

AUXIER & ASSOCIATES, INC.

1428 PAP-KAN

**STANDARD LEVEL IV
REPORT OF ANALYSIS**

WORK ORDER #15-10152-OR

December 8, 2015

**Eberline Analytical
Oak Ridge Laboratory
OAK RIDGE, TN**

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STANDARD OPERATING PROCEDURE

MP-001, Rev. 15
Effective: 2/2/15
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Sample Receiving

**Eberline Services – Oak Ridge Laboratory
LABORATORY DATA SUPPORT CHECKLIST**

MP-001-3


Eberline Services Work Order # 15 - 10152

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

Date for Partial	Initials	Date	Initials	Checklist Items
		10-27-15	JEB	Sample Log-In
		11/11/15	JG	Data Compilation
		11-23-15	MLT	First Technical Data Review
		11-24-15	MSA	Second Technical Data Review
		12-4-15		Data Entry/Electronic Deliverable
		12-4-15	J	Case Narrative
		12-7-15	RBA	Electronic Deliverable Proof
		12-7-15	MSA	Samples Analyzed within Holding Time Yes? <input checked="" type="checkbox"/> No? <input type="checkbox"/>
		12-7-15	MSA	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:


Laboratory Manager

 12/8/15
Date

Copy No. _____

Radiochemistry Services

: 00003

SECTION I
CHAIN OF CUSTODY
& pH CHECK

Chain of Custody Record

No 7256

Eberline Services
501 Scarboro Road
Oak Ridge, TN 37830
(865) 481-0683 Phone • (865) 483-4621 Fax



Project Name:	Project Number:	Page	of				
PAP/KAN	1428						
Send Report To: Cecilia Green/Alexis	Sampler (Print Name):	REC'D OCT 12 2015					
Address:	Sampler (Print Name):	15-10065					
9821 Cogdill Rd Suite 1	Shipment Method: Federal Express	15-10128					
Knoxville TN 37932	Airbill Number:	15-10153					
Phone: 865-675-3669	Laboratory Receiving:	Purchase Order #:					
Fax: 865-675-3677							
Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Analysis Requested	Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
4 KC91-159-L	9/26/15	9:25	Water	1	X	Analyze TSS & TDS	
5 KC91-159-U	9/26/15	10:10	Water	1	X	contact Cecilia	
6 OW-008-L	9/26/15	10:57	Water	1	X	Fiter as directed	
7 KC-90-137-U	9/26/15	12:05	Water	1	X	Analyze GAs & GAs	
8 KC90-137-L	9/26/15	12:40	Water	1	X	contact Cecilia	
9 RB-01-09/21/15	9/26/15	11:20	Water	1	X	Proceed as directed	
Total Dissolved Solids Gross Alpha Gross Beta Isotope Uranium Isotope Thorium					X		
Total Suspended Solids					X		
Total Dissolved Solids					X		
Gross Alpha					X		
Gross Beta					X		
Isotope Uranium					X		
Isotope Thorium					X		
Relinquished by: (Signature) <i>James Swagler</i> Received by: (Signature) <i>Fe de X</i> Date: 10/5/15 Time: 15:47					Sample Custodian Remarks (Completed By Laboratory): Turnaround Total # Containers Received? COC Seals Present? COC Seals Intact? Received Containers Intact? Temperature?		
Relinquished by: (Signature) <i>James Swagler</i> Received by: (Signature) <i>James Swagler</i> Date: 10-12-15 Time: 1235							
Relinquished by: (Signature) <i>James Swagler</i> Received by: (Signature) <i>James Swagler</i> Date: 10-12-15 Time: 1235							

6
9/26/15
10:57



EBERLINE
SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #

15-10152

Lab Deadline

11/16/2015

Analysis

UISO - Level 4

Sample Matrix

Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
Re-log of 15-10128 fractions 04, 05 & 07	04	36	NN1.1
	05	37	NN1.1
	06	33	NN1.1

	Location (circle one)						Initials	Date
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			
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 #	15-10152
Lab Deadline	11/16/2015
Analysis	ThISO - Level 4
Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
Re-log of 15-10128 fractions 04, 05 & 07	04	36	NN1.1
	05	37	NN1.1
	06	33	NN1.1

	Location (circle one)						Initials	Date
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			
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			

	Sample Receiving Report (Volumes, pH, & CPM)	Internal Work Order
		15-10152
		Received By JBAILEY

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	NN1.1		
02	BLANK	0		WA	NN1.1		
03	DUP	0		WA	NN1.1		
04	KC91-159-L ✓	1		WA	NN1.1	3.76	36
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	36
05	KC91-159-U ✓	1		WA	NN1.1	3.76	37
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	37
06	KC-90-137-U ✓	1		WA	NN1.1	3.76	33
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	33

