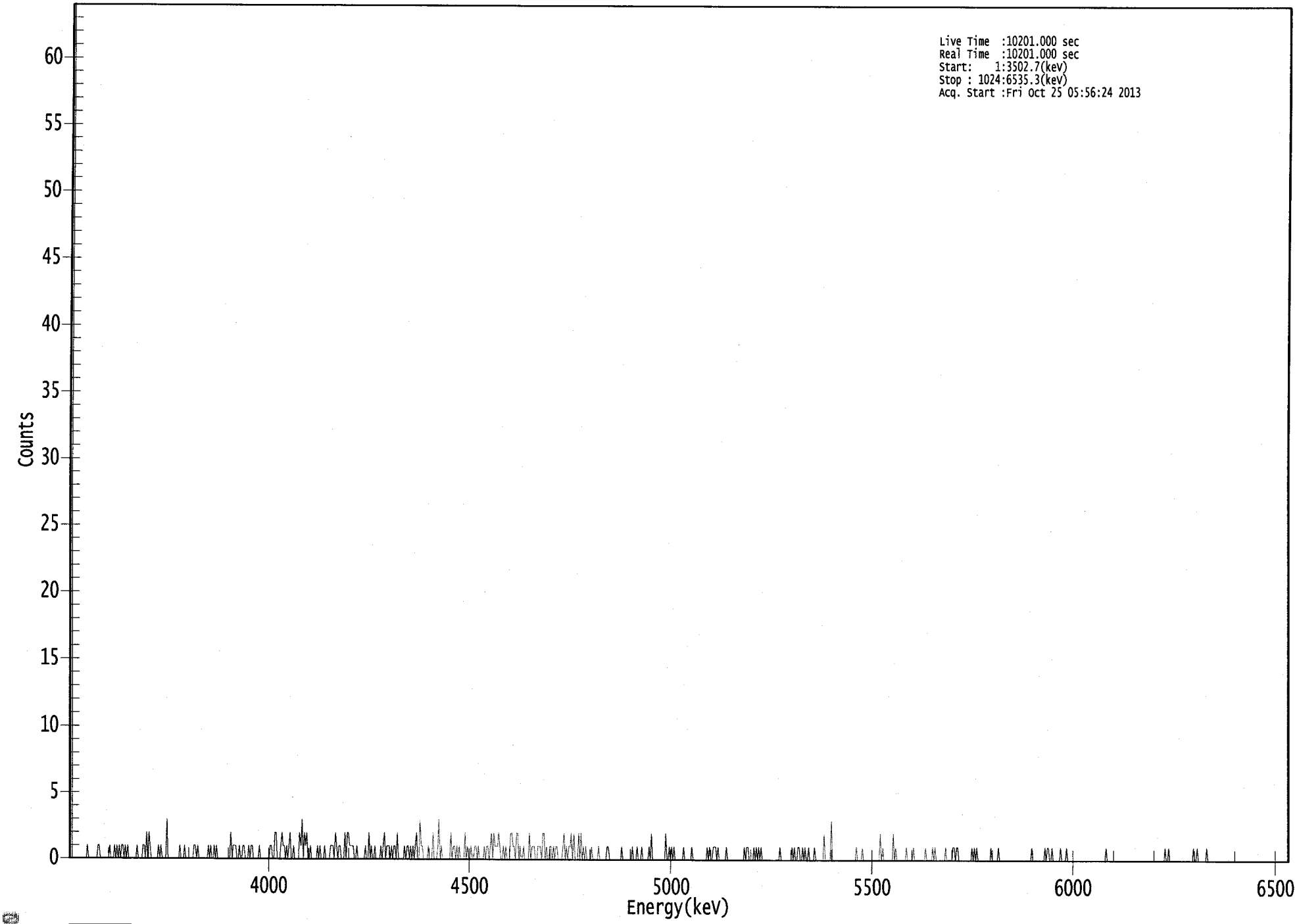
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.524	18.49	46.31	0.51	0.00E+000	3.0
RA-226	4.600	89.66	20.75	0.34	0.00E+000	3.7

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.967	5685.50*	6.93E-001 +/- 3.22E-001	1.97E-001 +/- 6.69E-003
RA-226	0.956	4785.00*	3.18E+000 +/- 6.68E-001	1.69E-001 +/- 5.75E-003

AG
10/25/13

0000071995.CNF



ROI Type: 1

0251

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 05

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	1
17:	0	0	0	0	0	0	0	0
25:	1	1	0	0	0	0	0	0
33:	0	0	1	0	0	0	1	0
41:	1	0	1	0	1	1	0	1
49:	0	1	0	0	0	0	0	0
57:	0	1	0	0	0	0	1	1
65:	0	2	0	2	1	0	0	0
73:	0	0	0	1	0	1	0	0
81:	0	0	3	0	0	0	0	0
89:	0	0	0	0	0	1	0	0
97:	0	1	0	0	0	0	0	0
105:	0	1	1	0	1	0	0	0
113:	0	0	0	0	0	1	0	1
121:	0	0	1	0	1	0	0	0
129:	0	0	0	0	0	0	0	0
137:	2	0	1	1	1	0	0	1
145:	0	0	1	1	0	0	0	1
153:	0	1	1	0	0	0	0	0
161:	1	0	0	0	0	0	0	0
169:	0	1	1	0	0	2	2	0
177:	0	0	1	2	1	1	0	1
185:	0	1	2	0	0	1	0	0
193:	0	0	2	1	3	0	2	1
201:	2	0	0	1	0	0	0	0
209:	0	1	0	1	0	0	0	1
217:	0	0	0	0	1	1	1	0
225:	2	1	0	1	1	0	0	0
233:	2	0	2	2	1	1	1	1
241:	0	0	1	0	0	0	0	0
249:	0	1	0	0	2	0	1	0
257:	0	1	0	0	0	0	1	0
265:	1	2	0	1	1	1	0	1
273:	0	1	1	0	2	0	0	0
281:	0	0	1	0	1	1	0	1
289:	0	1	0	1	2	0	0	3
297:	1	1	0	0	0	0	1	0
305:	0	0	2	0	0	0	1	3
313:	0	1	0	0	0	0	0	0
321:	0	2	0	1	1	0	1	0
329:	1	0	0	0	0	2	0	1
337:	0	0	1	0	0	1	1	0
345:	1	0	0	0	0	1	0	1
353:	1	0	1	2	0	2	1	1
361:	1	2	1	0	0	1	0	1

369:	0	0	0	2	2	1	1	0

Sample Title: 05

Channel								
377:	2	2	0	1	0	0	1	0
385:	0	0	0	2	0	1	1	1
393:	0	0	1	1	1	0	2	2
401:	0	1	0	0	1	1	0	1
409:	0	1	1	0	0	0	0	1
417:	2	0	1	0	1	1	2	0
425:	2	0	0	0	2	0	2	0
433:	1	0	1	0	0	0	0	1
441:	0	0	0	0	0	1	0	0
449:	0	0	0	0	1	1	0	0
457:	0	0	0	0	0	0	0	0
465:	1	0	0	0	0	0	0	0
473:	0	1	0	0	0	1	0	0
481:	0	1	0	0	0	0	0	1
489:	0	2	0	0	0	0	0	0
497:	0	0	0	0	0	2	0	0
505:	1	0	1	0	1	0	0	0
513:	0	0	0	0	1	0	0	0
521:	0	0	0	1	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	1	0	1	0	0	1	1	1
545:	0	1	0	0	0	0	0	0
553:	1	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	1
569:	0	1	1	0	0	0	0	1
577:	0	1	0	1	0	1	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	1	0	0
601:	0	0	0	0	0	0	0	1
609:	0	1	0	0	1	1	0	0
617:	1	0	1	0	0	1	0	0
625:	0	0	1	0	0	0	0	0
633:	0	0	2	0	0	0	0	0
641:	3	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	1	0	0
665:	0	0	1	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	2	0	1	0	0	0	0
689:	0	0	0	0	2	0	1	0
697:	0	0	0	0	0	0	0	1
705:	0	0	0	0	0	1	0	0
713:	0	0	0	0	0	0	0	1
721:	0	0	0	0	0	1	0	1
729:	0	0	0	0	0	0	0	0
737:	1	0	0	0	0	0	1	1
745:	0	1	1	0	0	0	0	0
753:	0	0	0	0	0	0	1	0
761:	1	0	1	0	0	0	0	0
769:	0	0	0	0	0	0	1	0
777:	0	0	0	0	1	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 05

Channel								
809:	1	0	0	0	0	0	0	0
817:	0	0	0	1	0	1	1	0
825:	0	1	0	0	0	0	0	0
833:	1	0	0	0	0	1	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	1	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	1
921:	0	0	1	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	1
945:	0	0	1	0	0	0	0	0
953:	0	0	1	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

C
10/25

Sample Description: WLL20131008F1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 06
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_013
Chamber Serial Number:
Detector Serial Number: 13
Env. Background: System Bkgd 70357
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.840E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:25 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9177 +/- 0.0000
Counting Efficiency: 0.1869 +/- 0.0035 on 12/15/2012 11:26:45 AM
Effective Efficiency: 0.1715 +/- 0.0032

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

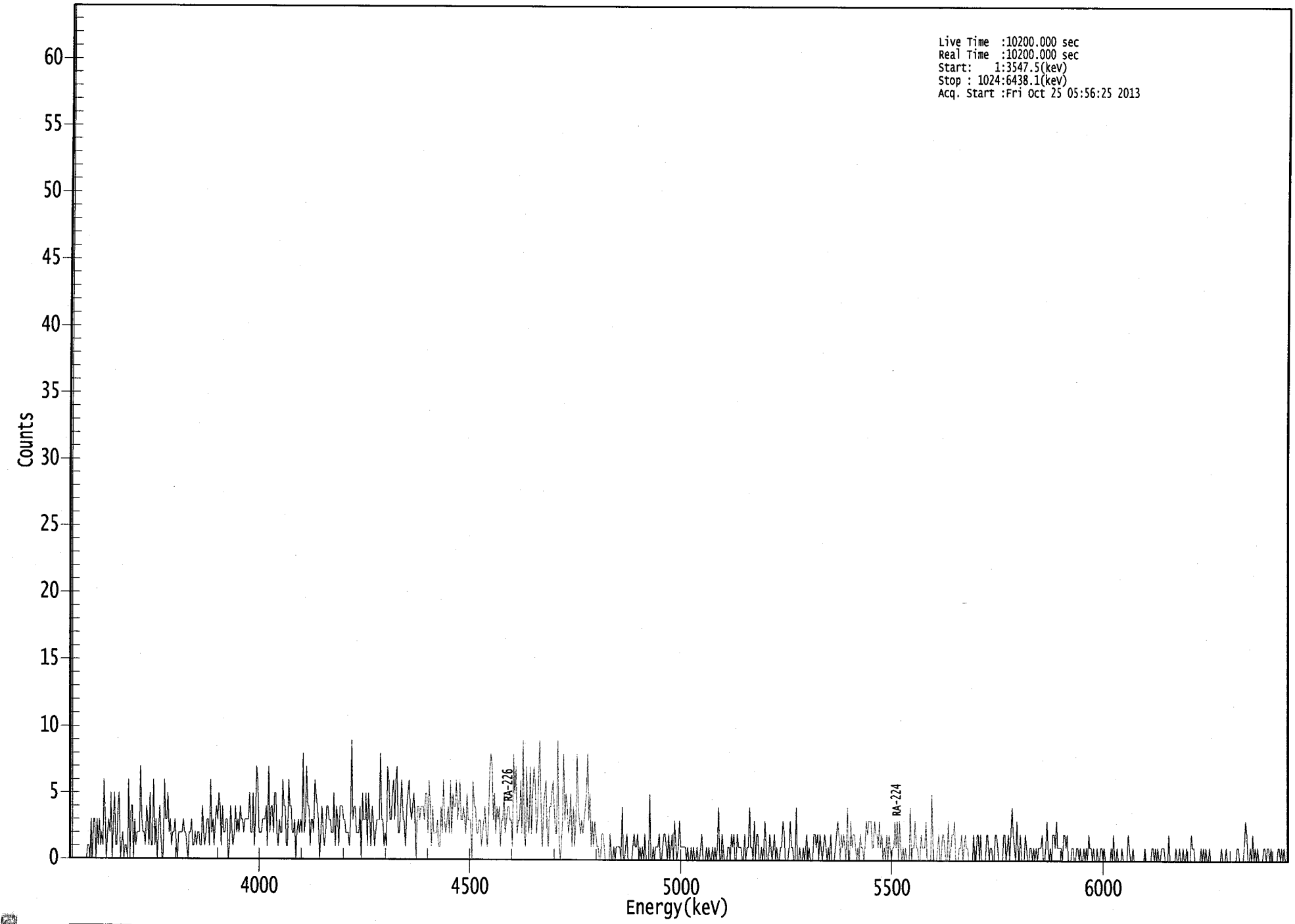
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.513	130.26	17.46	3.74	0.00E+000	3.2
RA-226	4.594	552.30	8.36	1.70	0.00E+000	3.6

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.962	5685.50*	6.04E+000 +/- 1.08E+000	4.45E-001 +/- 1.61E-002
RA-226	0.953	4785.00*	2.42E+001 +/- 2.21E+000	3.22E-001 +/- 1.17E-002

AG
10/25/13

0000071992.CNF



ROI Type: 1

0266

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 06

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	1
17:	1	0	3	0	3	3	0	3
25:	1	3	1	2	1	6	3	0
33:	2	3	2	5	0	3	5	1
41:	1	4	5	0	1	2	0	1
49:	1	0	6	0	4	4	0	3
57:	1	2	2	2	7	3	2	2
65:	1	4	3	1	5	1	1	6
73:	1	3	0	2	4	2	0	0
81:	6	3	3	5	2	3	1	2
89:	2	3	1	0	2	2	2	2
97:	3	2	2	1	0	2	2	3
105:	1	1	2	1	2	2	1	1
113:	4	2	1	2	3	3	1	6
121:	2	3	1	3	4	3	5	4
129:	1	4	2	2	3	3	0	1
137:	4	2	1	2	4	2	3	2
145:	4	3	3	2	3	3	3	3
153:	5	2	2	5	1	3	7	6
161:	2	2	2	3	3	3	4	1
169:	7	2	4	4	2	5	5	2
177:	1	3	2	2	6	4	4	1
185:	1	6	4	4	2	2	3	0
193:	2	3	2	3	2	8	2	3
201:	7	4	4	1	3	3	2	6
209:	5	4	3	0	2	4	2	1
217:	2	4	4	3	3	2	2	5
225:	1	4	3	1	4	4	4	3
233:	3	2	2	2	1	3	9	3
241:	4	4	2	2	2	4	0	5
249:	3	3	5	1	5	3	1	4
257:	3	1	2	3	3	3	8	3
265:	3	1	2	1	7	6	3	3
273:	5	6	3	6	7	2	2	4
281:	6	3	3	1	4	5	6	4
289:	3	4	5	3	0	4	4	3
297:	4	4	4	3	5	5	2	6
305:	4	1	4	2	2	2	3	1
313:	1	4	2	6	3	2	3	4
321:	2	6	2	5	4	4	6	3
329:	4	6	3	3	4	3	2	5
337:	3	3	3	0	6	4	4	2
345:	2	3	3	1	2	3	4	2
353:	1	3	7	8	7	3	5	2
361:	4	3	4	1	3	3	5	2

369:	3	4	4	3	3	1	8	5

Sample Title: 06

Channel								
377:	7	2	3	3	6	2	9	2
385:	1	7	3	2	7	2	5	7
393:	6	2	3	7	9	3	1	4
401:	5	6	2	1	4	4	5	6
409:	4	2	2	9	2	0	1	3
417:	8	3	5	4	2	3	5	1
425:	4	1	3	8	4	3	2	3
433:	2	3	4	5	8	3	5	1
441:	3	1	3	2	1	1	0	0
449:	2	2	1	0	0	0	0	2
457:	0	0	1	0	1	1	1	1
465:	0	4	0	0	1	2	0	0
473:	0	0	1	2	1	1	2	0
481:	1	0	1	0	2	0	0	0
489:	5	0	0	1	0	1	1	1
497:	2	0	0	1	2	2	1	0
505:	2	0	1	2	0	3	1	0
513:	1	3	1	1	1	1	1	0
521:	1	0	0	1	0	1	0	0
529:	1	0	0	1	2	0	0	0
537:	1	0	1	0	0	1	0	1
545:	0	1	4	0	0	2	1	0
553:	0	0	1	1	0	2	1	2
561:	0	0	2	1	1	1	0	0
569:	2	0	1	1	4	1	1	0
577:	3	0	2	2	0	0	1	0
585:	1	3	1	0	0	2	1	0
593:	1	2	0	1	0	0	1	1
601:	3	2	0	0	0	1	3	1
609:	1	0	0	4	0	0	1	0
617:	0	1	0	1	2	0	1	0
625:	0	0	2	2	1	2	0	2
633:	1	0	1	2	1	0	1	0
641:	2	0	0	0	1	2	3	2
649:	0	2	1	2	1	0	4	0
657:	0	3	1	2	2	1	0	1
665:	0	2	1	1	0	1	3	2
673:	3	3	3	1	1	3	2	2
681:	1	3	1	2	0	1	0	2
689:	0	2	1	0	1	1	3	1
697:	3	0	3	1	0	1	0	1
705:	0	0	0	4	0	1	1	3
713:	1	1	0	0	2	1	1	1
721:	3	0	0	0	0	5	1	0
729:	0	0	1	2	0	0	2	2
737:	1	0	0	3	0	1	2	2
745:	3	0	0	0	1	1	2	0
753:	1	2	1	1	0	0	0	0
761:	2	0	0	2	2	0	2	0
769:	0	0	0	2	2	0	1	1
777:	0	0	2	2	1	0	0	0
785:	0	2	2	0	1	2	0	2
793:	4	2	1	0	3	1	0	2

801:	0	0	0	2	1	0	0	1

Sample Title: 06

Channel								
809:	1	0	1	0	1	0	1	1
817:	1	2	0	0	1	3	1	0
825:	1	0	2	2	1	3	1	1
833:	1	1	0	2	2	1	2	0
841:	0	0	1	1	0	0	1	1
849:	0	1	0	0	1	0	1	0
857:	2	1	1	0	1	0	0	1
865:	0	0	1	1	0	1	0	0
873:	0	0	0	1	0	2	0	0
881:	1	0	0	0	1	0	0	0
889:	0	2	1	0	0	1	0	0
897:	0	0	0	0	0	0	0	1
905:	0	0	0	0	0	1	1	0
913:	1	0	1	0	0	1	1	1
921:	0	0	0	2	0	0	0	0
929:	0	1	0	0	1	0	0	1
937:	0	0	1	0	0	0	2	1
945:	1	0	0	0	0	0	1	0
953:	1	0	1	0	0	1	0	0
961:	0	0	0	0	0	0	0	1
969:	0	0	0	1	0	0	0	0
977:	0	0	0	0	1	1	0	0
985:	0	0	1	3	2	0	0	1
993:	0	2	0	1	0	1	0	0
1001:	0	0	1	1	0	1	1	0
1009:	1	0	0	0	0	0	1	1
1017:	0	1	0	1	0	0	0	0

Apex-Alpha™

C 10/25

Sample Description: WLL20131008F2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 07
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_014
Chamber Serial Number:
Detector Serial Number: 14
Env. Background: System Bkgd 70358
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.790E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:26 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9379 +/- 0.0000
Counting Efficiency: 0.1846 +/- 0.0034 on 12/15/2012 11:26:44 AM
Effective Efficiency: 0.1731 +/- 0.0032

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

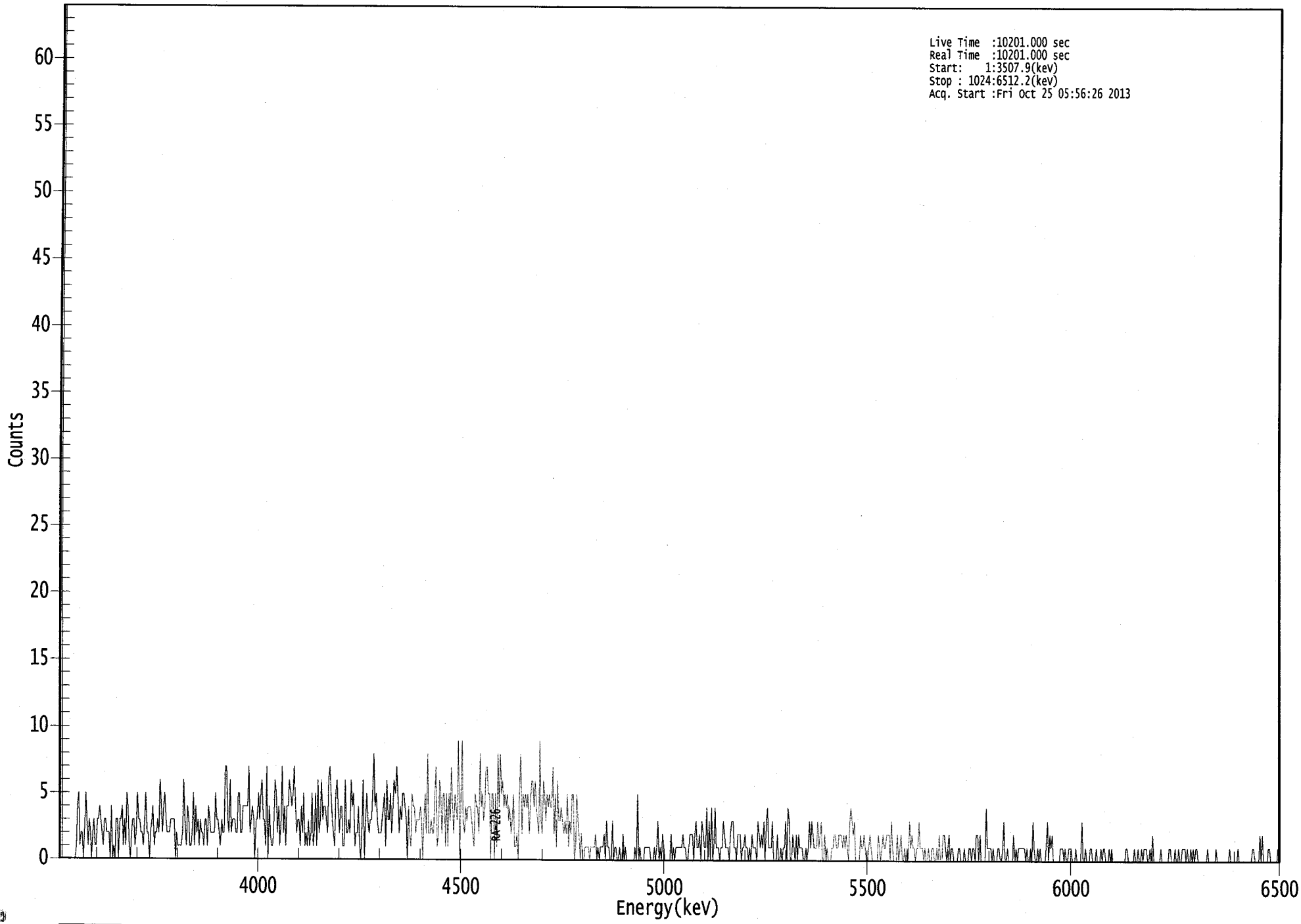
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.515	108.92	19.19	4.08	0.00E+000	9.8
RA-226	4.588	553.11	8.36	2.89	0.00E+000	3.7

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.963	5685.50*	4.92E+000 +/- 9.61E-001	4.47E-001 +/- 1.63E-002
RA-226	0.951	4785.00*	2.36E+001 +/- 2.15E+000	3.74E-001 +/- 1.36E-002

AG
10/25/13

0000071993.CNF



****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 07

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	0	0	0	0	1	4
17:	5	1	2	2	0	2	5	3
25:	1	3	2	0	2	3	1	1
33:	3	3	4	3	2	1	3	3
41:	2	2	2	0	4	0	1	0
49:	3	3	0	3	3	4	1	3
57:	1	5	4	1	0	2	3	3
65:	1	2	5	3	3	2	2	1
73:	3	5	2	2	0	2	3	4
81:	1	2	2	3	2	6	4	2
89:	4	5	3	2	2	2	3	3
97:	3	3	0	2	1	1	1	1
105:	2	6	3	1	4	3	1	1
113:	2	5	1	4	2	3	1	3
121:	2	2	1	3	3	1	4	3
129:	2	2	2	2	5	3	3	2
137:	1	3	2	2	7	7	3	2
145:	6	2	3	3	3	2	2	5
153:	5	2	2	4	4	4	4	4
161:	7	2	3	4	3	0	3	3
169:	5	3	5	6	3	3	1	7
177:	0	4	2	1	1	3	6	5
185:	2	4	1	3	7	2	4	1
193:	4	4	6	5	4	5	7	4
201:	2	3	3	1	4	2	5	1
209:	2	1	3	1	2	5	1	2
217:	5	1	6	2	3	6	3	4
225:	4	3	2	6	7	5	3	2
233:	1	5	6	4	2	4	4	1
241:	1	6	2	2	3	2	6	4
249:	5	1	2	2	4	1	0	3
257:	6	0	3	5	3	2	3	3
265:	5	8	4	5	3	2	2	2
273:	3	4	5	1	6	3	3	5
281:	2	4	6	5	7	5	2	4
289:	3	5	5	4	3	0	4	2
297:	1	5	4	4	2	3	3	3
305:	4	3	0	3	5	2	8	2
313:	2	3	2	2	5	7	1	2
321:	6	5	2	5	5	1	5	1
329:	5	3	7	4	2	5	4	3
337:	9	0	4	9	3	2	4	3
345:	4	4	4	3	2	1	5	4
353:	4	2	8	4	5	3	4	7
361:	7	5	5	0	5	5	0	5

369:	1	8	4	8	5	6	4	5

Sample Title: 07

Channel								
377:	4	5	3	4	2	3	5	1
385:	1	2	0	5	8	2	5	4
393:	5	4	5	2	4	6	6	4
401:	6	4	3	2	9	3	2	6
409:	5	3	5	4	5	4	4	7
417:	2	5	1	6	3	3	4	3
425:	2	3	2	5	1	3	2	5
433:	5	0	1	5	3	2	0	2
441:	0	0	1	1	1	1	0	1
449:	1	1	1	2	0	1	0	1
457:	1	1	2	0	3	1	1	0
465:	0	3	0	1	1	0	0	1
473:	0	0	2	0	1	0	0	0
481:	0	0	0	0	1	0	5	0
489:	1	0	0	0	1	1	1	1
497:	1	0	0	0	1	0	1	3
505:	0	1	0	2	1	0	0	0
513:	0	0	2	0	1	0	1	1
521:	1	1	1	1	2	1	1	0
529:	0	1	2	2	2	0	2	3
537:	1	1	2	0	3	2	1	1
545:	4	0	3	0	4	0	1	4
553:	1	1	1	0	1	1	3	2
561:	1	1	1	0	2	3	3	1
569:	1	0	2	2	2	0	1	1
577:	2	1	1	0	1	0	2	1
585:	1	1	0	3	2	1	2	1
593:	3	0	3	4	1	1	1	3
601:	0	0	0	2	0	0	1	0
609:	1	1	3	0	4	3	0	0
617:	2	1	0	2	0	2	1	1
625:	1	0	0	1	0	1	3	1
633:	3	2	1	1	1	3	1	2
641:	3	0	0	2	0	1	0	0
649:	0	1	1	2	2	1	1	2
657:	2	2	1	2	1	2	1	0
665:	3	4	3	2	3	0	0	0
673:	0	2	1	1	2	1	0	0
681:	1	2	1	0	0	0	0	0
689:	2	1	0	1	2	1	1	2
697:	2	2	0	3	1	0	0	0
705:	2	0	1	2	0	0	1	0
713:	1	0	3	1	2	1	1	0
721:	1	1	3	1	1	1	0	1
729:	0	0	1	0	0	1	1	0
737:	0	1	0	2	0	0	2	2
745:	1	0	1	2	0	1	1	0
753:	0	0	0	1	1	0	0	0
761:	1	0	0	0	1	1	0	1
769:	1	0	2	2	0	2	0	0
777:	0	0	4	1	1	1	1	0
785:	1	0	0	0	1	1	0	0
793:	1	3	0	0	1	0	0	0

801:	0	2	0	1	0	1	1	1

Sample Title: 07

Channel								
809:	1	1	1	0	1	0	0	1
817:	0	3	1	0	0	1	0	1
825:	0	0	0	0	1	3	0	2
833:	1	2	0	0	0	0	0	0
841:	1	1	1	0	1	0	0	1
849:	1	1	0	0	0	1	0	0
857:	0	0	3	0	0	1	0	0
865:	0	1	1	0	0	0	1	0
873:	0	0	1	0	1	1	0	0
881:	0	1	0	1	0	0	0	0
889:	0	0	0	0	0	0	0	1
897:	1	0	0	0	0	0	1	0
905:	0	1	0	0	1	0	1	1
913:	1	0	0	1	0	2	0	0
921:	0	0	0	0	1	0	0	0
929:	0	0	0	1	1	0	0	0
937:	1	0	0	1	0	0	1	1
945:	1	0	1	0	0	1	0	1
953:	0	1	1	0	0	0	0	0
961:	0	0	0	1	0	0	0	0
969:	0	0	1	0	0	0	0	0
977:	0	0	0	0	0	1	0	0
985:	0	0	0	0	1	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	1	1	0	0	0	0	2	0
1009:	2	0	0	0	0	1	1	0
1017:	0	0	0	0	0	1	0	1

Apex-Alpha™

Sample Description: WLL20131008K1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 08
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_015
Chamber Serial Number:
Detector Serial Number: 15
Env. Background: System Bkgd 70359
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.870E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:27 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9015 +/- 0.0000
Counting Efficiency: 0.1477 +/- 0.0027 on 7/20/2013 6:27:27 PM
Effective Efficiency: 0.1332 +/- 0.0024

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

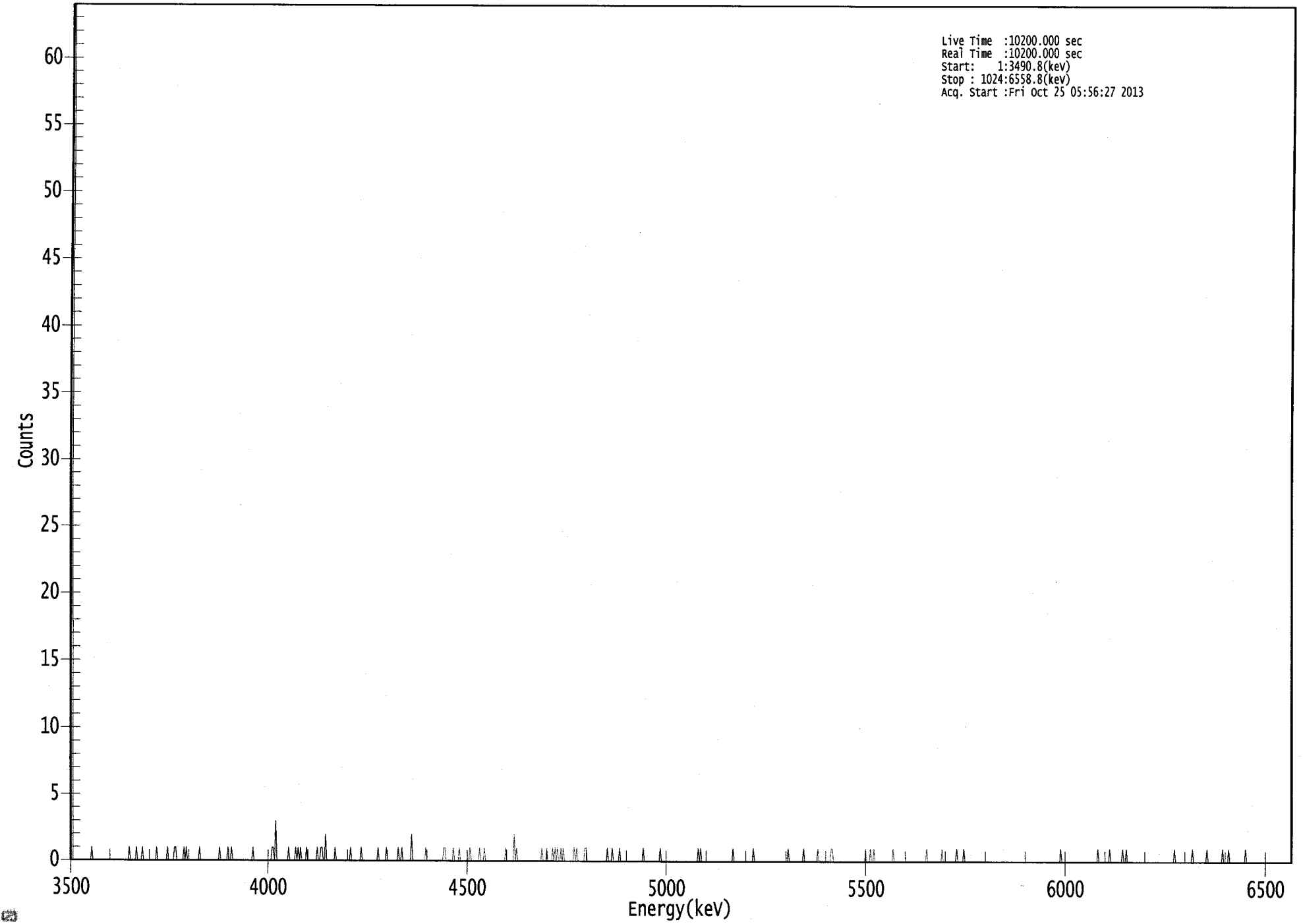
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.508	8.66	68.12	0.34	0.00E+000	3.0
RA-226	4.618	22.66	41.53	0.34	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.960	5685.50*	5.23E-001 +/- 3.57E-001	2.89E-001 +/- 1.02E-002
RA-226	0.964	4785.00*	1.29E+000 +/- 5.39E-001	2.73E-001 +/- 9.64E-003

AG
10/25/13

0000071996.CNF



ROI Type: 1

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 08

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	1	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	1	0	0	0	0	0
57:	1	0	0	0	0	1	0	0
65:	0	0	0	0	0	0	0	0
73:	0	1	0	0	0	0	0	0
81:	0	0	1	0	0	0	0	0
89:	1	1	0	0	0	0	0	0
97:	1	0	1	0	0	0	0	0
105:	0	0	0	0	0	1	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	1	0
129:	0	0	0	0	0	1	0	0
137:	1	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	1	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	1	1	0	3	0	0
177:	0	0	0	0	0	0	0	0
185:	1	0	0	0	0	0	1	0
193:	1	0	1	0	0	0	0	1
201:	0	0	0	0	0	0	0	0
209:	1	0	0	1	1	0	0	2
217:	0	0	0	0	0	0	0	1
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	1	0	0	0
241:	0	0	0	0	0	1	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	1	0	0	0	0
265:	0	0	1	0	0	0	0	0
273:	0	0	0	0	1	0	0	1
281:	0	0	0	0	0	0	0	2
289:	0	0	0	0	0	0	0	0
297:	0	0	0	1	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	1	1	0	0	0	0
321:	0	0	1	0	0	0	0	1
329:	0	0	0	0	0	0	0	0
337:	1	0	0	0	0	0	0	0
345:	1	0	0	0	1	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	1	0

369:	0	0	0	0	0	2	0	1

Sample Title: 08

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	1	0	0	0
401:	1	0	0	0	0	1	0	1
409:	0	1	0	0	1	0	1	0
417:	0	0	0	0	0	0	0	1
425:	0	1	0	0	0	0	0	0
433:	1	1	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	1	0	0	0	1
457:	0	0	0	0	0	1	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	1	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	1
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	1
529:	0	1	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	1	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	1	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	1	0	0	0	0	0
609:	0	0	0	0	0	0	0	1
617:	0	0	0	0	0	0	0	0
625:	0	0	0	1	0	0	0	0
633:	0	0	0	0	0	0	1	1
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	1	0	0	0	1
673:	0	0	1	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	1	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	1	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	1	0	0	0	0
737:	0	0	0	0	0	0	0	1
745:	0	0	0	0	0	1	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 08

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	1	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	1	0	0
865:	0	0	0	0	0	0	0	1
873:	0	0	0	0	0	0	0	0
881:	0	0	1	0	0	1	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	1	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	1	0	0	0
945:	0	0	0	0	0	0	0	0
953:	1	0	0	0	0	0	0	0
961:	0	0	0	0	0	1	0	0
969:	0	0	1	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	1	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

C 10/25

Sample Description: WLL201310008K2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 09
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_019
Chamber Serial Number:
Detector Serial Number: 19
Env. Background: System Bkgd 70360
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.910E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:28 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8595 +/- 0.0000
Counting Efficiency: 0.1659 +/- 0.0029 on 2/17/2013 10:45:23 AM
Effective Efficiency: 0.1426 +/- 0.0025