✓
EJR
10/27/15

Received by:  Date: 10-27-15

SECTION II

SAMPLE ACKNOWLEDGEMENT



Eberline Services – Oak Ridge Laboratory

SAMPLE RECEIPT CHECKLIST

MP-001-2

WORK ORDER # 15-10152

SAMPLE MATRIX/MATRICES:

(CIRCLE ONE OR BOTH)

AQUEOUS NON-AQUEOUS

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

WERE SAMPLES:

Received in good condition?	<input checked="" type="radio"/> Y	N	
If aqueous, properly preserved	<input checked="" type="radio"/> Y	N	N/A

WERE CHAIN OF CUSTODY SEALS:

Present on outside of package?	<input checked="" type="radio"/> Y	N
Unbroken on outside of package?	<input checked="" type="radio"/> Y	N
Present on samples?	<input checked="" type="radio"/> Y	N
Unbroken on samples?	<input checked="" type="radio"/> Y	N
Was chain of custody present upon sample receipt?	<input checked="" type="radio"/> Y	N

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

REMARKS: _____

SIGNATURE: *James E. Bailey* DATE: 10-27-15

SECTION III
CASE NARRATIVE



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

EBS-OR-40043

December 8, 2015

Cecilia Greene
Auxier & Associates, Inc.
9821 Cogdill Road #1
Knoxville, TN 37932

CASE NARRATIVE
Work Order # 15-10152-OR

SAMPLE RECEIPT

This work order contains three water samples relogged 10/27/2015 at the request of the client. These samples were analyzed for Isotopic Uranium and Isotopic Thorium.

<u>CLIENT ID</u>	<u>LAB ID</u>
KC91-159-L	15-10152-04
KC91-159-U	15-10152-05
KC-90-137-U	15-10152-06

ANALYTICAL METHODS

Isotopic Uranium was analyzed using Method EML U-02 Modified. Isotopic Thorium was analyzed using Method EML Th-01 Modified.

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 2-sigma value.

Minimum Detectable Activity (MDA) values for data represented in this report are sample-specific. MDA measurements are determined based on factors and conditions including instrument settings, aliquot size and matrix type.

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 acceptable for all samples. The Uranium-234, Uranium-235 and Uranium-238 method blank demonstrated acceptable results. Results for the Uranium-234 and Uranium-238 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the Uranium-235 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.

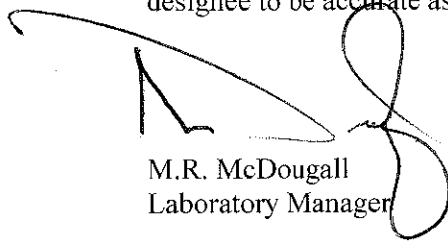
ISOTOPIC THORIUM

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.

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: 12/8/2015

Eberline Analytical wants and encourages your feedback regarding our performance providing radioanalytical services. Please visit <http://www.eberlineservices.com/client.htm> to provide us with feedback on our services.

SECTION IV
ANALYTICAL RESULTS SUMMARY

Eberline Analytical

Final Report of Analysis

Cecilia Greene
Auxier & Associates, Inc.
9821 Cogdill Road, Suite 1
Knoxville, TN 37932

SDG: 15-10152
Project: PAP-KAN
Analysis Category: ENVIRONMENTAL
Sample Matrix: WA

Work Order Details:

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	CV	Report Units
15-10152-01	LCS	KNOWN	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-228	EML Th-01 Modified	4.88E+00	1.76E-01				pCi/l
15-10152-01	LCS	LCS	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-228	EML Th-01 Modified	5.05E+00	1.04E+00	1.14E+00	1.60E-01	3.07E-02	pCi/l
15-10152-02	MBL	BLANK	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-228	EML Th-01 Modified	8.59E-03	5.39E-02	5.39E-02	1.30E-01	2.94E-02	pCi/l
15-10152-03	DUP	KC-90-137-J	09/26/15 12:05	10/26/2015	11/10/2015	15-10152	Thorium-228	EML Th-01 Modified	4.50E-01	2.35E-01	2.35E-01	1.76E-01	3.24E-02	pCi/l
15-10152-04	TRG	KC91-159-L	09/26/15 09:25	10/26/2015	11/10/2015	15-10152	Thorium-228	EML Th-01 Modified	2.79E-01	1.82E-01	1.84E-01	1.70E-01	3.12E-02	pCi/l
15-10152-05	TRG	KC91-159-U	09/26/15 10:10	10/26/2015	11/10/2015	15-10152	Thorium-228	EML Th-01 Modified	2.97E-01	1.88E-01	1.90E-01	1.59E-01	2.35E-02	pCi/l
15-10152-06	DO	KC-90-137-J	09/26/15 12:05	10/26/2015	11/10/2015	15-10152	Thorium-228	EML Th-01 Modified	2.18E-01	1.82E-01	1.83E-01	2.19E-01	5.05E-02	pCi/l
15-10152-01	LCS	KNOWN	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-230	EML Th-01 Modified	5.65E+00	1.53E-01				pCi/l
15-10152-01	LCS	LCS	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-230	EML Th-01 Modified	6.35E+00	1.24E+00	1.47E+00	1.46E-01	1.20E-01	pCi/l
15-10152-02	MBL	BLANK	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-230	EML Th-01 Modified	2.42E-02	5.24E-02	5.25E-02	1.03E-01	1.03E-01	pCi/l
15-10152-03	DUP	KC-90-137-J	09/26/15 12:05	10/26/2015	11/10/2015	15-10152	Thorium-230	EML Th-01 Modified	2.60E-01	1.72E-01	1.75E-01	1.53E-01	1.48E-01	pCi/l
15-10152-04	TRG	KC91-159-L	09/26/15 09:25	10/26/2015	11/10/2015	15-10152	Thorium-230	EML Th-01 Modified	3.71E-01	2.02E-01	2.08E-01	1.48E-01	1.22E-01	pCi/l
15-10152-05	TRG	KC91-159-U	09/26/15 10:10	10/26/2015	11/10/2015	15-10152	Thorium-230	EML Th-01 Modified	2.55E-01	1.70E-01	1.73E-01	1.53E-01	1.26E-01	pCi/l
15-10152-06	DO	KC-90-137-J	09/26/15 12:05	10/26/2015	11/10/2015	15-10152	Thorium-230	EML Th-01 Modified	1.33E-01	1.28E-01	1.29E-01	1.37E-01	1.50E-01	pCi/l
15-10152-01	LCS	KNOWN	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-232	EML Th-01 Modified	4.88E+00	1.76E-01				pCi/l
15-10152-01	LCS	LCS	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-232	EML Th-01 Modified	4.58E+00	9.59E-01	1.04E+00	1.16E-01	9.87E-03	pCi/l
15-10152-02	MBL	BLANK	10/27/15 00:00	10/26/2015	11/10/2015	15-10152	Thorium-232	EML Th-01 Modified	5.17E-02	6.31E-02	6.32E-02	7.63E-02	4.36E-03	pCi/l
15-10152-03	DUP	KC-90-137-J	09/26/15 12:05	10/26/2015	11/10/2015	15-10152	Thorium-232	EML Th-01 Modified	1.98E-01	1.48E-01	1.47E-01	1.22E-01	1.04E-02	pCi/l
15-10152-04	TRG	KC91-159-L	09/26/15 09:25	10/26/2015	11/10/2015	15-10152	Thorium-232	EML Th-01 Modified	1.03E-01	1.11E-01	1.11E-01	1.48E-01	2.26E-02	pCi/l
15-10152-05	TRG	KC91-159-U	09/26/15 10:10	10/26/2015	11/10/2015	15-10152	Thorium-232	EML Th-01 Modified	2.71E-01	1.71E-01	1.73E-01	1.22E-01	1.03E-02	pCi/l
15-10152-06	DO	KC-90-137-J	09/26/15 12:05	10/26/2015	11/10/2015	15-10152	Thorium-232	EML Th-01 Modified	1.04E-01	1.14E-01	1.14E-01	1.36E-01	1.16E-02	pCi/l
15-10152-01	LCS	KNOWN	10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-234	EML U-02 Modified	8.08E+00	2.91E-01				pCi/l
15-10152-01	LCS	LCS	10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-234	EML U-02 Modified	6.89E+00	1.05E+00	1.16E+00	9.61E-02	1.71E-02	pCi/l
15-10152-02	MBL	BLANK	10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-234	EML U-02 Modified	3.43E-02	5.84E-02	5.85E-02	1.03E-01	3.72E-03	pCi/l
15-10152-03	DUP	KC-90-137-J	09/26/15 12:05	10/26/2015	11/9/2015	15-10152	Uranium-234	EML U-02 Modified	2.04E+00	6.21E-01	6.37E-01	2.47E-01	4.84E-02	pCi/l
15-10152-04	TRG	KC91-159-L	09/26/15 09:25	10/26/2015	11/9/2015	15-10152	Uranium-234	EML U-02 Modified	8.51E-01	3.58E-01	3.60E-01	2.75E-01	9.76E-02	pCi/l
15-10152-05	TRG	KC91-159-U	09/26/15 10:10	10/26/2015	11/9/2015	15-10152	Uranium-234	EML U-02 Modified	7.83E-01	3.28E-01	3.30E-01	1.86E-01	3.31E-02	pCi/l
15-10152-06	DO	KC-90-137-J	09/26/15 12:05	10/26/2015	11/9/2015	15-10152	Uranium-234	EML U-02 Modified	1.73E+00	5.20E-01	5.34E-01	2.34E-01	5.72E-02	pCi/l

CU=Counting Uncertainty; CSU=Combined Standard Uncertainty (2-sigma); MDA=Minimal Detected Activity; LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original; CV=Critical Value



EBERLINE
SERVICES

EBERLINE ANALYTICAL CORPORATION

601 SCARBORO ROAD OAK RIDGE, TN 37830 865/481-0683 FAX 865/483-4621

Eberline Analytical

Final Report of Analysis

Cecilia Greene
Auxier & Associates, Inc.
9821 Cogdill Road, Suite 1
Knoxville, TN 37932

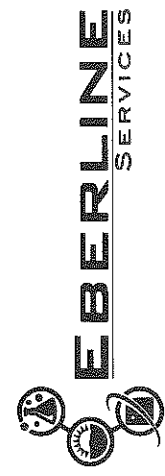
15-10152
PAP-KAN
ENVIRONMENTAL
WA

Report To:

Work Order Details:

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	CV	Report Units
15-10152-01	LCS		10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-235	EML U-02 Modified	4.23E-01	1.89E-01	1.92E-01	9.47E-02	6.59E-03	pCi/l
15-10152-02	MBL		10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-235	EML U-02 Modified	4.23E-02	7.21E-02	7.21E-02	1.27E-01	1.22E-03	pCi/l
15-10152-03	DUP	KC-90-137-U	09/26/15 12:05	10/26/2015	11/9/2015	15-10152	Uranium-235	EML U-02 Modified	3.14E-01	2.56E-01	2.57E-01	2.54E-01	2.27E-02	pCi/l
15-10152-04	TRG	KC91-159-L	09/26/15 09:25	10/26/2015	11/9/2015	15-10152	Uranium-235	EML U-02 Modified	7.66E-02	1.35E-01	1.36E-01	2.44E-01	3.43E-02	pCi/l
15-10152-05	TRG	KC91-159-U	09/26/15 10:10	10/26/2015	11/9/2015	15-10152	Uranium-235	EML U-02 Modified	6.38E-02	1.08E-01	1.08E-01	1.84E-01	1.28E-02	pCi/l
15-10152-06	DO	KC-90-137-U	09/26/15 12:05	10/26/2015	11/9/2015	15-10152	Uranium-235	EML U-02 Modified	2.30E-01	1.98E-01	1.99E-01	1.94E-01	1.35E-02	pCi/l
15-10152-01	LCS	KNOWN	10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-238	EML U-02 Modified	7.88E+00	2.84E-01				pCi/l
15-10152-01	LCS		10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-238	EML U-02 Modified	7.07E+00	1.07E+00	1.19E+00	9.57E-02	1.50E-02	pCi/l
15-10152-02	MBL		10/27/15 00:00	10/26/2015	11/9/2015	15-10152	Uranium-238	EML U-02 Modified	1.96E-02	4.91E-02	4.91E-02	1.02E-01	1.59E-02	pCi/l
15-10152-03	DUP	KC-90-137-U	09/26/15 12:05	10/26/2015	11/9/2015	15-10152	Uranium-238	EML U-02 Modified	1.37E+00	4.93E-01	5.02E-01	2.34E-01	3.25E-03	pCi/l
15-10152-04	TRG	KC91-159-L	09/26/15 09:25	10/26/2015	11/9/2015	15-10152	Uranium-238	EML U-02 Modified	7.98E-01	3.27E-01	3.32E-01	1.64E-01	1.86E-02	pCi/l
15-10152-05	TRG	KC91-159-U	09/26/15 10:10	10/26/2015	11/9/2015	15-10152	Uranium-238	EML U-02 Modified	6.66E-01	2.96E-01	3.00E-01	1.63E-01	1.84E-02	pCi/l
15-10152-06	DO	KC-90-137-U	09/26/15 12:05	10/26/2015	11/9/2015	15-10152	Uranium-238	EML U-02 Modified	1.10E+00	4.04E-01	4.12E-01	2.25E-01	4.73E-02	pCi/l

CU=Counting Uncertainty; CSU=Combined Standard Uncertainty (2-sigma); MDA=Minimal Detected Activity; LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original; CV=Critical Value



EBERLINE ANALYTICAL CORPORATION

601 SCARBORO ROAD OAK RIDGE, TN 37830 865/481-0683 FAX 865/483-4621

SECTION V
ANALYTICAL STANDARD

U-8

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

CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Radionuclide: U-238NAT
Half Life: $(4.468 \pm 0.005) \times 10^9$ years
Catalog No.: 7338
Source No.: 479-50

Customer: TMA EBERLINE
P.O.No.: OR2778
Reference Date: January 1 1995 12:00 PST.
Contained Radioactivity: (Total U) 8.016 μ Ci
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 μ Ci/g.