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

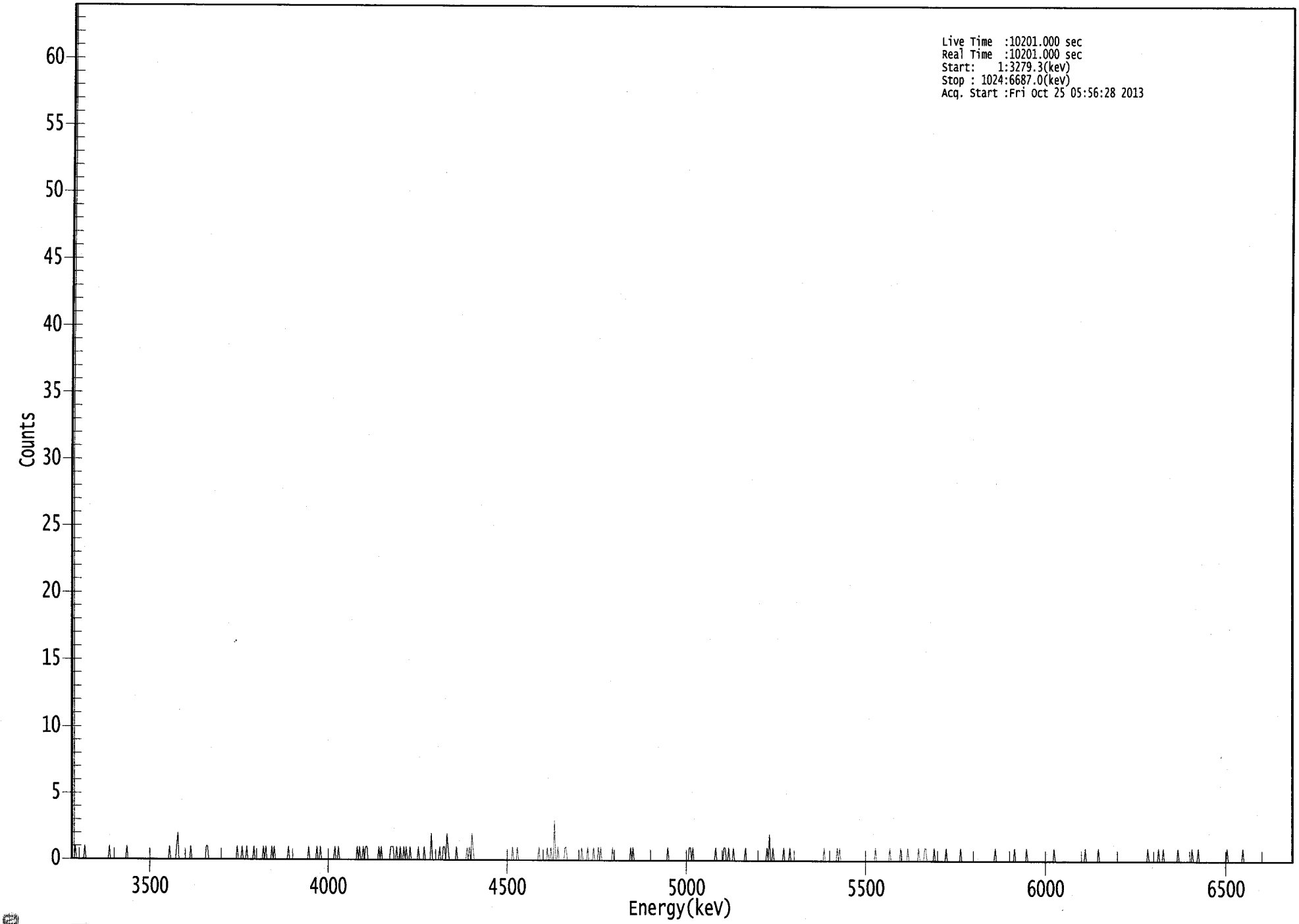
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.552	8.64	72.56	1.36	0.00E+000	3.3
RA-226	4.600	21.83	42.14	0.17	0.00E+000	3.3

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.977	5685.50*	4.94E-001 +/- 3.59E-001	3.92E-001 +/- 1.36E-002
RA-226	0.956	4785.00*	1.18E+000 +/- 4.99E-001	2.26E-001 +/- 7.83E-003

AG
10/25/13

0000071997.CNF



ROI Type: 1

0281

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 09

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	1	0	0	0	0
9:	0	0	0	1	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	1	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	1
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	1	0	0	0	0
89:	0	1	2	0	0	0	0	0
97:	0	0	0	0	0	1	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	1	1	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	1	0	0	0
145:	1	0	0	0	1	0	0	0
153:	0	0	1	0	0	0	0	0
161:	0	0	1	0	1	0	0	0
169:	0	1	0	1	0	0	0	0
177:	0	0	0	0	0	0	0	1
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	1	0	0	0	0	0	0	1
209:	0	0	1	0	0	0	0	0
217:	0	0	0	0	0	0	1	0
225:	0	1	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	1	0	1	0	0	1	0
249:	1	1	0	0	0	0	0	0
257:	0	0	0	1	0	1	0	0
265:	0	0	0	0	0	1	1	1
273:	0	0	1	0	0	1	0	0
281:	1	0	1	0	0	1	0	0
289:	0	0	0	0	1	0	0	0
297:	0	1	0	0	0	0	0	2
305:	0	0	0	0	0	0	1	0
313:	0	1	1	0	2	1	0	0
321:	0	0	0	0	1	0	0	0
329:	0	0	0	0	0	1	0	1
337:	0	2	1	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	1	0	0	0	1

Sample Title: 09

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	1	0	0	0	0	0	0
401:	1	0	0	1	0	0	3	0
409:	0	1	0	0	0	0	0	1
417:	1	0	0	0	0	0	0	0
425:	0	0	0	0	0	1	0	0
433:	0	0	1	0	0	0	0	1
441:	0	0	0	1	0	1	0	0
449:	0	0	0	0	0	0	0	1
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	1	0
473:	1	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	1	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	1
521:	1	0	1	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	1	0	0
545:	0	0	0	0	1	1	0	0
553:	1	0	0	0	1	0	0	0
561:	0	0	0	0	0	0	1	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	1	0	2	0	0	1	0	0
593:	0	0	0	0	0	0	1	0
601:	0	0	0	1	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	1	0	0	0	0	0	0	0
641:	0	0	0	1	0	1	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	1	0	0	0	0
681:	0	0	0	0	0	0	0	1
689:	0	0	0	0	0	0	0	0
697:	1	0	0	0	0	0	1	0
705:	0	0	0	0	0	0	0	1
713:	0	0	0	0	1	1	0	0
721:	0	0	0	0	1	0	0	0
729:	0	0	0	0	0	0	1	0
737:	0	0	0	0	0	0	0	0
745:	0	0	1	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	1
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	1
793:	0	0	0	0	0	0	0	0

801:	0	1	0	0	0	0	0	0

Sample Title: 09

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	1	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	1	0	0	0	0	0
857:	0	0	0	0	0	1	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	1	0
905:	0	0	0	0	0	0	0	1
913:	0	0	0	1	0	0	0	0
921:	0	0	0	0	0	0	0	1
929:	0	0	0	0	0	0	0	0
937:	0	0	0	1	0	0	0	0
945:	1	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	1	0	0	0	0	0	0	0
977:	0	0	0	0	0	1	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

C
10/25

Sample Description: WLL20131009L1
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 10
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_022
Chamber Serial Number:
Detector Serial Number: 22
Env. Background: System Bkgd 70361
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 1.660E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/9/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:29 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.3724 +/- 0.0000
Counting Efficiency: 0.1531 +/- 0.0029 on 12/15/2012 1:57:26 PM
Effective Efficiency: 0.0570 +/- 0.0011

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.485	19.30	46.86	1.70	0.00E+000	3.1
RA-226	4.606	28.81	37.39	1.19	0.00E+000	4.7

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.949	5685.50*	1.57E+000 +/- 7.40E-001	5.99E-001 +/- 2.24E-002
RA-226	0.959	4785.00*	2.22E+000 +/- 8.35E-001	5.08E-001 +/- 1.90E-002

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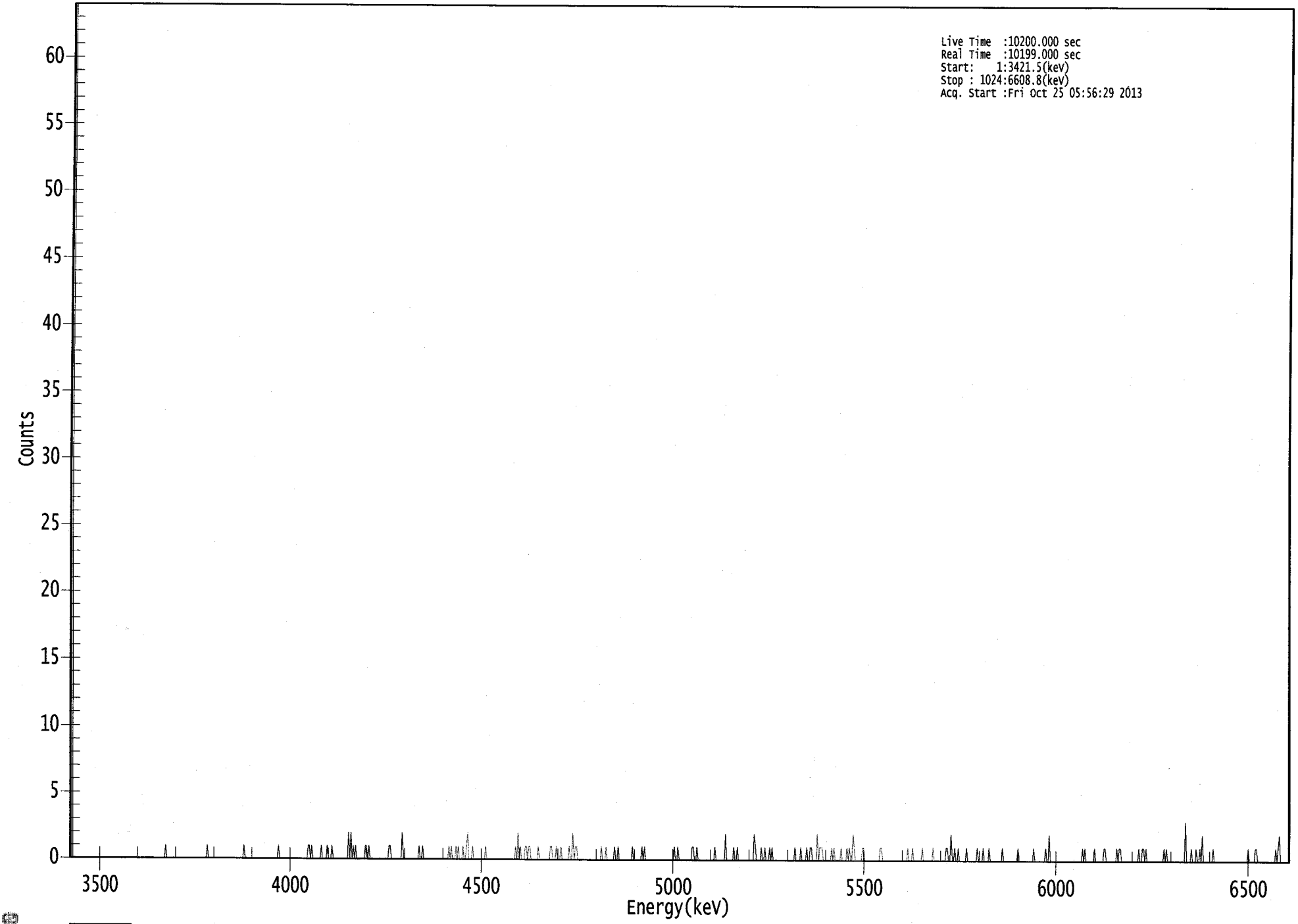
0000071998.CNF



ROI Type: 1

0286

****
***** S P E C T R A L D A T A R E P O R T *****
****

Sample Title: 10

Elapsed Live time: 10200
Elapsed Real Time: 10199

Channel								
1:	10199	10200	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	1	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	1	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	1	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	1	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	1	1	0	1	0	0	0
209:	0	0	0	0	1	0	0	0
217:	0	1	0	0	0	1	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	2	0	2	0	1
241:	0	1	0	0	0	0	0	0
249:	0	1	1	0	1	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	1	1	0
273:	0	0	0	0	0	0	0	0
281:	2	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	1	0
297:	0	1	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	1
321:	0	1	0	0	0	1	0	1
329:	0	0	0	1	0	0	1	2
337:	0	0	0	1	0	0	0	0
345:	0	0	0	0	0	0	1	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	1

Sample Title: 10

Channel								
377:	0	2	0	1	0	0	0	1
385:	1	0	1	1	0	0	0	0
393:	0	0	1	0	0	0	0	0
401:	0	0	0	0	1	1	0	0
409:	0	1	0	0	0	1	0	0
417:	0	0	0	0	1	0	0	2
425:	0	1	1	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	1
449:	0	0	0	1	0	0	0	0
457:	0	0	1	0	0	1	0	0
465:	0	0	0	0	0	0	0	0
473:	0	1	0	0	0	0	0	0
481:	0	1	0	1	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	1	0	0	1
513:	0	0	0	0	0	0	0	0
521:	0	0	0	1	1	0	0	1
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	1	0
545:	0	0	0	0	0	0	0	2
553:	0	0	0	0	0	0	1	0
561:	0	1	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	2
577:	1	0	0	0	0	1	0	0
585:	1	0	0	0	1	0	1	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	1	0	0	0	0	1	0
617:	0	0	0	1	0	0	1	1
625:	0	0	0	0	2	0	1	1
633:	1	0	0	0	0	0	0	0
641:	1	0	1	0	0	0	0	0
649:	1	0	0	0	0	1	0	1
657:	0	0	2	1	0	0	0	0
665:	0	0	1	1	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	1	1	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	1	0	0	0	1	0	0	0
713:	0	0	0	0	1	0	0	0
721:	0	0	0	0	0	1	0	0
729:	0	0	0	0	0	0	0	0
737:	1	1	0	0	2	0	0	1
745:	0	0	1	0	0	0	0	0
753:	0	1	0	0	0	0	0	0
761:	0	0	1	0	0	0	0	1
769:	0	0	0	0	1	0	0	0
777:	0	0	0	0	0	0	0	1
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	1	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 10

Channel								
809:	0	1	0	0	0	0	0	0
817:	0	0	0	1	0	0	2	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	1	0	1	0	0	0
857:	0	0	0	0	1	0	0	0
865:	0	0	0	0	1	1	0	0
873:	0	0	0	0	0	0	0	1
881:	0	1	1	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	1	0	0	1	1	0	1
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	1	0
921:	1	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	3	0	0	0	0	1	0	0
945:	0	1	0	0	1	0	2	0
953:	0	0	0	0	0	0	0	1
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	1	0	0	0
993:	0	0	1	1	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	1	0	1	2	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

Sample Description: WLL201310009L2
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00000719
Batch Identification: 1310043A-RA
Sample Identification: 11
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_024
Chamber Serial Number:
Detector Serial Number: 24
Env. Background: System Bkgd 70362
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.400E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/9/2013 5:27:33 AM
Acquisition Date/Time: 10/25/2013 5:56:30 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.5920 +/- 0.0000
Counting Efficiency: 0.1710 +/- 0.0032 on 12/15/2012 2:02:15 PM
Effective Efficiency: 0.1012 +/- 0.0019

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.493	8.11	81.93	2.89	0.00E+000	3.1
RA-226	4.605	25.62	40.77	2.38	0.00E+000	3.1

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.953	5685.50*	5.38E-001 +/- 4.42E-001	5.81E-001 +/- 2.13E-002
RA-226	0.959	4785.00*	1.61E+000 +/- 6.59E-001	5.15E-001 +/- 1.89E-002

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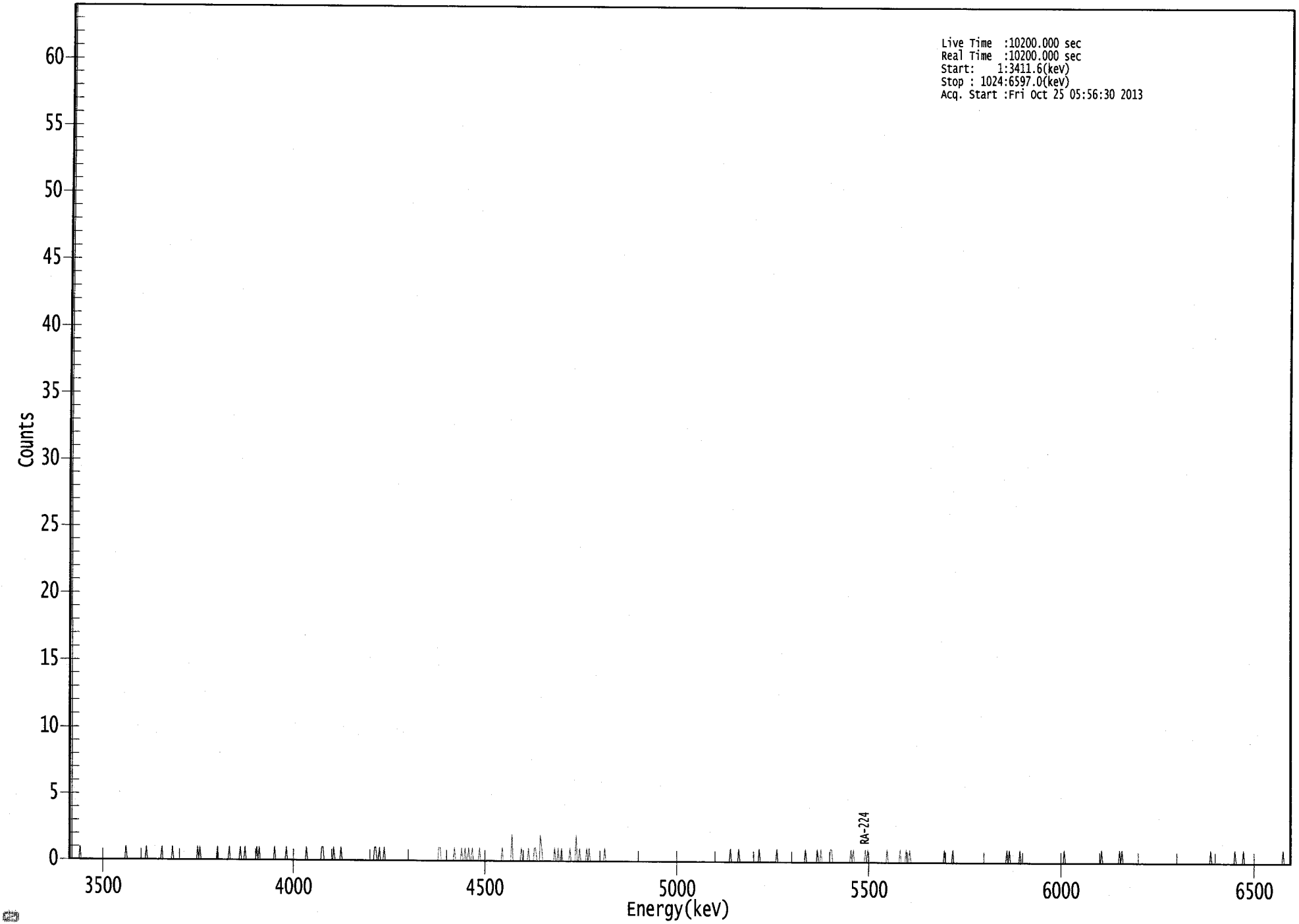
10/25/13

0290

0000071999.CNF



ROI Type: 1

```
*****************************************************
*****   S P E C T R A L   D A T A   R E P O R T   *****
*****************************************************
```

Sample Title: 11

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	10200	10200	0	0	0	0	0	0
9:	0	1	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	1	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	1	0	0	0	0	0	0
73:	0	0	0	0	0	0	1	0
81:	0	0	0	0	0	0	0	1
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	1	0	1	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	1	0	0
129:	0	0	0	0	0	0	0	1
137:	0	0	0	0	0	0	0	0
145:	1	0	0	0	1	0	0	0
153:	0	0	0	0	0	0	1	0
161:	1	0	0	0	0	0	0	0
169:	0	0	0	0	0	1	0	0
177:	0	0	0	0	0	0	0	1
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	1	0	0	0	0	0	0	0
209:	0	0	0	0	0	1	1	0
217:	0	0	0	0	0	0	0	1
225:	0	0	0	0	0	1	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	1	1	0	0	1	0	0
265:	0	1	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	1
313:	1	0	0	0	0	0	0	0
321:	0	0	0	0	1	0	0	0
329:	0	0	1	0	0	1	0	0
337:	1	0	0	1	0	0	0	0
345:	0	1	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	1	0	0	0

369:	0	0	0	0	2	0	0	0

Sample Title: 11

Channel								
377:	0	0	0	0	1	0	0	0
385:	0	0	1	0	0	0	0	1
393:	1	0	0	0	2	1	0	0
401:	0	0	0	0	0	0	0	0
409:	1	0	0	1	0	0	1	0
417:	0	0	0	0	0	1	0	0
425:	0	0	2	0	0	1	0	0
433:	0	0	0	1	0	1	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	1	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	1	0	0	0	0
561:	0	0	1	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	1	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	1	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	1	0	0	0	0	0
625:	0	0	0	0	1	0	0	1
633:	0	0	0	0	0	0	0	1
641:	1	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	1	0	1	0	0	0	0	0
665:	0	0	0	0	1	0	1	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	1	0
689:	0	0	0	0	0	0	0	0
697:	0	1	0	0	0	0	1	0
705:	0	1	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	1	0
737:	0	0	0	0	0	1	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	1	0	1	0	0	0
793:	0	0	0	0	0	1	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 11

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	1	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	1	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	1	0	1	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	0	0
953:	0	0	0	0	1	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	1	0	0	0	0	0	0	1
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	1	0	0	0	0	0	0	0

10/25/2013 6:05:02 AM

Apex-Alpha™

QA SUMMARY REPORT
Review Of QA Results - Pulser Check

Date : 10/25/2013
Time : 6:05:02 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_001	21f	ALL	Not Done	
Alpha_002	21f	ALL	Not Done	
Alpha_003	21f	ALL	Passed	10/25/2013 5:22:24 AM
Alpha_004	21f	ALL	Passed	10/25/2013 5:22:25 AM
Alpha_005	21f	ALL	Not Done	
Alpha_006	21f	ALL	Not Done	
Alpha_007	21f	ALL	Not Done	
Alpha_008	21f	ALL	Not Done	
Alpha_009	21f	ALL	Not Done	
Alpha_010	21f	ALL	Passed	10/25/2013 5:22:26 AM
Alpha_011	21f	ALL	Passed	10/25/2013 5:22:27 AM
Alpha_012	21f	ALL	Passed	10/25/2013 5:22:28 AM
Alpha_013	21f	ALL	Passed	10/25/2013 5:22:28 AM
Alpha_014	21f	ALL	Passed	10/25/2013 5:22:29 AM
Alpha_015	21f	Peak Energy	Action	10/25/2013 5:22:30 AM
Alpha_016	21f	ALL	Not Done	
Alpha_017	AIM730	ALL	Not Done	
Alpha_018	AIM730	ALL	Not Done	
Alpha_019	AIM730	ALL	Passed	10/25/2013 5:22:31 AM
Alpha_020	AIM730	ALL	Not Done	
Alpha_021	AIM730	ALL	Not Done	
Alpha_022	AIM730	ALL	Passed	10/25/2013 5:22:32 AM
Alpha_023	AIM730	ALL	Not Done	
Alpha_024	AIM730	ALL	Passed	10/25/2013 5:22:33 AM
Alpha_025	AIM730	ALL	Passed	10/25/2013 5:22:33 AM
Alpha_026	AIM730	ALL	Not Done	
Alpha_027	AIM730	ALL	Passed	10/25/2013 5:22:34 AM
Alpha_028	AIM730	ALL	Not Done	
Alpha_029	AIM730	ALL	Passed	10/25/2013 5:22:35 AM
Alpha_030	AIM730	ALL	Not Done	
Alpha_031	AIM730	ALL	Not Done	
Alpha_032	AIM730	ALL	Not Done	
Alpha_033	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:36 AM
Alpha_034	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:38 AM
Alpha_035	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:39 AM
Alpha_036	Alpha Analyst100DC	ALL	Not Done	
Alpha_037	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:41 AM
Alpha_038	Alpha Analyst100DC	Peak Energy	Action	10/18/2013 6:33:11 AM
Alpha_039	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:43 AM
Alpha_040	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:45 AM
Alpha_041	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:46 AM
Alpha_042	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:49 AM

Review of QA Results - Pulser Check

10/25/2013 6:05:02 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_043	Alpha Analyst100DC	ALL	Passed	10/24/2013 5:08:06 AM
Alpha_044	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:54 AM
Alpha_045	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:57 AM
Alpha_046	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:22:59 AM
Alpha_047	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:23:02 AM
Alpha_048	Alpha Analyst100DC	ALL	Passed	10/25/2013 5:23:05 AM

APPROVED BY: _____

APPROVAL DATE: 10/25/13

****
***** L I B R A R Y L I S T I N G R E P O R T *****
****

Nuclide Library Title: Radium

Nuclide Library Description: Ra-226, Po-218, Rn-222

Nuclide Name	Half-Life (Seconds)	Energy (keV)	Energy Uncert. (keV)	Yield (%)	Yield Uncert.(Abs.+-)
PO-218	5.049E+010	6003.000*	0.000	99.9800	0.0000
RN-222	5.049E+010	5490.000*	0.000	99.9200	0.0000
RA-226	5.049E+010	4785.000*	0.000	100.0000	0.0000

* = key line

TOTALS: 3 Nuclides 3 Energy Lines

SECTION XI

ANALYTICAL DATA (RADIUM-228)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

13-10043
Ra228
Run 1

Work Order	13-10043
Analysis Code	Ra228
Run	1
Date Received	10/10/2013
Lab Deadline	10/31/2013
Client	Missouri Dept. of Natural Resources
Project	C310163001
Report Level	4
Activity Units	pCi
Aliquot Units	l
Matrix	WA
Method	EPA 904.0 Modified
Instrument Type	Alpha/Beta GPC
Radiometric Tracer	Ba-133
Radiometric Sol#	Ba-6a
Tracer Act (dpm/g)	977.397
Carrier	Yttirum
Carrier Conc (mg/ml)	29.072

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/10/13 00:00	1.0000E+00
02	MBL	BLANK		10/10/13 00:00	1.0000E+00
03	DUP	WLL20131008E1	53	10/08/13 11:15	1.0000E+00
04	DO	WLL20131008E1	53	10/08/13 11:15	1.0000E+00
05	TRG	WLL201310008E2	47	10/08/13 11:15	1.0000E+00
06	TRG	WLL20131008F1	56	10/08/13 12:10	1.0000E+00
07	TRG	WLL20131008F2	52	10/08/13 12:10	1.0000E+00
08	TRG	WLL20131008K1	49	10/08/13 16:05	1.0000E+00
09	TRG	WLL201310008K2	45	10/08/13 16:05	1.0000E+00
10	TRG	WLL20131009L1	48	10/09/13 10:55	1.0000E+00
11	TRG	WLL201310009L2	57	10/09/13 10:55	1.0000E+00

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
Ra228
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	0.9163	895.6	374.7	92.88	2.000	0.0911	0.1429	0.0518	89.09	82.75	1.00	1.00
02	MBL	0.9108	890.2	366.0	91.27	2.000	0.0907	0.1423	0.0516	88.75	81.00	1.00	1.00
03	DUP	0.9081	887.6	267.1	66.81	2.000	0.0915	0.1432	0.0517	88.92	59.40	1.00	1.00
04	DO	0.9055	885.0	325.2	81.57	2.000	0.0912	0.1435	0.0523	89.95	73.37	1.00	1.00
05	TRG	0.9052	884.7	406.6	102.02	2.000	0.0911	0.1434	0.0523	89.95	91.77	1.00	1.00
06	TRG	0.9049	884.4	365.6	91.77	2.000	0.0913	0.1446	0.0533	91.67	84.12	1.00	1.00
07	TRG	0.9040	883.6	373.3	93.79	2.000	0.0911	0.1444	0.0533	91.67	85.98	1.00	1.00
08	TRG	0.9063	885.8	359.7	90.15	2.000	0.0907	0.1413	0.0506	87.03	78.45	1.00	1.00
09	TRG	0.9040	883.6	342.1	85.95	2.000	0.0916	0.1448	0.0532	91.50	78.65	1.00	1.00
10	TRG	0.9046	884.2	148.3	37.24	2.000	0.0911	0.1441	0.0530	91.15	33.94	1.00	1.00
11	TRG	0.9074	886.9	236.5	59.20	2.000	0.0908	0.1442	0.0534	91.84	54.37	1.00	1.00

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

13-10043
Ra228
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
02	MBL			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
03	DUP			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
04	DO			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
05	TRG			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
06	TRG			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
07	TRG			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
08	TRG			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
09	TRG			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
10	TRG			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH
11	TRG			10/18/13 08:06	JWOLFE	10/24/13 07:39	TSMITH	11/04/13 04:46	TSMITH

* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. ** Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Eberline Services
Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-Ra228-1

Run	Analysis Code	Eberline Services Work Order	Client
1	Ra228	13-10043	Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-228	LCS	LCS	pCi/l	8.96E+00	9.45E-01	1.21E+00	8.49E+00	105.59	OK		OK	
02	RA-228	MBL	BLANK	pCi/l	2.33E+00	6.13E-01	1.01E+00					OK	OK
03	RA-228	DUP	WLL20131008E1	pCi/l	3.57E+00	9.57E-01	1.66E+00				NA	OK	
04	RA-228	DO	WLL20131008E1	pCi/l	2.25E+00	6.92E-01	1.21E+00					OK	
05	RA-228	TRG	WLL201310008E2	pCi/l	1.55E+00	6.51E-01	1.23E+00					OK	
06	RA-228	TRG	WLL20131008F1	pCi/l	3.50E+00	7.41E-01	1.22E+00					OK	
07	RA-228	TRG	WLL20131008F2	pCi/l	3.08E+00	7.48E-01	1.29E+00					OK	
08	RA-228	TRG	WLL20131008K1	pCi/l	2.18E+00	6.97E-01	1.25E+00					OK	
09	RA-228	TRG	WLL201310008K2	pCi/l	5.68E+00	8.41E-01	1.21E+00					OK	
10	RA-228	TRG	WLL20131009L1	pCi/l	6.77E+00	1.84E+00	3.24E+00					INV	
11	RA-228	TRG	WLL201310009L2	pCi/l	6.36E+00	1.22E+00	1.98E+00					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-Ra228-1

Run: 1
Analysis Code: Ra228
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	RA-228	LCS	10/10/13 00:00	1.00E+00	92.88	89.09	82.75	1.00	10/24/2013 7:39	11/4/2013 4:46
02	RA-228	MBL	10/10/13 00:00	1.00E+00	91.27	88.75	81.00	1.00	10/24/2013 7:39	11/4/2013 4:46
03	RA-228	DUP	10/08/13 11:15	1.00E+00	66.81	88.92	59.40	1.00	10/24/2013 7:39	11/4/2013 4:46
04	RA-228	DO	10/08/13 11:15	1.00E+00	81.57	89.95	73.37	1.00	10/24/2013 7:39	11/4/2013 4:46
05	RA-228	TRG	10/08/13 11:15	1.00E+00	102.02	89.95	91.77	1.00	10/24/2013 7:39	11/4/2013 4:46
06	RA-228	TRG	10/08/13 12:10	1.00E+00	91.77	91.67	84.12	1.00	10/24/2013 7:39	11/4/2013 4:46
07	RA-228	TRG	10/08/13 12:10	1.00E+00	93.79	91.67	85.98	1.00	10/24/2013 7:39	11/4/2013 4:46
08	RA-228	TRG	10/08/13 16:05	1.00E+00	90.15	87.03	78.45	1.00	10/24/2013 7:39	11/4/2013 4:46
09	RA-228	TRG	10/08/13 16:05	1.00E+00	85.95	91.50	78.65	1.00	10/24/2013 7:39	11/4/2013 4:46
10	RA-228	TRG	10/09/13 10:55	1.00E+00	37.24	91.15	33.94	1.00	10/24/2013 7:39	11/4/2013 4:46
11	RA-228	TRG	10/09/13 10:55	1.00E+00	59.20	91.84	54.37	1.00	10/24/2013 7:39	11/4/2013 4:46

Preliminary Data Report & Analytical Calculations

Work Order: 13-10043-Ra228-1

Run: 1
Analysis Code: Ra228
Eberline Services Work Order: 13-10043
Client: Missouri Dept. of Natural Resources

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-228	LCS	11/04/13 08:46		LB4110R	A1	120	680	1.216666667	0.4776
02	RA-228	MBL	11/04/13 08:46		LB4110R	A2	120	228	0.783333333	0.4699
03	RA-228	DUP	11/04/13 08:46		LB4110R	A3	120	298	1.2	0.4809
04	RA-228	DO	11/04/13 08:46		LB4110R	A4	120	230	0.933333333	0.4732
05	RA-228	TRG	11/04/13 08:46		LB4110R	B1	120	290	1.566666667	0.4754
06	RA-228	TRG	11/04/13 08:46		LB4110R	B2	120	353	1.216666667	0.4658
07	RA-228	TRG	11/04/13 08:46		LB4110R	B3	120	366	1.483333333	0.4713
08	RA-228	TRG	11/04/13 08:46		LB4110R	B4	120	263	1.166666667	0.4773
09	RA-228	TRG	11/04/13 08:46		LB4110R	C1	120	445	1.066666667	0.4705
10	RA-228	TRG	11/04/13 08:46		LB4110R	C3	120	326	1.383333333	0.4614
11	RA-228	TRG	11/04/13 08:46		LB4110R	C4	120	412	1.383333333	0.4714

Count Room Report
Client: Missouri Dept. of Natural

13-10043-Ra228-1 (pCi/l) in WA
Tracer ID: Ba-6a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	10/10/13 00:00	1.0000	0.9163	895.5889	374.7000	92.88	1.00	1.00
02	MBL	BLANK	10/10/13 00:00	1.0000	0.9108	890.2132	366.0000	91.27	1.00	1.00
03	DUP	WLL20131008E1	10/08/13 11:15	1.0000	0.9081	887.5742	267.1000	66.81	1.00	1.00
04	DO	WLL20131008E1	10/08/13 11:15	1.0000	0.9055	885.0330	325.2000	81.57	1.00	1.00
05	TRG	WLL201310008E2	10/08/13 11:15	1.0000	0.9052	884.7398	406.6000	102.02	1.00	1.00
06	TRG	WLL20131008F1	10/08/13 12:10	1.0000	0.9049	884.4465	365.6000	91.77	1.00	1.00
07	TRG	WLL20131008F2	10/08/13 12:10	1.0000	0.9040	883.5669	373.3000	93.79	1.00	1.00
08	TRG	WLL20131008K1	10/08/13 16:05	1.0000	0.9063	885.8149	359.7000	90.15	1.00	1.00
09	TRG	WLL201310008K2	10/08/13 16:05	1.0000	0.9040	883.5669	342.1000	85.95	1.00	1.00
10	TRG	WLL20131009L1	10/09/13 10:55	1.0000	0.9046	884.1533	148.3000	37.24	1.00	1.00
11	TRG	WLL201310009L2	10/09/13 10:55	1.0000	0.9074	886.8900	236.5000	59.20	1.00	1.00

Eberline Services
Oak Ridge Laboratory

Spike and Tracer Worksheet

Printed: 10/18/2013 8:06 AM

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
13-10043	1	Ra228	10/18/2013 8:05	JWOLFE	JW	

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estimate	Known pCi	Error Estimate	Added pCi	Error Estimate
Ra-228	Ra-11	36.744	10/18/2013	0.540	0.5127				8.49	0.433	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	Ba-133	Ba-6a	977.397	10/18/2013	0.9163	1.0400
02	Ba-133	Ba-6a	977.397	10/18/2013	0.9108	1.0400
03	Ba-133	Ba-6a	977.397	10/18/2013	0.9081	1.0400
04	Ba-133	Ba-6a	977.397	10/18/2013	0.9055	1.0400
05	Ba-133	Ba-6a	977.397	10/18/2013	0.9052	1.0400
06	Ba-133	Ba-6a	977.397	10/18/2013	0.9049	1.0400
07	Ba-133	Ba-6a	977.397	10/18/2013	0.9040	1.0400
08	Ba-133	Ba-6a	977.397	10/18/2013	0.9063	1.0400
09	Ba-133	Ba-6a	977.397	10/18/2013	0.9040	1.0400
10	Ba-133	Ba-6a	977.397	10/18/2013	0.9046	1.0400
11	Ba-133	Ba-6a	977.397	10/18/2013	0.9074	1.0400

Balance Printer Tapes

Tracer	LCS

Matrix Spike

Version 2.0 08/99

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
13-10043	1	Ra228	liters	10/31/2013	JWOLFE

Lab Fraction	Missouri Dept. of Natural Resources Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	WLL20131008E1	DUP					1.0000E+00	1.0000E+00				
04	WLL20131008E1	DO					1.0000E+00	1.0000E+00				
05	WLL201310008E2	TRG					1.0000E+00	1.0000E+00				
06	WLL20131008F1	TRG					1.0000E+00	1.0000E+00				
07	WLL20131008F2	TRG					1.0000E+00	1.0000E+00				
08	WLL20131008K1	TRG					1.0000E+00	1.0000E+00				
09	WLL201310008K2	TRG					1.0000E+00	1.0000E+00				
10	WLL20131009L1	TRG					1.0000E+00	1.0000E+00				
11	WLL201310009L2	TRG					1.0000E+00	1.0000E+00				

Comments	

Technician: JWolfe Date: 10/18/13

Eberline Services - Oak Ridge
Version 1.0 9/1999

Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
13-10043	1	Ra228	Yttirum	29.0720	TSMITH