Method of Calibration

Activity calculations are based upon known specific activity and mass.

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

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).

[Signature], ERIC ALLAS
QUALITY CONTROL

29 DECEMBER 1994
Date Signed



ISOTOPE PRODUCTS LABORATORIES
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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 SOLUTIONS
PRIMARY DILUTION RECERTIFICATION
MP 009

SOLUTION REFERENCE # IPL 479-50 CURRENT DATE 10/1/2015 0:00
SOLUTION # U-8

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

Radionuclide ^{234, 235, 238}U Reference Date 1/1/1995 0:00
Certified Activity 8.016E+00 μCi
Certified Concentration $\mu\text{Ci per gram}$

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 HNO₃

Dilution Instructions: Dilution Solvent Used 1M HNO₃

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: July 27, 2016

Verified & Approved By [Signature]

Date: 10/1/2015 0:00

QC Approval [Signature]

Date: 10/1/15



QUALITY CONTROL PROGRAM
MP-009

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

Solution Reference # MP-009 | JPL 479-50 | Date 10/1/2015 0:00
Solution # U-8a

Principal Radionuclide	Half Life, Years	Half Life, Days
<u>234, 235, 238 U</u>	<u>4.468E+09</u>	<u>1.632E+12</u>

Radionuclide of Interest 234, 235, 238 U | Reference Date 1/1/1995 0:00
Parent Solution Conc. 1.7796E+04 dpm/ml

Chemical Composition of Standard Solution
Uranly Nitrate in 1M HNO₃

Dilution Instructions: | Dilution Solvent Used 1M HNO₃

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution: 4.0000 ml
Total Activity: 7.1182E+04 dpm | Final Activity Concentration: 7.1182E+01 dpm/ml
Final Volume: 1000.00 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: July 27, 2016

Verified & Approved By [Signature]
QC Approval [Signature]

Date: 10/1/2015 0:00
Date: 10/1/15

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

Accuracy Method of measurement (see reverse of this certificate)
Random uncertainty is: $\pm 0.7\%$ Systematic uncertainty: $\pm 0.5\%$
Overall uncertainty in the radioactive concentration quoted above: $\pm 1.7\%$
Overall uncertainty is defined on the reverse of this certificate.

Radiometric 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

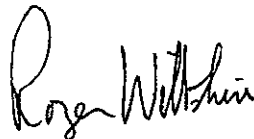
Chemical Composition Calculated weight of U-232, 4.42E-08 grams, as 2M HNO3 solution in a flame sealed glass vial.
This Tracer solution has been produced 'carrier free'.

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

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



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

SOLUTION REFERENCE # AEA/Amersham 92/232/67 CURRENT DATE 10/27/2015 0:00
SOLUTION # U-10

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

Radionuclide ²³²U Reference Date 3/1/2000 0:00
Certified Activity 9.760E-01 μCi
Certified Concentration $\mu\text{Ci per gram}$

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
²³²U(NO₃)₆ in 2M HNO₃

Dilution Instructions: Dilution Solvent Used 2M HNO₃


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: October 26, 2016

Verified & Approved By  Date: 10/27/2015 0:00

QC Approval  Date: 10/28/15



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

MP-009 Date: 10/27/2015 0:00
Solution Reference # AEA/Amersham 92/232/67 Solution # U-10a

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

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

Chemical Composition of Standard Solution
 $^{232}\text{U}(\text{NO}_3)_6$ 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 Activity Concentration: 2.1670E+01 dpm/ml
Final Volume: 1000.00 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: October 26, 2016

Verified & Approved By  Date: 10/27/2015 0:00
QC Approval  Date: 10/28/15

CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Radionuclide:	Th-232	Customer:	TMA EBERLINE
Half Life:	$(1.405 \pm 0.006) \times 10^{10}$ 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 μ Ci.
		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 μ Ci/g.

Method of Calibration

Activity calculations are based upon known specific activity and mass.

Uncertainty of Measurement

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

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).