TRetec Fraction	Missouri Dept. of Natural Resources Client ID	Sample Type	Carrier Data: Carrier Added (ml)	Filter Data: Filter Tare (g)	Filter Data: Filter Final (g)	Filter Data: Filter Net (g)	Gravimetric: % Recovery
01	LCS	LCS	2.0000	0.0911	0.1429	0.0518	89.09
02	BLANK	MBL	2.0000	0.0907	0.1423	0.0516	88.75
03	DUP	DUP	2.0000	0.0915	0.1432	0.0517	88.92
04	WLL20131008E1	DO	2.0000	0.0912	0.1435	0.0523	89.95
05	WLL201310008E2	TRG	2.0000	0.0911	0.1434	0.0523	89.95
06	WLL20131008F1	TRG	2.0000	0.0913	0.1446	0.0533	91.67
07	WLL20131008F2	TRG	2.0000	0.0911	0.1444	0.0533	91.67
08	WLL20131008K1	TRG	2.0000	0.0907	0.1413	0.0506	87.03
09	WLL201310008K2	TRG	2.0000	0.0916	0.1448	0.0532	91.50
10	WLL20131009L1	TRG	2.0000	0.0911	0.1441	0.0530	91.15
11	WLL201310009L2	TRG	2.0000	0.0908	0.1442	0.0534	91.84

Technician: [illegible] Date: 11/4/13

0308

1114113

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
C1	1310043-09	38	445	120	1400	11/4/13 10:46
C3	1310043-10	27	326	120	1400	11/4/13 10:46
C4	1310043-11	38	412	120	1400	11/4/13 10:46
A1	1310043-01	22	680	120	1400	11/4/13 10:46
A2	1310043-02	20	228	120	1400	11/4/13 10:46
A3	1310043-03	14	298	120	1400	11/4/13 10:46
A4	1310043-04	9	230	120	1400	11/4/13 10:46
B1	1310043-05	8	290	120	1400	11/4/13 10:46
B2	1310043-06	16	353	120	1400	11/4/13 10:46
B3	1310043-07	19	366	120	1400	11/4/13 10:46
B4	1310043-08	18	263	120	1400	11/4/13 10:46

Eberline Analytical
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GPC Detector Report
(ALL Backgrounds)

C
11/4/13

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/18/2007	11/4/2013	0.00E+00	P	-2.09E+01	2.74E-01	2.15E+01
LB4110A - A2	Alpha	11/18/2007	11/4/2013	5.00E-02	P	-1.78E+01	2.46E-01	1.83E+01
LB4110A - A3	Alpha	11/18/2007	11/4/2013	5.00E-02	P	-1.73E+01	2.11E-01	1.77E+01
LB4110A - A4	Alpha	11/18/2007	11/4/2013	1.67E-02	P	-1.84E+01	2.30E-01	1.88E+01
LB4110A - B1	Alpha	11/18/2007	11/4/2013	6.67E-02	P	-9.53E-02	7.54E-02	2.46E-01
LB4110A - B2	Alpha	11/18/2007	11/4/2013	6.67E-02	P	-7.67E-02	7.20E-02	2.21E-01
LB4110A - B3	Alpha	11/18/2007	11/4/2013	1.67E-02	P	-6.27E-02	5.39E-02	1.71E-01
LB4110A - B4	Alpha	11/18/2007	11/4/2013	5.00E-02	P	-1.38E-01	7.90E-02	2.96E-01
LB4110A - C1	Alpha	11/18/2007	11/4/2013	5.00E-02	P	-1.46E-01	8.86E-02	3.23E-01
LB4110A - C2	Alpha	11/18/2007	11/4/2013	0.00E+00	P	-1.75E-01	8.53E-02	3.45E-01
LB4110A - C3	Alpha	11/18/2007	11/4/2013	1.67E-02	P	-1.69E-01	9.95E-02	3.68E-01
LB4110A - C4	Alpha	11/18/2007	11/4/2013	0.00E+00	P	-6.21E-02	6.85E-02	1.99E-01
LB4110A - D1	Alpha	11/18/2007	10/30/2013	0.00E+00	P	-5.46E-02	8.21E-02	2.19E-01
LB4110A - D2	Alpha	11/18/2007	10/30/2013	0.00E+00	P	-7.13E-02	6.11E-02	1.93E-01
LB4110A - D3	Alpha	11/18/2007	10/30/2013	0.00E+00	P	-4.93E-02	6.97E-02	1.89E-01
LB4110A - D4	Alpha	11/18/2007	10/30/2013	0.00E+00	P	-6.76E-02	7.09E-02	2.09E-01
LB4110R - A1	Alpha	11/24/2006	11/4/2013	1.00E-01	P	-9.64E-02	1.01E-01	2.99E-01
LB4110R - A2	Alpha	11/24/2006	11/4/2013	1.67E-02	P	-8.81E-02	7.57E-02	2.39E-01
LB4110R - A3	Alpha	11/24/2006	11/4/2013	1.17E-01	P	-7.36E-02	7.87E-02	2.31E-01
LB4110R - A4	Alpha	11/24/2006	11/4/2013	3.33E-02	P	-5.20E-02	7.08E-02	1.94E-01
LB4110R - B1	Alpha	11/24/2006	11/4/2013	5.00E-02	P	-9.28E-02	6.18E-02	2.16E-01
LB4110R - B2	Alpha	11/24/2006	11/4/2013	6.67E-02	P	-6.87E-02	6.31E-02	1.95E-01
LB4110R - B3	Alpha	11/24/2006	11/4/2013	5.00E-02	P	-6.47E-02	7.04E-02	2.05E-01
LB4110R - B4	Alpha	11/24/2006	11/4/2013	0.00E+00	P	-6.31E-02	6.99E-02	2.03E-01
LB4110R - C1	Alpha	11/24/2006	11/4/2013	1.67E-02	P	-7.62E-02	7.37E-02	2.24E-01
LB4110R - C2	Alpha	11/24/2006	11/4/2013	6.67E-02	P	-7.48E-02	7.06E-02	2.16E-01
LB4110R - C3	Alpha	11/24/2006	11/4/2013	5.00E-02	P	-8.68E-02	8.47E-02	2.56E-01
LB4110R - C4	Alpha	11/24/2006	11/4/2013	3.33E-02	P	-6.08E-02	8.10E-02	2.23E-01
LB4110R - D1	Alpha	11/24/2006	11/4/2013	0.00E+00	P	-1.05E-01	6.80E-02	2.41E-01
LB4110R - D2	Alpha	11/24/2006	11/4/2013	0.00E+00	P	-8.10E-02	6.75E-02	2.16E-01
LB4110R - D3	Alpha	11/24/2006	11/4/2013	0.00E+00	P	-8.58E-02	6.73E-02	2.20E-01
LB4110R - D4	Alpha	11/24/2006	11/4/2013	0.00E+00	P	-7.89E-02	7.19E-02	2.23E-01
LB5100 - 1	Alpha	7/10/2006	10/26/2007	5.00E-02	P	-1.56E-02	9.58E-02	2.07E-01

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GPC Detector Report
(ALL Backgrounds)

c
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Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/18/2007	11/4/2013	7.17E+00	P	-2.84E+02	7.59E+00	2.99E+02
LB4110A - A2	Beta	11/18/2007	11/4/2013	3.40E+00	P	-2.97E+01	2.63E+00	3.49E+01
LB4110A - A3	Beta	11/18/2007	11/4/2013	1.63E+00	P	-4.92E+01	2.59E+00	5.44E+01
LB4110A - A4	Beta	11/18/2007	11/4/2013	7.45E+00	P	-3.17E+01	3.38E+00	3.84E+01
LB4110A - B1	Beta	11/18/2007	11/4/2013	5.82E+00	P	-1.02E+01	3.22E+00	1.66E+01
LB4110A - B2	Beta	11/18/2007	11/4/2013	1.55E+00	P	-7.47E+00	1.98E+00	1.14E+01
LB4110A - B3	Beta	11/18/2007	11/4/2013	1.27E+00	P	1.30E-01	1.36E+00	2.59E+00
LB4110A - B4	Beta	11/18/2007	11/4/2013	1.57E+00	P	-8.13E+00	2.01E+00	1.22E+01
LB4110A - C1	Beta	11/18/2007	11/4/2013	1.90E+00	P	-5.28E+00	2.09E+00	9.46E+00
LB4110A - C2	Beta	11/18/2007	11/4/2013	1.15E+00	P	2.60E-01	1.28E+00	2.29E+00
LB4110A - C3	Beta	11/18/2007	11/4/2013	1.27E+00	P	3.11E-01	1.46E+00	2.61E+00
LB4110A - C4	Beta	11/18/2007	11/4/2013	1.40E+00	P	-1.73E+00	2.07E+00	5.88E+00
LB4110A - D1	Beta	11/18/2007	10/30/2013	0.00E+00	P	-2.35E+00	2.55E+00	7.44E+00
LB4110A - D2	Beta	11/18/2007	10/30/2013	0.00E+00	P	-3.10E+00	1.60E+00	6.31E+00
LB4110A - D3	Beta	11/18/2007	10/30/2013	0.00E+00	F	1.02E+00	4.46E+00	7.90E+00
LB4110A - D4	Beta	11/18/2007	10/30/2013	0.00E+00	P	-7.35E+00	1.48E+00	1.03E+01
LB4110R - A1	Beta	11/24/2006	11/4/2013	1.22E+00	P	-5.99E+01	3.59E+00	6.71E+01
LB4110R - A2	Beta	11/24/2006	11/4/2013	7.83E-01	P	-4.76E+01	1.98E+00	5.15E+01
LB4110R - A3	Beta	11/24/2006	11/4/2013	1.20E+00	P	-4.40E+01	2.69E+00	4.94E+01
LB4110R - A4	Beta	11/24/2006	11/4/2013	9.33E-01	P	-4.39E+01	1.97E+00	4.78E+01
LB4110R - B1	Beta	11/24/2006	11/4/2013	1.57E+00	P	-4.62E+01	2.00E+00	5.02E+01
LB4110R - B2	Beta	11/24/2006	11/4/2013	1.22E+00	P	-4.62E+01	2.02E+00	5.02E+01
LB4110R - B3	Beta	11/24/2006	11/4/2013	1.48E+00	P	-4.60E+01	2.61E+00	5.12E+01
LB4110R - B4	Beta	11/24/2006	11/4/2013	1.17E+00	P	-4.63E+01	1.90E+00	5.01E+01
LB4110R - C1	Beta	11/24/2006	11/4/2013	1.07E+00	P	-4.61E+01	2.91E+00	5.19E+01
LB4110R - C2	Beta	11/24/2006	11/4/2013	1.63E+00	P	-4.61E+01	2.68E+00	5.14E+01
LB4110R - C3	Beta	11/24/2006	11/4/2013	1.38E+00	P	-4.65E+01	2.48E+00	5.15E+01
LB4110R - C4	Beta	11/24/2006	11/4/2013	1.38E+00	P	-5.25E+01	2.91E+00	5.83E+01
LB4110R - D1	Beta	11/24/2006	11/4/2013	0.00E+00	P	-4.39E+01	5.38E+00	5.47E+01
LB4110R - D2	Beta	11/24/2006	11/4/2013	0.00E+00	P	-4.71E+01	1.82E+00	5.07E+01
LB4110R - D3	Beta	11/24/2006	11/4/2013	0.00E+00	P	-5.05E+01	5.36E+00	6.12E+01
LB4110R - D4	Beta	11/24/2006	11/4/2013	0.00E+00	P	-4.68E+01	2.16E+00	5.11E+01
LB5100 - 1	Beta	7/10/2006	10/26/2007	4.52E+00	F	-3.19E-01	1.58E+00	3.48E+00

GPC Detector Report
(ALL Efficiencies)

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Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/18/2007	11/4/2013	0.2311	P	-0.0081	0.2168	0.4416
LB4110A - A2	Alpha	11/18/2007	11/4/2013	0.2083	P	-0.0456	0.1753	0.3961
LB4110A - A3	Alpha	11/18/2007	11/4/2013	0.1983	P	-0.0687	0.1648	0.3982
LB4110A - A4	Alpha	11/18/2007	11/4/2013	0.2313	P	-0.0472	0.1835	0.4142
LB4110A - B1	Alpha	11/18/2007	11/4/2013	0.2148	P	0.1943	0.2241	0.2538
LB4110A - B2	Alpha	11/18/2007	11/4/2013	0.1948	W	0.1919	0.2209	0.2499
LB4110A - B3	Alpha	11/18/2007	11/4/2013	0.2266	P	0.1298	0.2323	0.3348
LB4110A - B4	Alpha	11/18/2007	11/4/2013	0.2170	P	0.2085	0.2360	0.2635
LB4110A - C1	Alpha	11/18/2007	11/4/2013	0.2134	P	0.1977	0.2206	0.2435
LB4110A - C2	Alpha	11/18/2007	11/4/2013	0.2201	P	0.1974	0.2251	0.2527
LB4110A - C3	Alpha	11/18/2007	11/4/2013	0.2515	P	0.2236	0.2494	0.2752
LB4110A - C4	Alpha	11/18/2007	11/4/2013	0.2181	P	0.1972	0.2255	0.2538
LB4110A - D1	Alpha	11/18/2007	10/30/2013	0.0000	F	0.1796	0.2314	0.2831
LB4110A - D2	Alpha	11/18/2007	10/30/2013	0.0000	F	0.2010	0.2566	0.3122
LB4110A - D3	Alpha	11/18/2007	10/30/2013	0.0000	F	0.2042	0.2618	0.3195
LB4110A - D4	Alpha	11/18/2007	10/30/2013	0.0000	F	0.1476	0.1979	0.2481
LB4110R - A1	Alpha	11/24/2006	11/4/2013	0.2347	P	0.1987	0.2383	0.2780
LB4110R - A2	Alpha	11/24/2006	11/4/2013	0.2205	P	0.1850	0.2198	0.2546
LB4110R - A3	Alpha	11/24/2006	11/4/2013	0.2195	P	0.1923	0.2241	0.2558
LB4110R - A4	Alpha	11/24/2006	11/4/2013	0.2440	P	0.2120	0.2452	0.2784
LB4110R - B1	Alpha	11/24/2006	11/4/2013	0.2231	P	0.1836	0.2255	0.2674
LB4110R - B2	Alpha	11/24/2006	11/4/2013	0.2107	P	0.1755	0.2166	0.2578
LB4110R - B3	Alpha	11/24/2006	11/4/2013	0.2501	P	0.2022	0.2439	0.2855
LB4110R - B4	Alpha	11/24/2006	11/4/2013	0.2169	P	0.1881	0.2309	0.2736
LB4110R - C1	Alpha	11/24/2006	11/4/2013	0.2109	P	0.1836	0.2148	0.2461
LB4110R - C2	Alpha	11/24/2006	11/4/2013	0.2178	P	0.1933	0.2243	0.2553
LB4110R - C3	Alpha	11/24/2006	11/4/2013	0.2317	P	0.2036	0.2392	0.2748
LB4110R - C4	Alpha	11/24/2006	11/4/2013	0.2066	P	0.1821	0.2217	0.2614
LB4110R - D1	Alpha	11/24/2006	11/4/2013	0.0000	W	-0.0185	0.1932	0.4049
LB4110R - D2	Alpha	11/24/2006	11/4/2013	0.0000	W	-0.0205	0.2197	0.4599
LB4110R - D3	Alpha	11/24/2006	11/4/2013	0.0000	W	-0.0201	0.2158	0.4518
LB4110R - D4	Alpha	11/24/2006	11/4/2013	0.0000	W	-0.0174	0.1740	0.3654
LB5100 - 1	Alpha	7/10/2006	10/26/2007	0.3368	P	0.3332	0.3455	0.3578

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GPC Detector Report
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Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/18/2007	11/4/2013	0.5840	P	0.2176	0.5626	0.9075
LB4110A - A2	Beta	11/18/2007	11/4/2013	0.5083	P	0.1683	0.4658	0.7633
LB4110A - A3	Beta	11/18/2007	11/4/2013	0.4887	P	0.0973	0.4579	0.8185
LB4110A - A4	Beta	11/18/2007	11/4/2013	0.5593	P	0.1499	0.4906	0.8312
LB4110A - B1	Beta	11/18/2007	11/4/2013	0.5599	P	0.4633	0.5297	0.5962
LB4110A - B2	Beta	11/18/2007	11/4/2013	0.5149	P	0.4635	0.5265	0.5895
LB4110A - B3	Beta	11/18/2007	11/4/2013	0.6027	P	0.3208	0.5324	0.7440
LB4110A - B4	Beta	11/18/2007	11/4/2013	0.5811	P	0.4920	0.5539	0.6157
LB4110A - C1	Beta	11/18/2007	11/4/2013	0.5623	F	0.4496	0.5033	0.5570
LB4110A - C2	Beta	11/18/2007	11/4/2013	0.6570	F	0.4183	0.5030	0.5878
LB4110A - C3	Beta	11/18/2007	11/4/2013	0.6660	F	0.5273	0.5918	0.6563
LB4110A - C4	Beta	11/18/2007	11/4/2013	0.5958	F	0.4576	0.5252	0.5929
LB4110A - D1	Beta	11/18/2007	10/30/2013	0.0000	F	0.4246	0.5498	0.6749
LB4110A - D2	Beta	11/18/2007	10/30/2013	0.0000	F	0.4389	0.5834	0.7279
LB4110A - D3	Beta	11/18/2007	10/30/2013	0.0000	F	0.4761	0.6116	0.7470
LB4110A - D4	Beta	11/18/2007	10/30/2013	0.0000	F	0.3466	0.4687	0.5908
LB4110R - A1	Beta	11/24/2006	11/4/2013	0.6091	P	0.4754	0.5674	0.6593
LB4110R - A2	Beta	11/24/2006	11/4/2013	0.5408	P	0.4170	0.5087	0.6004
LB4110R - A3	Beta	11/24/2006	11/4/2013	0.5520	P	0.4508	0.5381	0.6253
LB4110R - A4	Beta	11/24/2006	11/4/2013	0.6211	P	0.5043	0.5917	0.6791
LB4110R - B1	Beta	11/24/2006	11/4/2013	0.5770	P	0.4474	0.5422	0.6370
LB4110R - B2	Beta	11/24/2006	11/4/2013	0.5426	P	0.4256	0.5193	0.6131
LB4110R - B3	Beta	11/24/2006	11/4/2013	0.6529	P	0.4949	0.5926	0.6903
LB4110R - B4	Beta	11/24/2006	11/4/2013	0.5819	P	0.4545	0.5487	0.6429
LB4110R - C1	Beta	11/24/2006	11/4/2013	0.5227	P	0.4154	0.5010	0.5867
LB4110R - C2	Beta	11/24/2006	11/4/2013	0.6590	F	0.4384	0.5295	0.6207
LB4110R - C3	Beta	11/24/2006	11/4/2013	0.6290	P	0.4762	0.5709	0.6656
LB4110R - C4	Beta	11/24/2006	11/4/2013	0.5531	P	0.4259	0.5245	0.6230
LB4110R - D1	Beta	11/24/2006	11/4/2013	0.0000	W	-0.0450	0.4620	0.9690
LB4110R - D2	Beta	11/24/2006	11/4/2013	0.0000	W	-0.0500	0.5192	1.0883
LB4110R - D3	Beta	11/24/2006	11/4/2013	0.0000	W	-0.0486	0.5042	1.0571
LB4110R - D4	Beta	11/24/2006	11/4/2013	0.0000	W	-0.0426	0.4151	0.8727
LB5100 - 1	Beta	7/10/2006	10/26/2007	0.4428	F	0.4555	0.4731	0.4906

SECTION XII

BARIUM-133 ANALYTICAL TRACER DATA

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:09:44.70 10/24/13

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004301_GE1_BAFIL_196951.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : SPIKE
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 10:54:27
Sample ID : 1310043-01 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE1 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:00.28 0.0%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	3	28.08	66	51	1.56	28.27	27	15	7.38E-02	18.8	3.23E+01
2	3	30.98	2097	58	1.43	31.17	27	15	2.33E+00	2.2	
3	3	34.98	474	56	1.74	35.17	27	15	5.26E-01	5.4	
4	3	52.87	52	72	1.78	53.07	48	25	5.79E-02	27.3	2.87E+00
5	3	61.95	257	68	1.80	62.14	48	25	2.86E-01	8.1	
6	3	66.35	136	64	1.81	66.55	48	25	1.51E-01	13.0	
7	3	81.23	808	50	1.47	81.43	76	12	8.98E-01	3.7	6.84E-01
8	3	84.94	20	46	1.52	85.14	76	12	2.24E-02	62.2	
9	0	91.96	49	91	1.89	92.16	88	9	5.48E-02	37.5	
10	2	111.98	222	60	1.71	112.19	108	14	2.47E-01	8.5	1.90E+00
11	2	116.51	51	70	1.72	116.72	108	14	5.68E-02	27.9	
12	0	161.14	64	66	2.08	161.36	157	9	7.12E-02	26.0	
13	0	276.68	64	29	1.27	276.92	274	7	7.08E-02	18.7	
14	2	299.66	14	4	1.91	299.91	299	9	1.56E-02	29.2	3.57E+01
15	2	303.01	168	39	1.83	303.26	299	9	1.87E-01	9.0	
16	0	333.97	95	27	1.65	334.23	330	7	1.06E-01	13.6	
17	0	356.29	564	30	1.92	356.55	351	12	6.27E-01	4.6	
18	0	365.11	16	13	1.59	365.38	362	6	1.83E-02	42.7	
19	2	384.07	138	13	1.86	384.34	381	19	1.53E-01	11.8	5.29E+00
20	2	387.39	198	16	1.90	387.66	381	19	2.20E-01	8.7	
21	2	391.64	64	14	1.72	391.91	381	19	7.16E-02	16.3	
22	0	415.32	23	26	1.22	415.59	412	6	2.52E-02	41.1	
23	0	419.36	28	27	1.66	419.64	417	7	3.08E-02	37.3	
24	0	437.21	92	9	1.90	437.49	433	9	1.02E-01	12.0	
25	0	468.24	26	10	1.98	468.53	463	8	2.85E-02	29.1	
26	0	511.95	21	10	3.67	512.25	507	8	2.33E-02	34.0	
27	0	517.45	8	0	1.47	517.75	516	5	8.89E-03	35.4	
28	0	532.55	8	4	4.46	532.85	528	8	9.26E-03	53.7	
29	0	569.91	10	4	1.76	570.22	567	7	1.12E-02	48.0	

Sample ID : 1310043-01 Acquisition date : 24-OCT-2013 10:54:27

Total number of lines in spectrum	29	
Number of unidentified lines	24	
Number of lines tentatively identified by NID	5	17.24%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	3.746E+02	3.747E+02	0.690E+02	18.43	
NP-237	2.14E+06Y	1.00	3.131E+01	3.131E+01	3.918E+01	125.14	
			---	---			
Total Activity :			4.060E+02	4.060E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	3.469E+02	3.469E+02	0.590E+02	17.02	
			---	---			
Total Activity :			3.469E+02	3.469E+02			

Grand Total Activity :	7.529E+02	7.529E+02

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-01
Acquisition date : 24-OCT-2013 10:54:27

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.963E+01	3.746E+02	3.747E+02	18.43	OK
	302.84	17.80	4.915E+00	5.774E+02	5.774E+02	34.33	OK
	356.01	60.00	6.963E+00	4.054E+02	4.054E+02	17.77	OK

Final Mean for 3 Valid Peaks = 3.747E+02+/- 6.905E+01 (18.43%)

NP-237	86.50	12.60*	1.532E+01	3.131E+01	3.131E+01	125.14	OK

Final Mean for 1 Valid Peaks = 3.131E+01+/- 3.918E+01 (125.14%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	5.865E+01	3.469E+02	3.469E+02	17.02	OK

Final Mean for 1 Valid Peaks = 3.469E+02+/- 5.904E+01 (17.02%)

Flag: "*" = Keyline

Sample ID : 1310043-01
Acquisition date : 24-OCT-2013 10:54:27

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	3.747E+02	6.905E+01	1.727E+01	2.835E+00	21.694
TH-234	3.469E+02	5.904E+01	4.962E+01	1.590E+00	6.991
NP-237	3.131E+01	3.918E+01	4.845E+01	5.899E+00	0.646

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	2.805E+00		1.369E+01	2.258E+01	7.050E+00	0.124
CD-109	6.927E+01		1.273E+02	1.994E+02	2.579E+01	0.347
PA-231	0.000E+00		0.000E+00	1.933E-01	3.632E-03	0.000
PA-234	9.782E+00		1.749E+00	3.691E+00	6.936E-02	2.650
AM-241	1.093E+01		3.087E+00	6.392E+00	1.500E-01	1.710

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:10:15.07

10/24/13

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004302_GE2_BAFIL_196952.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : BLANK
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 10:54:48
Sample ID : 1310043-02 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE2 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:00.30 0.0%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	3	30.98	2055	94	1.49	31.03	26	15	2.28E+00	2.3	1.14E+01
2	3	35.33	540	81	1.62	35.38	26	15	6.00E-01	5.1	
3	0	52.77	62	61	1.63	52.82	50	6	6.90E-02	23.5	
4	1	62.09	220	57	1.44	62.13	57	13	2.45E-01	8.4	6.12E+00
5	1	65.89	82	49	1.45	65.94	57	13	9.06E-02	18.2	
6	1	81.09	723	43	1.48	81.13	77	11	8.04E-01	4.1	6.84E+00
7	1	83.96	16	44	1.35	84.00	77	11	1.75E-02	116.2	
8	0	92.92	18	102	1.25	92.96	89	8	1.98E-02	101.1	
9	1	111.94	183	41	1.53	111.98	108	19	2.03E-01	9.2	1.85E+00
10	1	115.82	42	39	1.54	115.86	108	19	4.61E-02	29.1	
11	0	161.15	23	72	1.17	161.18	157	7	2.57E-02	64.7	
12	0	185.06	18	96	1.80	185.09	181	9	2.03E-02	99.1	
13	0	239.40	16	31	1.72	239.42	237	6	1.82E-02	58.5	
14	0	277.43	49	37	1.83	277.45	273	8	5.41E-02	26.5	
15	0	296.33	17	15	1.77	296.34	293	7	1.93E-02	43.3	
16	0	303.22	138	46	1.31	303.23	299	8	1.54E-01	12.0	
17	0	333.87	62	34	1.39	333.87	330	7	6.92E-02	18.9	
18	0	356.25	540	18	1.77	356.26	352	9	6.00E-01	4.5	
19	5	384.04	101	9	1.57	384.04	382	14	1.12E-01	12.0	1.48E+00
20	5	387.13	176	11	1.66	387.13	382	14	1.96E-01	8.4	
21	5	391.56	30	19	2.71	391.55	382	14	3.31E-02	51.2	
22	2	415.02	49	3	2.06	415.02	410	20	5.40E-02	16.1	1.48E+00
23	2	418.36	24	3	2.06	418.36	410	20	2.68E-02	35.8	
24	2	422.36	14	3	2.07	422.35	410	20	1.54E-02	44.1	
25	1	434.01	7	0	1.72	434.00	433	10	7.90E-03	7.0	1.90E+00
26	1	437.18	75	5	1.89	437.17	433	10	8.37E-02	13.5	
27	1	468.04	21	6	1.92	468.02	463	12	2.35E-02	28.8	2.94E-01
28	1	472.19	5	6	1.92	472.17	463	12	6.10E-03	92.9	
29	0	510.88	22	9	1.45	510.86	507	9	2.44E-02	32.5	
30	1	555.85	9	2	1.98	555.82	552	10	1.00E-02	43.2	5.23E-01
31	1	559.02	8	1	1.98	559.00	552	10	8.35E-03	52.0	
32	0	888.91	6	0	2.74	888.83	886	6	6.67E-03	40.8	

Sample ID : 1310043-02 Acquisition date : 24-OCT-2013 10:54:48

Total number of lines in spectrum	32	
Number of unidentified lines	28	
Number of lines tentatively identified by NID	4	12.50%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	3.660E+02	3.660E+02	0.706E+02	19.30	
			---	---			
	Total Activity :		3.660E+02	3.660E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	7.551E+02	7.551E+02	1.450E+02	19.21	
			---	---			
	Total Activity :		7.551E+02	7.551E+02			

Grand Total Activity : 1.121E+03 1.121E+03

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-02
Acquisition date : 24-OCT-2013 10:54:48

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.799E+01	3.660E+02	3.660E+02	19.30	OK
	302.84	17.80	7.560E+00	3.090E+02	3.090E+02	38.34	OK
	356.01	60.00	7.170E+00	3.770E+02	3.770E+02	17.65	OK

Final Mean for 3 Valid Peaks = 3.660E+02+/- 7.064E+01 (19.30%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	2.305E+01	7.551E+02	7.551E+02	19.21	OK

Final Mean for 1 Valid Peaks = 7.551E+02+/- 1.450E+02 (19.21%)

Flag: "*" = Keyline

Sample ID : 1310043-02
Acquisition date : 24-OCT-2013 10:54:48

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	3.660E+02	7.064E+01	1.841E+01	3.135E+00	19.877
TH-234	7.551E+02	1.450E+02	1.423E+02	1.176E+01	5.307

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	2.645E+00		5.098E+00	9.470E+00	1.454E+00	0.279
CD-109	-2.879E+01		1.208E+02	1.679E+02	1.928E+01	-0.171
PA-231	2.697E+01		4.673E+00	9.048E+00	1.723E-01	2.981
PA-234	3.818E+00		1.837E+00	3.367E+00	6.945E-02	1.134
NP-237	-1.135E+01		3.480E+01	4.767E+01	5.382E+00	-0.238
AM-241	1.493E+01		9.783E+00	1.773E+01	1.372E+00	0.842

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:10:30.12

10/24/13

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004303_GE3_BAFIL_196953.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL20131008E1
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 10:55:12
Sample ID : 1310043-03 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE3 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:04.46 0.5%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	2	30.90	1548	60	1.46	31.07	26	15	1.72E+00	2.7	7.68E+00
2	2	35.08	348	54	1.47	35.25	26	15	3.87E-01	6.4	
3	0	53.54	71	105	3.14	53.73	50	8	7.85E-02	27.9	
4	3	61.74	158	63	1.68	61.93	58	16	1.76E-01	11.2	2.81E+00
5	3	65.96	83	64	1.69	66.15	58	16	9.26E-02	18.7	
6	2	81.08	557	55	1.57	81.27	76	13	6.19E-01	4.8	4.40E+00
7	2	83.80	13	36	1.30	84.00	76	13	1.41E-02	140.5	
8	0	91.86	40	30	1.26	92.06	89	6	4.44E-02	27.3	
9	3	109.23	19	16	1.78	109.44	108	13	2.10E-02	33.8	5.33E+00
10	3	112.04	136	26	1.78	112.25	108	13	1.51E-01	10.8	
11	3	115.80	32	25	1.63	116.01	108	13	3.56E-02	32.9	
12	0	161.22	27	36	1.48	161.46	159	6	3.00E-02	39.6	
13	0	276.65	50	25	1.78	276.94	272	10	5.53E-02	23.6	
14	1	302.85	122	15	1.59	303.15	298	14	1.35E-01	10.1	1.47E+00
15	1	307.61	26	13	1.68	307.92	298	14	2.93E-02	28.8	
16	0	329.46	3	7	3.33	329.78	328	4	3.33E-03	133.3	
17	0	335.03	35	27	1.71	335.35	331	7	3.87E-02	29.8	
18	0	356.28	369	44	1.91	356.61	353	10	4.10E-01	6.3	
19	4	383.79	74	6	2.07	384.13	381	21	8.20E-02	14.1	2.22E+00
20	4	386.93	146	4	1.96	387.27	381	21	1.62E-01	10.2	
21	4	391.21	35	4	2.33	391.55	381	21	3.93E-02	28.1	
22	2	415.30	17	10	1.94	415.66	411	18	1.89E-02	41.7	1.02E+00
23	2	418.30	17	6	1.94	418.66	411	18	1.90E-02	41.1	
24	2	421.98	11	3	1.95	422.34	411	18	1.23E-02	58.2	
25	1	433.47	5	1	1.78	433.84	433	10	5.59E-03	22.8	5.21E+00
26	1	436.79	57	6	1.78	437.16	433	10	6.36E-02	15.1	
27	0	467.90	16	7	1.47	468.29	465	8	1.74E-02	37.7	
28	0	511.25	20	0	2.49	511.65	508	10	2.22E-02	22.4	
29	0	609.61	8	7	2.59	610.06	606	6	8.48E-03	67.1	
30	0	1010.02	6	0	1.92	1010.67	1008	6	6.67E-03	40.8	

Sample ID : 1310043-03 Acquisition date : 24-OCT-2013 10:55:12

Total number of lines in spectrum	30	
Number of unidentified lines	26	
Number of lines tentatively identified by NID	4	13.33%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	2.671E+02	2.671E+02	0.495E+02	18.53	
			---	---			
	Total Activity :		2.671E+02	2.671E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	4.728E+02	4.728E+02	1.104E+02	23.34	
			---	---			
	Total Activity :		4.728E+02	4.728E+02			

Grand Total Activity : 7.399E+02 7.399E+02

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-03
Acquisition date : 24-OCT-2013 10:55:12

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.899E+01	2.671E+02	2.671E+02	18.53	OK
	302.84	17.80	6.222E+00	3.297E+02	3.298E+02	28.84	OK
	356.01	60.00	5.860E+00	3.148E+02	3.148E+02	18.61	OK

Final Mean for 3 Valid Peaks = 2.671E+02+/- 4.948E+01 (18.53%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	2.648E+01	4.728E+02	4.728E+02	23.34	OK

Final Mean for 1 Valid Peaks = 4.728E+02+/- 1.104E+02 (23.34%)

Flag: "*" = Keyline

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	2.671E+02	4.948E+01	1.673E+01	2.559E+00	15.961
TH-234	4.728E+02	1.104E+02	1.117E+02	6.002E+00	4.231

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	-3.828E+00		4.840E+00	7.066E+00	8.073E-01	-0.542
CD-109	2.520E+01		9.627E+01	1.492E+02	1.230E+01	0.169
PA-231	2.641E+00		1.748E+00	3.474E+00	4.941E-02	0.760
PA-234	2.794E+00		1.268E+00	2.464E+00	3.504E-02	1.134
NP-237	1.260E+01		2.830E+01	4.500E+01	3.638E+00	0.280
AM-241	1.528E+01		7.786E+00	1.478E+01	7.266E-01	1.034

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:11:14.45

10/24/13

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004304_GE5_BAFIL_196954.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL20131008E1
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 10:55:51
Sample ID : 1310043-04 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE5 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:01.26 0.1%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	10.03	19	11	0.94	103.21	94	21	2.15E-02	47.7	
2	0	21.15	79	30	0.51	209.74	201	17	8.80E-02	20.1	
3	0	25.17	37	0	0.39	248.16	240	17	4.11E-02	16.4	
4	0	28.09	35	23	1.20	276.18	267	17	3.84E-02	37.3	
5	0	30.87	1808	52	0.80	302.78	289	31	2.01E+00	2.6	
6	1	35.00	335	21	0.67	342.31	332	27	3.72E-01	6.6	1.31E+00
7	1	35.96	76	4	0.64	351.48	332	27	8.41E-02	23.0	
8	0	50.17	8	7	0.32	487.48	481	10	9.41E-03	60.4	
9	0	53.28	32	9	0.43	517.29	510	15	3.50E-02	25.6	
10	0	61.76	185	27	0.65	598.49	586	23	2.05E-01	9.6	
11	0	66.01	110	23	0.82	639.17	625	28	1.22E-01	14.2	
12	0	80.07	15	42	0.99	773.81	754	21	1.69E-02	99.3	
13	0	81.07	644	38	0.58	783.39	774	20	7.16E-01	4.4	
14	0	111.88	184	16	0.72	1078.35	1066	24	2.04E-01	8.8	
15	0	116.16	50	15	0.87	1119.31	1111	16	5.50E-02	20.9	
16	0	161.14	22	24	0.70	1549.92	1532	23	2.50E-02	51.6	
17	6	276.64	30	9	0.94	2655.72	2642	22	3.31E-02	26.3	1.10E+00
18	6	277.20	8	1	0.58	2661.02	2642	22	9.07E-03	43.4	
19	0	302.94	113	0	0.75	2907.51	2894	25	1.26E-01	9.4	
20	0	333.61	59	5	1.20	3201.12	3187	25	6.51E-02	15.6	
21	0	356.22	318	10	0.73	3417.57	3403	28	3.53E-01	6.0	
22	1	383.94	31	5	1.07	3683.00	3668	28	3.43E-02	28.9	6.68E-01
23	1	384.57	28	4	1.07	3689.00	3668	28	3.08E-02	24.8	
24	4	386.34	31	8	1.17	3705.98	3698	26	3.41E-02	30.6	1.29E+00
25	4	387.18	104	8	0.89	3714.02	3698	26	1.16E-01	11.9	

Sample ID : 1310043-04 Acquisition date : 24-OCT-2013 10:55:51

Total number of lines in spectrum	25	
Number of unidentified lines	18	
Number of lines tentatively identified by NID	7	28.00%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	3.252E+02	3.252E+02	0.574E+02	17.65	
			---	---			
Total Activity :			3.252E+02	3.252E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
PA-231	3.28E+04Y	1.00	1.382E+00	1.382E+00	1.321E+00	95.54	
PA-234	4.47E+09Y	1.00	3.665E+00	3.665E+00	1.481E+00	40.42	
TH-234	4.47E+09Y	1.00	1.668E+02	1.668E+02	0.328E+02	19.67	
			---	---			
Total Activity :			1.719E+02	1.719E+02			

Grand Total Activity : 4.971E+02 4.971E+02

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-04
Acquisition date : 24-OCT-2013 10:55:51

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.802E+01	3.252E+02	3.252E+02	17.65	OK
	302.84	17.80	2.575E+00	7.402E+02	7.403E+02	32.42	OK
	356.01	60.00	4.312E+00	3.687E+02	3.687E+02	18.81	OK