ISOTOPE PRODUCTS LABORATORIES
 1800 North Keystone Street
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Arma U. Khan

 QUALITY CONTROL

Nov. 8, 1993

 Date Signed



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

SOLUTION REFERENCE # IPL 435-104-2 **CURRENT DATE** 9/29/2015 0:00
SOLUTION # Th-8

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

Radionuclide ^{232 & 228}Th **Reference Date** 11/1/1993 0:00
Certified Activity 9.330E-02 μ Ci
Certified Concentration μ Ci 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	μ Ci

Chemical Composition of Standard Solution

Th(NO₃)₄ in H₂O

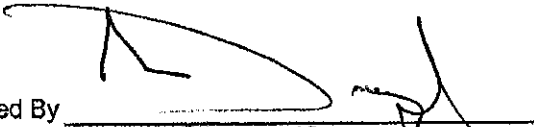
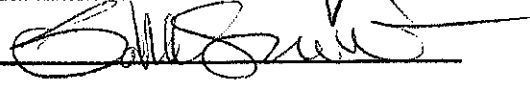
Dilution Instructions: **Dilution Solvent Used** 1% Nitric Acid

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 0.0933 μ Ci **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: August 25, 2016

Verified & Approved By  Date: 9/29/2015 0:00
QC Approval  Date: 9/30/15



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

Solution Reference # MP-009 IPL 435-104-2		Date 9/29/2015 0:00 Solution # Th-8b
Principal Radionuclide 228 & 232 Th	Half Life, Years 1.405E+10	Half Life, Days 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(NO₃)₄ in 1% HNO₃		

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: **August 25, 2016**

Verified & Approved By 

Date: **9/29/2015 0:00**

QC Approval 

Date: **9/30/15**

QA/QC REVIEWED

Date 10/14/91 Initials ut

CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Received
OCT 14 1991
TMA/Eberline
Oak Ridge Lab

Radionuclide Th-230
Half Life: $(7.54 \pm 0.03) \times 10^4$ years
Catalog No.: 7230
Source No.: 388-116

Customer: TMA EBERLINE
P.O.No.: TT4944
Reference Date: November 1 1991 12:00 PST.
Contained Radioactivity: 1.036 μ Ci.

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 μ Ci/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: $\pm 2.0\%$
- b. Random uncertainty in assay: $\pm 0.5\%$
- c. Random uncertainty in weighing(s): $\pm 0.2\%$
- d. Total uncertainty at the 99% confidence level: $\pm 2.7\%$

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)



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[Signature]
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QUALITY CONTROL PROGRAM

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Rev. 14; 10/10/2012

Title: Radioactive Reference Standards Solutions & Records

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

SOLUTION REFERENCE # IPL 388-116 CURRENT DATE 4/15/2015 0:00
SOLUTION # Th-1

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

Radionuclide ²³⁰Thorium Reference Date 11/1/1991 0:00
Certified Activity 1.036E+00 μCi
Certified Concentration $\mu\text{Ci per gram}$

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
²³⁰Th(NO₃)₄ in 0.1N HNO₃

Dilution Instructions: Dilution Solvent Used 0.1N HNO₃

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: February 12, 2016

Recertified By Date: 4/15/2015 0:00
QC Approval Date: 4/15/15



QUALITY CONTROL PROGRAM
MP-009

Rev.14; 10/10/2012
Title: Radioactive Reference Standards Solutions & Records

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

Solution Reference #		MP-009 IPL 388-116	Date	4/15/2015 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	Reference Date		
Parent Solution Conc.	2.30E+03 dpm/ml	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 HNO₃


SECONDARY VOLUMETRIC DILUTION

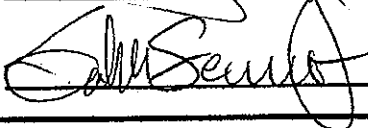
Vol. Parent Solution:	10.0000 ml	Final Activity Concentration:	2.2999E+01 dpm/ml
Total Activity:	2.2999E+04 dpm		
Final Volume:	1000.00 ml		

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: February 12, 2016

Recertified By 

QC Approval 

Date: 4/15/2015 0:00

Date: 4/15/15



**Isotope Products
Laboratories**

An Eckert & Ziegler Company

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Valencia, California 91355

Tel 661•309•1010
Fax 661•257•8303

Th-18

**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:	1.013 μCi 37.48 kBq (Th-229 only)

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.

Am U Khan
Quality Control

9-Jan-02
Date Signed

IPL Ref. No.: 867-54

ISO 9001 CERTIFIED

Medical Imaging Laboratory
24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory
1800 North Keystone Street Burbank, California 91504

: 00031



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

SOLUTION REFERENCE # IPL 867-54 CURRENT DATE 9/29/2015 0:00
SOLUTION # Th-18

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

Radionuclide ²²⁹Th Reference Date 1/15/2002 0:00
Certified Activity 1.013E+00 μ Ci
Certified Concentration μ Ci 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 μ Ci

Chemical Composition of Standard Solution
²²⁹Th(NO₃)₄ in 0.1M HNO₃

Dilution Instructions: Dilution Solvent Used 0.1 M HNO₃

Dilute to a volume of 1000.00 milliliters

Certified Total Activity of 1.0130 μ Ci 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: August 24, 2016

Verified & Approved By [Signature]

Date: 9/29/2015 0:00

QC Approval [Signature]

Date: 9/30/15



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

Solution Reference #	MP-009 IPL 867-54	Date	9/29/2015 0:00
		Solution #	Th-18a
Principal Radionuclide	Half Life, Years	Half Life, Days	
^{228}Th	7.340E+03	2.681E+06	
Radionuclide of Interest	^{228}Th	Reference Date	1/15/2002 0:00
Parent Solution Conc.	2.25E+03 dpm/ml		
Chemical Composition of Standard Solution			
TH(NO ₃) ₄ in 0.1M HNO ₃			

Dilution Instructions: Dilution Solvent Used 0.1M HNO₃

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: August 24, 2016

Verified & Approved By 

Date: 9/29/2015 0:00

QC Approval 

Date: 9/30/15

SECTION VI
QUALITY CONTROL SAMPLE RESULTS SUMMARY

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
15-10152	UJISO	1	pCi	I	Auxier & Associates, Inc.

Laboratory Control Sample

Analyte	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	85.23%	16.85%	100.00%	3.60%	8.08E+00	2.91E-01	6.89E+00	1.16E+00	U-8a	3.52E+01	3.60E+00	5.09E-01
U-238	89.70%	16.77%	100.00%	3.60%	7.88E+00	2.84E-01	7.07E+00	1.19E+00	U-8a	3.44E+01	3.60E+00	5.09E-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)

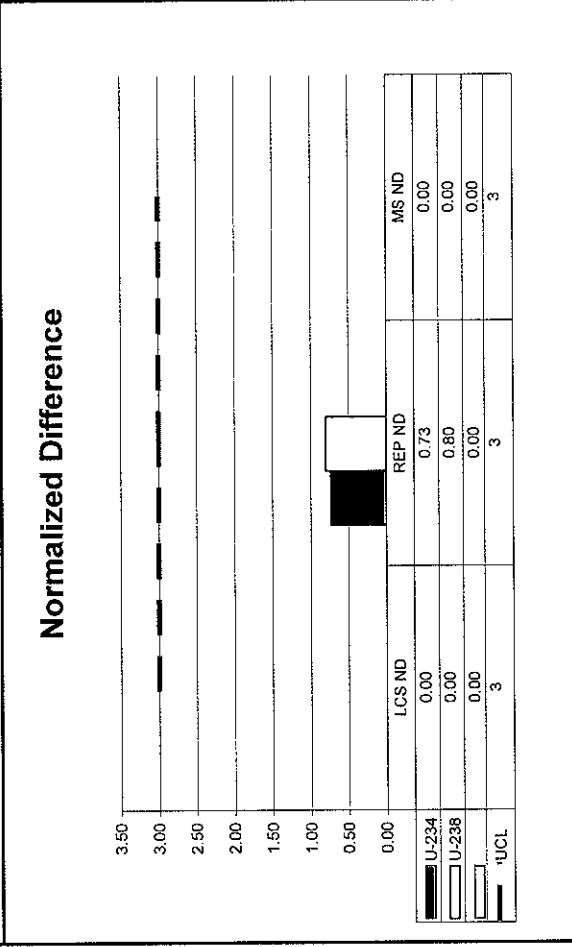
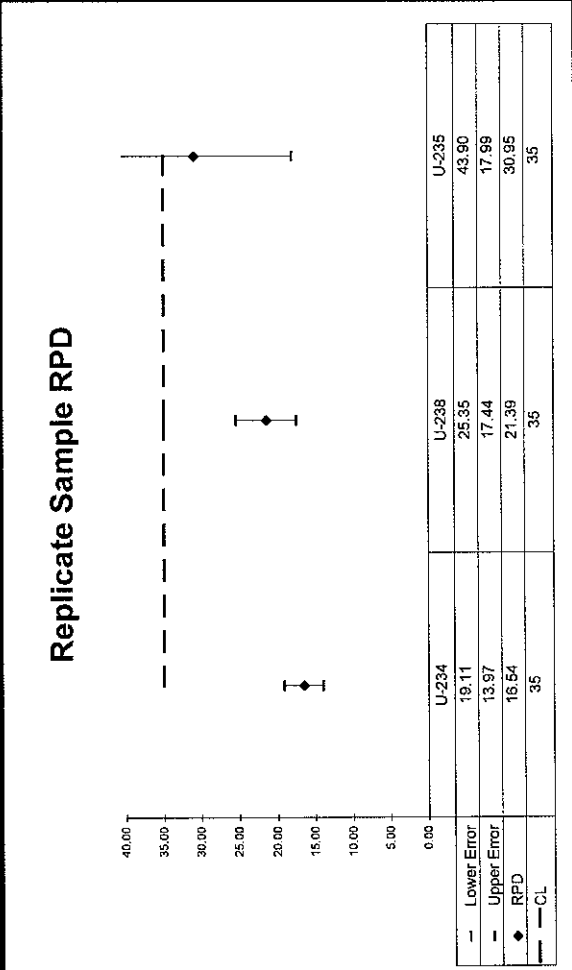
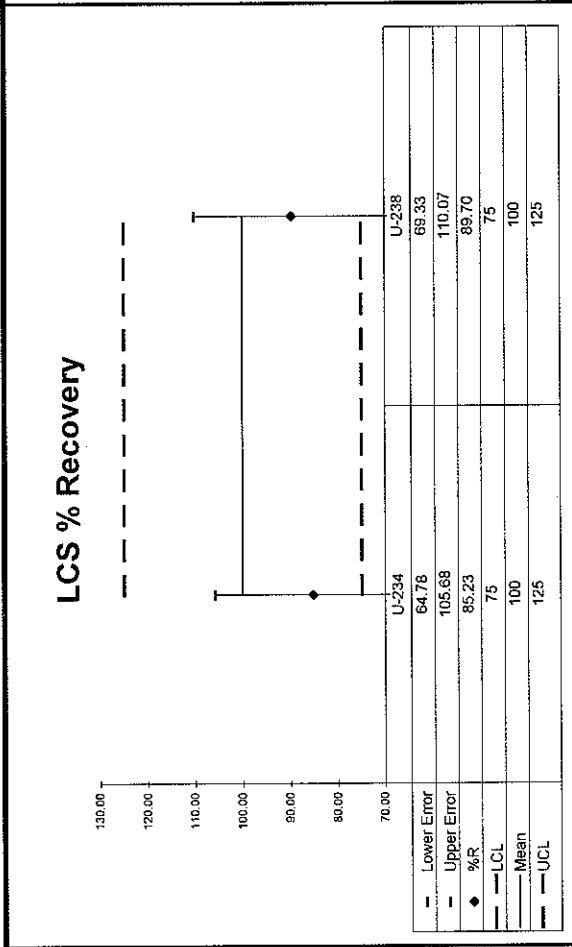
Replicate Sample