Final Mean for 3 Valid Peaks = 3.252E+02+/- 5.739E+01 (17.65%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
PA-231	9.28	42.00*	1.000E+02	1.382E+00	1.382E+00	95.54	OK
	10.11	20.20	1.000E+02	2.874E+00	2.874E+00	95.54	OK
	283.67	1.60	2.191E+00	----- Line Not Found		-----	Absent
	302.67	2.30	2.572E+00	5.737E+03	5.737E+03	30.84	OK

Final Mean for 3 Valid Peaks = 1.382E+00+/- 1.321E+00 (95.54%)

PA-234	9.89	89.00	1.000E+02	6.523E-01	6.523E-01	95.54	OK
	21.72	64.90*	1.000E+02	3.665E+00	3.665E+00	40.42	OK
	37.93	23.75	1.000E+02	9.571E+00	9.571E+00	46.27	OK
	131.42	20.40	2.473E+00	----- Line Not Found		-----	Absent

Final Mean for 3 Valid Peaks = 3.665E+00+/- 1.481E+00 (40.42%)

TH-234	63.29	3.80*	8.750E+01	1.668E+02	1.668E+02	19.67	OK

Final Mean for 1 Valid Peaks = 1.668E+02+/- 3.281E+01 (19.67%)

Flag: "*" = Keyline

Sample ID : 1310043-04 Acquisition date : 24-OCT-2013 10:55:51

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	3.252E+02	5.739E+01	1.245E+01	1.833E+00	26.129
PA-231	1.382E+00	1.321E+00	1.819E+00	2.047E-02	0.760
PA-234	3.665E+00	1.481E+00	8.334E-01	9.381E-03	4.397
TH-234	1.668E+02	3.281E+01	2.095E+01	2.695E-01	7.963

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	-1.032E+01		1.545E+01	2.494E+01	8.455E+00	-0.414
CD-109	1.080E+02		8.554E+01	1.845E+02	1.775E+01	0.586
NP-237	-6.724E+00		2.473E+01	4.361E+01	3.847E+00	-0.154
AM-241	-5.299E-01		1.450E+00	2.105E+00	2.369E-02	-0.252

KB 10/24/13

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:28:12.43

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004305_GE1_BAFIL_196955.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL201310008E2
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 11:12:56
Sample ID : 1310043-05 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE1 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:00.27 0.0%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	3	27.94	28	31	1.42	28.13	27	13	3.06E-02	26.9	5.97E+01
2	3	30.97	1986	51	1.43	31.16	27	13	2.21E+00	2.3	
3	3	34.98	479	46	1.74	35.17	27	13	5.32E-01	5.2	
4	0	46.81	18	55	2.55	47.01	43	6	2.04E-02	67.5	
5	0	52.73	54	99	2.21	52.92	50	7	5.97E-02	33.5	
6	2	61.97	234	90	1.64	62.17	58	12	2.59E-01	9.0	2.62E+00
7	2	65.92	109	85	1.64	66.12	58	12	1.21E-01	16.5	
8	0	81.30	877	117	1.93	81.50	76	11	9.74E-01	4.1	
9	0	91.87	41	136	2.61	92.07	88	11	4.50E-02	57.7	
10	0	111.73	191	99	1.93	111.94	107	8	2.12E-01	11.6	
11	0	160.55	30	84	1.60	160.77	157	9	3.34E-02	57.8	
12	0	186.34	13	81	1.50	186.56	183	7	1.39E-02	122.3	
13	0	249.01	12	35	1.10	249.25	245	7	1.28E-02	90.3	
14	0	264.58	25	17	1.30	264.82	262	7	2.80E-02	33.8	
15	0	276.72	41	47	1.56	276.96	272	10	4.53E-02	35.3	
16	0	287.08	16	32	2.98	287.32	283	9	1.72E-02	70.0	
17	2	302.99	158	31	1.60	303.24	300	12	1.75E-01	9.2	8.87E+00
18	2	307.72	28	36	1.91	307.97	300	12	3.10E-02	36.6	
19	1	330.71	10	12	1.76	330.96	329	9	1.08E-02	56.4	1.10E+01
20	1	333.90	91	34	1.76	334.16	329	9	1.02E-01	13.1	
21	0	338.86	20	24	1.55	339.12	337	6	2.21E-02	47.4	
22	0	356.40	493	51	1.93	356.66	353	10	5.48E-01	5.3	
23	0	364.85	13	22	2.96	365.11	362	7	1.41E-02	66.8	
24	4	383.88	106	15	2.02	384.15	381	18	1.18E-01	11.9	1.16E+01
25	4	386.99	277	9	1.95	387.26	381	18	3.08E-01	6.9	
26	4	391.78	51	1	2.27	392.05	381	18	5.63E-02	17.7	
27	4	414.96	45	10	2.41	415.24	410	16	4.97E-02	21.1	1.16E+00
28	4	417.79	22	8	2.41	418.07	410	16	2.45E-02	44.1	
29	4	421.77	11	5	2.42	422.05	410	16	1.20E-02	69.0	
30	0	437.20	109	6	1.97	437.48	432	11	1.21E-01	10.5	
31	0	468.30	25	14	1.63	468.58	464	8	2.79E-02	32.6	
32	0	511.45	29	9	2.77	511.75	507	10	3.19E-02	27.6	

Sample ID : 1310043-05 Acquisition date : 24-OCT-2013 11:12:56

Total number of lines in spectrum	32	
Number of unidentified lines	28	
Number of lines tentatively identified by NID	4	12.50%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	4.065E+02	4.066E+02	0.765E+02	18.82	
		Total Activity :	4.065E+02	4.066E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	3.146E+02	3.146E+02	0.591E+02	18.78	
		Total Activity :	3.146E+02	3.146E+02			

Grand Total Activity : 7.212E+02 7.212E+02

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-05
Acquisition date : 24-OCT-2013 11:12:56

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.963E+01	4.065E+02	4.066E+02	18.82	OK
	302.84	17.80	4.915E+00	5.421E+02	5.422E+02	34.50	OK
	356.01	60.00	6.963E+00	3.544E+02	3.544E+02	18.52	OK

Final Mean for 3 Valid Peaks = 4.066E+02+/- 7.651E+01 (18.82%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	5.865E+01	3.146E+02	3.146E+02	18.78	OK

Final Mean for 1 Valid Peaks = 3.146E+02+/- 5.909E+01 (18.78%)

Flag: "*" = Keyline

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	4.066E+02	7.651E+01	1.645E+01	2.700E+00	24.716
TH-234	3.146E+02	5.909E+01	6.107E+01	1.957E+00	5.152

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	4.956E+00		1.108E+01	2.034E+01	6.349E+00	0.244
CD-109	6.931E+01		1.139E+02	1.833E+02	2.371E+01	0.378
PA-231	0.000E+00		0.000E+00	1.933E-01	3.632E-03	0.000
PA-234	9.496E+00		1.620E+00	3.503E+00	6.582E-02	2.711
NP-237	2.554E+01		3.221E+01	5.301E+01	6.453E+00	0.482
AM-241	6.133E+00		3.349E+00	6.076E+00	1.426E-01	1.009

10B
10/24/13

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:28:57.15

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004306_GE2_BAFIL_196956.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL20131008F1
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 11:13:40
Sample ID : 1310043-06 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE2 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:00.29 0.0%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	3	31.04	1910	106	1.46	31.09	26	15	2.12E+00	2.4	9.50E+00
2	3	35.29	455	114	1.63	35.33	26	15	5.05E-01	5.9	
3	0	53.33	51	96	1.98	53.38	50	8	5.64E-02	36.7	
4	2	61.97	207	56	1.59	62.01	58	12	2.30E-01	9.2	3.13E+00
5	2	65.79	95	61	1.60	65.83	58	12	1.05E-01	17.6	
6	0	81.15	723	88	1.54	81.20	77	7	8.03E-01	4.3	
7	0	92.72	28	95	1.92	92.76	88	8	3.10E-02	64.0	
8	0	112.07	182	69	1.44	112.10	108	7	2.03E-01	10.6	
9	1	161.03	23	44	1.61	161.06	158	9	2.59E-02	47.3	2.39E+00
10	1	163.82	13	41	1.61	163.85	158	9	1.40E-02	89.9	
11	0	185.85	25	58	1.73	185.88	184	6	2.75E-02	52.1	
12	1	276.83	64	17	1.74	276.84	271	17	7.09E-02	16.6	2.20E+00
13	1	284.15	11	13	1.75	284.16	271	17	1.19E-02	61.4	
14	1	302.98	143	6	1.77	302.99	300	16	1.58E-01	9.0	3.80E+00
15	1	306.15	18	9	1.77	306.16	300	16	2.03E-02	52.0	
16	0	334.03	67	16	1.48	334.04	332	5	7.43E-02	15.1	
17	0	356.29	454	30	1.59	356.30	351	10	5.04E-01	5.2	
18	0	364.62	14	23	1.45	364.62	362	8	1.54E-02	65.1	
19	1	383.98	121	20	1.84	383.98	381	16	1.35E-01	11.6	3.55E+00
20	1	387.03	193	11	1.85	387.03	381	16	2.15E-01	9.1	
21	1	391.12	41	5	1.85	391.12	381	16	4.58E-02	24.2	
22	1	414.84	26	7	1.87	414.83	410	12	2.91E-02	29.0	1.30E+00
23	1	418.18	35	11	1.87	418.17	410	12	3.94E-02	24.6	
24	0	437.21	79	7	1.57	437.20	433	9	8.83E-02	12.7	
25	1	468.17	23	3	1.92	468.15	464	16	2.54E-02	23.8	7.88E-01
26	1	472.93	8	3	1.92	472.91	464	16	9.15E-03	52.2	
27	0	511.75	14	9	4.29	511.73	508	7	1.61E-02	42.8	
28	0	580.85	7	6	1.97	580.82	577	8	7.44E-03	74.7	

Sample ID : 1310043-06 Acquisition date : 24-OCT-2013 11:13:40

Total number of lines in spectrum	28	
Number of unidentified lines	23	
Number of lines tentatively identified by NID	5	17.86%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	3.656E+02	3.656E+02	0.712E+02	19.49	
			---	---			
Total Activity :			3.656E+02	3.656E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
PA-231	3.28E+04Y	1.00	2.462E+03	2.462E+03	0.823E+03	33.42	
TH-234	4.47E+09Y	1.00	7.099E+02	7.099E+02	1.455E+02	20.50	
			---	---			
Total Activity :			3.172E+03	3.172E+03			

Grand Total Activity :	3.538E+03	3.538E+03

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-06
Acquisition date : 24-OCT-2013 11:13:40

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.799E+01	3.656E+02	3.656E+02	19.49	OK
	302.84	17.80	7.560E+00	3.182E+02	3.183E+02	34.92	OK
	356.01	60.00	7.170E+00	3.169E+02	3.170E+02	18.38	OK

Final Mean for 3 Valid Peaks = 3.656E+02+/- 7.124E+01 (19.49%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
PA-231	9.28	42.00*	1.000E+02	----- Line Out Of Range ----			Absent
	10.11	20.20	1.000E+02	----- Line Out Of Range ----			Absent
	283.67	1.60	7.750E+00	2.595E+02	2.595E+02	125.83	OK
	302.67	2.30	7.562E+00	2.462E+03	2.462E+03	33.42	OK

Final Mean for 2 Valid Peaks = 2.462E+03+/- 8.228E+02 (33.42%)

TH-234	63.29	3.80*	2.305E+01	7.099E+02	7.099E+02	20.50	OK

Final Mean for 1 Valid Peaks = 7.099E+02+/- 1.455E+02 (20.50%)

Flag: "*" = Keyline

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	3.656E+02	7.124E+01	1.998E+01	3.402E+00	18.299
PA-231	2.462E+03	8.228E+02	9.179E+00	1.748E-01	268.265
TH-234	7.099E+02	1.455E+02	1.248E+02	1.031E+01	5.687

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	-2.686E+00		5.613E+00	9.354E+00	1.437E+00	-0.287
CD-109	-4.164E+01		1.157E+02	1.809E+02	2.077E+01	-0.230
PA-234	2.024E+00		1.813E+00	3.172E+00	6.543E-02	0.638
NP-237	-8.419E-02		3.702E+01	5.322E+01	6.009E+00	-0.002
AM-241	1.693E+01		8.991E+00	1.688E+01	1.307E+00	1.003

KD 20124117

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:29:43.02

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004307_GE3_BAFIL_196957.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL20131008F2
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 11:14:14
Sample ID : 1310043-07 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE3 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:04.29 0.5%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	3	30.97	2000	106	1.52	31.14	27	12	2.22E+00	2.4	5.85E+00
2	3	35.20	470	81	1.58	35.37	27	12	5.22E-01	5.6	
3	0	52.04	69	113	3.00	52.22	49	7	7.66E-02	28.2	
4	2	59.08	23	82	1.52	59.26	57	18	2.58E-02	64.5	9.12E+00
5	2	62.00	246	74	1.53	62.19	57	18	2.73E-01	8.5	
6	2	65.81	123	64	1.54	66.00	57	18	1.37E-01	14.3	
7	2	81.08	779	70	1.57	81.27	77	14	8.65E-01	4.0	4.56E+00
8	2	83.80	28	35	1.30	84.00	77	14	3.13E-02	75.5	
9	2	111.89	183	49	1.62	112.10	108	14	2.03E-01	9.8	5.24E+00
10	2	116.50	33	43	1.63	116.72	108	14	3.67E-02	38.3	
11	0	160.02	47	90	2.09	160.26	156	9	5.18E-02	39.5	
12	1	269.56	12	7	1.65	269.85	267	16	1.33E-02	56.7	3.38E+00
13	1	276.56	66	16	1.65	276.85	267	16	7.31E-02	14.7	
14	3	302.95	138	20	1.77	303.25	299	13	1.53E-01	9.7	5.03E+00
15	3	307.20	24	26	2.03	307.51	299	13	2.71E-02	47.6	
16	3	333.74	71	17	1.98	334.06	330	15	7.92E-02	14.9	2.33E+00
17	3	337.82	26	8	2.06	338.14	330	15	2.88E-02	35.7	
18	0	356.15	453	28	1.96	356.48	351	11	5.03E-01	5.2	
19	0	364.70	14	14	1.06	365.03	363	5	1.56E-02	47.7	
20	1	383.59	90	9	1.74	383.94	381	16	1.00E-01	11.7	6.28E+00
21	1	386.80	190	5	1.74	387.15	381	16	2.11E-01	8.3	
22	1	391.50	28	3	1.75	391.84	381	16	3.07E-02	26.1	
23	1	414.69	46	14	1.77	415.05	412	20	5.09E-02	18.7	2.00E+00
24	1	417.80	19	13	1.77	418.16	412	20	2.12E-02	43.3	
25	0	437.21	85	11	1.91	437.58	434	8	9.40E-02	12.9	
26	0	467.56	24	3	2.65	467.94	465	6	2.65E-02	23.5	
27	0	511.36	19	6	2.67	511.76	507	12	2.11E-02	34.5	
28	0	609.21	15	0	3.79	609.67	605	9	1.67E-02	25.8	

Summary of Nuclide Activity
Sample ID : 1310043-07 Acquisition date : 24-OCT-2013 11:14:14

Total number of lines in spectrum	28	
Number of unidentified lines	23	
Number of lines tentatively identified by NID	5	17.86%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	3.733E+02	3.733E+02	0.663E+02	17.76	
			---	---			
Total Activity :			3.733E+02	3.733E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	7.338E+02	7.338E+02	1.342E+02	18.28	
AM-241	432.20Y	1.00	6.713E+00	6.713E+00	8.676E+00	129.24	
			---	---			
Total Activity :			7.405E+02	7.405E+02			

Grand Total Activity :	1.114E+03	1.114E+03

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-07
Acquisition date : 24-OCT-2013 11:14:14

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.899E+01	3.733E+02	3.733E+02	17.76	OK
	302.84	17.80	6.222E+00	3.744E+02	3.745E+02	28.24	OK
	356.01	60.00	5.860E+00	3.865E+02	3.865E+02	17.17	OK

Final Mean for 3 Valid Peaks = 3.733E+02+/- 6.629E+01 (17.76%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	2.648E+01	7.338E+02	7.338E+02	18.28	OK

Final Mean for 1 Valid Peaks = 7.338E+02+/- 1.342E+02 (18.28%)

AM-241	59.54	35.90*	2.893E+01	6.713E+00	6.713E+00	129.24	OK

Final Mean for 1 Valid Peaks = 6.713E+00+/- 8.676E+00 (129.24%)

Flag: "*" = Keyline

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	3.733E+02	6.629E+01	1.832E+01	2.802E+00	20.378
TH-234	7.338E+02	1.342E+02	1.250E+02	6.715E+00	5.869
AM-241	6.713E+00	8.676E+00	1.209E+01	5.942E-01	0.555

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	-3.597E-01		5.226E+00	8.636E+00	9.866E-01	-0.042
CD-109	-3.910E+01		9.822E+01	1.687E+02	1.391E+01	-0.232
PA-231	1.871E+00		1.467E+00	2.950E+00	4.195E-02	0.634
PA-234	2.516E+00		1.354E+00	2.656E+00	3.778E-02	0.947
NP-237	1.279E+00		2.949E+01	5.262E+01	4.254E+00	0.024

KB 10/24/13

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:30:10.43

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004308_GE5_BAFIL_196958.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL20131008K1
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 11:14:51
Sample ID : 1310043-08 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE5 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:01.27 0.1%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	0	14.93	9	13	0.16	150.17	138	14	1.00E-02	93.6	
2	0	21.30	45	63	0.75	211.11	198	21	5.03E-02	47.7	
3	0	24.83	24	18	0.28	244.88	230	23	2.72E-02	48.6	
4	3	29.39	39	47	0.65	288.57	279	38	4.32E-02	45.0	7.54E-01
5	3	30.88	1914	32	0.77	302.88	279	38	2.13E+00	2.4	
6	1	35.03	441	16	0.67	342.58	332	29	4.90E-01	5.3	2.34E+00
7	1	35.74	64	7	0.67	349.42	332	29	7.06E-02	36.3	
8	0	53.25	38	9	0.14	517.05	511	12	4.17E-02	21.8	
9	0	61.86	231	46	0.69	599.40	584	32	2.57E-01	10.0	
10	4	65.82	120	10	0.97	637.31	626	28	1.33E-01	11.6	2.03E+00
11	4	66.33	30	7	0.45	642.25	626	28	3.29E-02	39.7	
12	4	66.93	30	8	0.68	648.00	626	28	3.37E-02	28.3	
13	0	81.07	712	67	0.59	783.33	771	23	7.92E-01	4.5	
14	0	84.59	17	19	0.25	817.07	805	16	1.90E-02	54.3	
15	0	100.97	16	4	0.39	973.87	966	13	1.74E-02	34.6	
16	0	111.96	152	48	0.64	1079.12	1067	22	1.69E-01	12.7	
17	0	276.59	45	0	1.69	2655.22	2641	24	5.00E-02	14.9	
18	0	302.97	106	4	0.76	2907.80	2893	25	1.18E-01	10.3	
19	1	333.39	38	1	1.02	3199.00	3190	24	4.28E-02	19.4	1.80E+00
20	1	334.01	37	2	1.02	3205.00	3190	24	4.08E-02	23.7	
21	0	356.20	371	12	0.93	3417.42	3403	26	4.13E-01	5.6	
22	0	384.05	78	2	0.34	3684.03	3668	27	8.65E-02	12.0	
23	1	386.35	11	6	1.07	3706.00	3698	26	1.20E-02	98.3	9.09E+00
24	1	386.97	231	14	1.07	3712.00	3698	26	2.57E-01	5.6	
25	1	390.73	28	9	1.07	3748.00	3735	27	3.12E-02	26.6	1.48E+00
26	1	391.36	30	4	1.07	3754.00	3735	27	3.31E-02	20.9	
27	8	414.92	30	5	1.23	3979.53	3969	19	3.37E-02	20.8	1.07E+00
28	8	415.47	11	1	0.72	3984.79	3969	19	1.26E-02	27.6	

Sample ID : 1310043-08 Acquisition date : 24-OCT-2013 11:14:51

Total number of lines in spectrum	28	
Number of unidentified lines	22	
Number of lines tentatively identified by NID	6	21.43%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	3.597E+02	3.597E+02	0.637E+02	17.72	
NP-237	2.14E+06Y	1.00	3.221E+01	3.221E+01	3.512E+01	109.04	
			---	---			
Total Activity :			3.919E+02	3.919E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	2.089E+02	2.089E+02	0.426E+02	20.40	
			---	---			
Total Activity :			2.089E+02	2.089E+02			

Grand Total Activity : 6.008E+02 6.008E+02

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-08
Acquisition date : 24-OCT-2013 11:14:51

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.802E+01	3.597E+02	3.597E+02	17.72	OK
	302.84	17.80	2.575E+00	6.968E+02	6.969E+02	33.47	OK
	356.01	60.00	4.312E+00	4.312E+02	4.313E+02	18.23	OK

Final Mean for 3 Valid Peaks = 3.597E+02+/- 6.372E+01 (17.72%)

NP-237	86.50	12.60*	1.262E+01	3.221E+01	3.221E+01	109.04	OK

Final Mean for 1 Valid Peaks = 3.221E+01+/- 3.512E+01 (109.04%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	8.750E+01	2.089E+02	2.089E+02	20.40	OK

Final Mean for 1 Valid Peaks = 2.089E+02+/- 4.262E+01 (20.40%)

Flag: "*" = Keyline

Sample ID : 1310043-08
Acquisition date : 24-OCT-2013 11:14:51

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	3.597E+02	6.372E+01	1.618E+01	2.382E+00	22.228
TH-234	2.089E+02	4.262E+01	1.313E+01	1.689E-01	15.916
NP-237	3.221E+01	3.512E+01	5.042E+01	4.448E+00	0.639

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	-6.300E+00		1.395E+01	2.385E+01	8.086E+00	-0.264
CD-109	-4.334E+01		1.002E+02	1.713E+02	1.649E+01	-0.253
PA-231	7.496E-02		8.259E-01	1.556E+00	1.752E-02	0.048
PA-234	2.093E+00	+	2.000E+00	1.831E+00	2.061E-02	1.143
AM-241	1.391E+00		1.531E+00	2.718E+00	3.060E-02	0.512

KB 10/24/13

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:43:35.35

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004309_GE1_BAFIL_196959.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL201310008K2
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 11:28:20
Sample ID : 1310043-09 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE1 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:00.26 0.0%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	3	30.98	1892	62	1.55	31.17	27	12	2.10E+00	2.4	2.75E+01
2	3	35.23	468	50	1.70	35.42	27	12	5.20E-01	5.2	
3	0	52.82	87	91	2.82	53.02	49	9	9.69E-02	22.4	
4	4	62.02	267	67	1.98	62.22	58	15	2.97E-01	7.9	3.78E+00
5	4	65.96	113	68	1.99	66.16	58	15	1.26E-01	17.4	
6	0	81.29	738	102	1.88	81.49	77	10	8.20E-01	4.5	
7	0	93.03	25	89	2.16	93.24	89	7	2.79E-02	65.8	
8	3	112.07	208	52	1.89	112.28	107	15	2.32E-01	8.8	2.88E+00
9	3	116.42	38	38	1.89	116.63	107	15	4.25E-02	35.9	
10	0	148.71	26	82	3.68	148.93	145	8	2.85E-02	64.7	
11	0	160.44	31	71	1.51	160.66	157	8	3.39E-02	50.9	
12	0	185.89	15	69	1.73	186.12	183	7	1.63E-02	97.0	
13	1	276.75	57	19	1.71	276.99	273	19	6.30E-02	17.9	1.05E+00
14	1	283.75	9	14	1.72	283.99	273	19	9.52E-03	74.6	
15	7	303.15	145	17	1.74	303.40	298	21	1.61E-01	9.0	3.90E+00
16	7	307.69	28	17	2.03	307.94	298	21	3.14E-02	32.5	
17	7	315.82	9	15	2.11	316.07	298	21	9.90E-03	82.6	
18	4	333.78	54	13	1.80	334.04	330	13	6.03E-02	16.7	5.34E-01
19	4	338.23	35	18	2.34	338.49	330	13	3.84E-02	28.6	
20	5	352.08	13	2	1.95	352.34	351	11	1.48E-02	24.6	8.62E-01
21	5	356.28	507	9	1.53	356.54	351	11	5.63E-01	4.5	
22	0	377.25	13	17	2.70	377.51	374	7	1.48E-02	58.4	
23	3	383.99	113	10	1.63	384.26	382	16	1.25E-01	11.0	3.28E+00
24	3	387.00	218	7	1.93	387.27	382	16	2.42E-01	8.4	
25	3	391.27	48	1	2.17	391.54	382	16	5.39E-02	25.5	
26	3	414.69	42	14	2.19	414.96	410	12	4.70E-02	23.0	4.46E-01
27	3	418.60	18	12	2.19	418.88	410	12	1.97E-02	37.3	
28	0	437.43	121	0	2.00	437.71	435	9	1.34E-01	9.1	
29	0	468.79	13	17	1.27	469.08	465	8	1.47E-02	59.4	
30	0	511.15	36	7	1.77	511.45	507	9	4.02E-02	21.1	
31	0	609.68	14	3	1.20	610.00	607	6	1.56E-02	33.1	
32	0	844.46	6	0	1.98	844.83	842	6	6.67E-03	40.8	

Sample ID : 1310043-09 Acquisition date : 24-OCT-2013 11:28:20

Total number of lines in spectrum	32	
Number of unidentified lines	27	
Number of lines tentatively identified by NID	5	15.63%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	3.421E+02	3.421E+02	0.655E+02	19.13	
			---	---			
	Total Activity :		3.421E+02	3.421E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
PA-231	3.28E+04Y	1.00	3.858E+03	3.858E+03	1.266E+03	32.81	
TH-234	4.47E+09Y	1.00	3.604E+02	3.604E+02	0.600E+02	16.66	
			---	---			
	Total Activity :		4.218E+03	4.218E+03			

Grand Total Activity : 4.560E+03 4.560E+03

Flags: "K" = Keyline not found "M" = Manually accepted
"E" = Manually edited "A" = Nuclide specific abn. limit

Sample ID : 1310043-09
Acquisition date : 24-OCT-2013 11:28:20

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.963E+01	3.421E+02	3.421E+02	19.13	OK
	302.84	17.80	4.915E+00	4.980E+02	4.980E+02	34.30	OK
	356.01	60.00	6.963E+00	3.641E+02	3.641E+02	17.66	OK

Final Mean for 3 Valid Peaks = 3.421E+02+/- 6.545E+01 (19.13%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
PA-231	9.28	42.00*	1.000E+02	----- Line Out Of Range ----			Absent
	10.11	20.20	1.000E+02	----- Line Out Of Range ----			Absent
	283.67	1.60	4.408E+00	3.647E+02	3.647E+02	152.56	OK
	302.67	2.30	4.910E+00	3.858E+03	3.858E+03	32.81	OK

Final Mean for 2 Valid Peaks = 3.858E+03+/- 1.266E+03 (32.81%)

TH-234	63.29	3.80*	5.865E+01	3.604E+02	3.604E+02	16.66	OK

Final Mean for 1 Valid Peaks = 3.604E+02+/- 6.003E+01 (16.66%)

Flag: "*" = Keyline

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	3.421E+02	6.545E+01	1.676E+01	2.752E+00	20.410
PA-231	3.858E+03	1.266E+03	1.933E-01	3.632E-03	19963.672
TH-234	3.604E+02	6.003E+01	5.147E+01	1.649E+00	7.002

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	6.838E+00		1.080E+01	1.908E+01	5.956E+00	0.358
CD-109	1.040E+01		1.402E+02	2.031E+02	2.627E+01	0.051
PA-234	1.138E+01		1.770E+00	3.802E+00	7.144E-02	2.994
NP-237	1.829E+00		3.872E+01	5.590E+01	6.805E+00	0.033
AM-241	6.516E+00		2.960E+00	5.611E+00	1.316E-01	1.161

ICB
10/24/13

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:44:28.13

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004310_GE2_BAFIL_196960.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL20131009L1
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 11:29:07
Sample ID : 1310043-10 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE2 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:00.22 0.0%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	3	31.10	839	76	1.45	31.15	27	12	9.32E-01	3.7	4.95E+00
2	3	35.20	167	82	1.66	35.25	27	12	1.85E-01	11.8	
3	6	62.37	70	66	2.32	62.41	58	13	7.82E-02	23.3	2.13E+00
4	6	66.10	24	62	2.17	66.14	58	13	2.65E-02	60.5	
5	0	81.31	293	69	1.51	81.35	77	9	3.26E-01	7.8	
6	0	111.73	95	68	1.43	111.77	107	8	1.06E-01	18.4	
7	0	186.57	24	47	1.32	186.59	183	8	2.71E-02	53.1	
8	3	276.46	21	11	2.11	276.48	271	15	2.34E-02	37.6	1.53E+00
9	3	280.51	9	8	2.11	280.53	271	15	1.03E-02	75.2	
10	0	303.08	55	15	1.33	303.09	300	7	6.07E-02	18.4	
11	0	338.78	20	19	2.28	338.79	336	8	2.24E-02	44.0	
12	0	356.23	226	10	1.44	356.23	351	10	2.51E-01	7.1	
13	4	384.07	47	18	2.46	384.07	380	10	5.22E-02	21.7	3.77E+00
14	4	387.23	67	13	1.59	387.22	380	10	7.45E-02	15.5	
15	0	391.57	23	11	1.60	391.57	390	6	2.59E-02	31.0	
16	0	437.40	33	4	1.52	437.39	436	4	3.67E-02	19.4	
17	0	468.51	9	2	1.96	468.50	466	6	1.03E-02	39.4	
18	0	511.68	27	5	3.31	511.66	506	10	2.99E-02	24.8	
19	0	582.85	9	4	2.78	582.82	579	7	9.44E-03	50.1	
20	1	590.21	10	0	2.01	590.18	588	9	1.06E-02	27.6	5.99E-01
21	1	593.85	6	0	2.01	593.82	588	9	6.39E-03	52.2	
22	0	610.15	8	7	1.87	610.11	605	9	9.41E-03	64.9	

Sample ID : 1310043-10
Acquisition date : 24-OCT-2013 11:29:07

Total number of lines in spectrum	22	
Number of unidentified lines	18	
Number of lines tentatively identified by NID	4	18.18%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	1.483E+02	1.483E+02	0.347E+02	23.40	
			---	---			
Total Activity :			1.483E+02	1.483E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	2.413E+02	2.413E+02	1.145E+02	47.47	
			---	---			
Total Activity :			2.413E+02	2.413E+02			

Grand Total Activity :	3.895E+02	3.896E+02

Flags: "K" = Keyline not found
"E" = Manually edited
"M" = Manually accepted
"A" = Nuclide specific abn. limit

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.799E+01	1.483E+02	1.483E+02	23.40	OK
	302.84	17.80	7.560E+00	1.219E+02	1.219E+02	47.36	OK
	356.01	60.00	7.170E+00	1.578E+02	1.578E+02	20.83	OK

Final Mean for 3 Valid Peaks = 1.483E+02+/- 3.470E+01 (23.40%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	2.305E+01	2.413E+02	2.413E+02	47.47	OK

Final Mean for 1 Valid Peaks = 2.413E+02+/- 1.145E+02 (47.47%)

Flag: "*" = Keyline

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	1.483E+02	3.470E+01	1.555E+01	2.648E+00	9.537
TH-234	2.413E+02	1.145E+02	1.106E+02	9.137E+00	2.182

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	-4.041E-01		4.129E+00	7.350E+00	1.129E+00	-0.055
CD-109	1.759E-01		8.510E+01	1.420E+02	1.631E+01	0.001
PA-231	2.820E+01		4.498E+00	8.811E+00	1.678E-01	3.201
PA-234	1.220E+00		1.434E+00	2.674E+00	5.516E-02	0.456
NP-237	-8.928E+00		2.520E+01	3.985E+01	4.499E+00	-0.224
AM-241	2.352E+00		6.321E+00	1.176E+01	9.102E-01	0.200

KB 10/24/13

VAX/VMS Peak Search Report Generated 24-OCT-2013 11:45:11.64

Configuration : DKA100:[GAMMA.SCUSR.ARCHIVE]SMP_131004311_GE3_BAFIL_196961.CN
Analyses by : PEAK V16.9 PEAKEFF V2.2
Client ID : WLL201310009L2
Deposition Date :
Sample Date : 24-OCT-2013 00:00:00 Acquisition date : 24-OCT-2013 11:29:53
Sample ID : 1310043-11 Sample Quantity : 1.00000E+00 filter
Sample type : FILTER Sample Geometry : 0
Detector name : GE3 Detector Geometry: BAFIL
Elapsed live time: 0 00:15:00.00 Elapsed real time: 0 00:15:04.18 0.5%
Start channel : 25 End channel : 4096
Sensitivity : 3.00000 Gaussian : 10.00000
Critical level : No

Pk	It	Energy	Area	Bkgnd	FWHM	Channel	Left	Pw	Cts/Sec	%Err	Fit
1	4	31.00	1353	66	1.55	31.17	27	16	1.50E+00	2.8	5.30E+00
2	4	35.32	329	46	1.77	35.49	27	16	3.66E-01	6.5	
3	7	62.04	190	92	2.06	62.23	58	13	2.11E-01	10.7	3.04E+00
4	7	66.48	69	94	2.17	66.67	58	13	7.65E-02	28.9	
5	0	81.21	493	82	1.95	81.41	78	8	5.48E-01	5.5	
6	0	93.53	39	76	2.46	93.73	89	9	4.36E-02	43.6	
7	0	111.78	140	78	1.87	111.99	108	8	1.55E-01	13.8	
8	0	136.61	19	26	2.49	136.83	134	5	2.13E-02	46.4	
9	0	276.41	39	40	1.24	276.70	273	8	4.39E-02	31.9	
10	1	302.85	87	10	1.68	303.15	297	17	9.69E-02	12.5	2.24E+00
11	1	307.85	15	8	1.68	308.15	297	17	1.67E-02	43.5	
12	0	335.03	66	23	2.45	335.35	330	11	7.30E-02	19.1	
13	0	356.33	264	42	1.94	356.66	353	9	2.93E-01	7.6	
14	0	385.61	179	22	4.96	385.95	381	9	1.99E-01	8.9	
15	1	414.48	13	10	1.77	414.84	411	12	1.43E-02	49.5	6.82E-01
16	1	417.80	10	15	1.77	418.16	411	12	1.13E-02	62.1	
17	0	436.99	64	0	2.08	437.36	433	9	7.11E-02	12.5	
18	0	467.65	23	3	2.02	468.03	464	7	2.54E-02	24.8	
19	0	510.39	15	2	2.22	510.80	507	8	1.65E-02	30.8	
20	0	609.70	13	2	1.85	610.15	607	8	1.40E-02	34.6	

Sample ID : 1310043-11
Acquisition date : 24-OCT-2013 11:29:53

Total number of lines in spectrum	20	
Number of unidentified lines	15	
Number of lines tentatively identified by NID	5	25.00%

Nuclide Type : FISSION

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
BA-133	10.50Y	1.00	2.365E+02	2.365E+02	0.455E+02	19.25	
			---	---			
	Total Activity :		2.365E+02	2.365E+02			

Nuclide Type : NATURAL

Nuclide	Hlife	Decay	Wtd Mean Uncorrected pCi/filter	Wtd Mean Decay Corr pCi/filter	Decay Corr 2-Sigma Error	2-Sigma %Error	Flags
TH-234	4.47E+09Y	1.00	5.679E+02	5.679E+02	1.268E+02	22.33	
			---	---			
	Total Activity :		5.679E+02	5.679E+02			

Grand Total Activity :	8.043E+02	8.043E+02

Flags: "K" = Keyline not found
"E" = Manually edited
"M" = Manually accepted
"A" = Nuclide specific abn. limit

Sample ID : 1310043-11
Acquisition date : 24-OCT-2013 11:29:53

Nuclide Type: FISSION

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
BA-133	81.00	33.00*	1.899E+01	2.365E+02	2.365E+02	19.25	OK
	302.84	17.80	6.222E+00	2.364E+02	2.364E+02	32.45	OK
	356.01	60.00	5.860E+00	2.253E+02	2.254E+02	20.50	OK

Final Mean for 3 Valid Peaks = 2.365E+02+/- 4.553E+01 (19.25%)

Nuclide Type: NATURAL

Nuclide	Energy	%Abn	%Eff	Uncorrected pCi/filter	Decay Corr pCi/filter	2-Sigma %Error	Status
TH-234	63.29	3.80*	2.648E+01	5.679E+02	5.679E+02	22.33	OK

Final Mean for 1 Valid Peaks = 5.679E+02+/- 1.268E+02 (22.33%)

Flag: "*" = Keyline

---- Identified Nuclides ----

Nuclide	Activity (pCi/filter)	Act error	MDA (pCi/filter)	MDA error	Act/MDA
BA-133	2.365E+02	4.553E+01	1.636E+01	2.503E+00	14.451
TH-234	5.679E+02	1.268E+02	1.253E+02	6.729E+00	4.533

---- Non-Identified Nuclides ----

Nuclide	Key-Line Activity (pCi/filter)	K.L. Ided	Act error	MDA (pCi/filter)	MDA error	Act/MDA
CO-57	-2.396E+00		4.478E+00	7.572E+00	8.651E-01	-0.316
CD-109	5.440E+00		1.071E+02	1.588E+02	1.309E+01	0.034
PA-231	2.137E+00		1.358E+00	2.816E+00	4.005E-02	0.759
PA-234	2.967E+00		1.174E+00	2.428E+00	3.453E-02	1.222
NP-237	-5.160E+00		3.236E+01	4.626E+01	3.739E+00	-0.112
AM-241	9.448E+00		7.583E+00	1.447E+01	7.115E-01	0.653