Analyte	Normalized Difference	RPD	Original Result	Expected MS Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
U-234	0.73	16.54	1.73E+00	2.04E+00	5.34E-01	6.37E-01	6.37E-01	0.85	OK			OK	OK
U-238	0.80	21.39	1.10E+00	1.37E+00	4.12E-01	5.02E-01	5.02E-01	0.90	OK			NA	OK
U-235	0.51	30.95	2.30E-01	3.14E-01	1.99E-01	2.57E-01	2.57E-01		OK			NA	OK

QC Summary



WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
15-10152	UUISO	1	pCi	1	Auxier & Associates, Inc.



No Matrix Spike

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
15-10152	ThISO	1	pCi	I	Auxier & Associates, Inc.

Laboratory Control Sample

Analyte	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	103.44%	22.57%	100.00%	3.60%	4.88E+00	1.76E-01	5.05E+00	1.14E+00	Th-8b	1.04E+02	3.60E+00	1.05E-01
TH-230	112.24%	23.14%	100.00%	2.70%	5.65E+00	1.53E-01	6.35E+00	1.47E+00	Th-1b	2.35E+01	2.70E+00	5.34E-01
TH-232	93.85%	22.72%	100.00%	3.60%	4.88E+00	1.76E-01	4.58E+00	1.04E+00	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

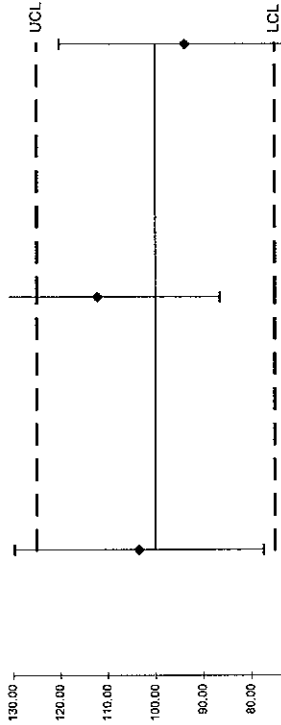
Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
TH-228	1.51	69.38	2.18E-01	1.83E-01	4.50E-01	2.38E-01	1.03	OK			NA	OK
TH-230	1.14	64.44	1.33E-01	1.29E-01	2.60E-01	1.75E-01	1.12	OK			NA	OK
TH-232	0.96	60.84	1.04E-01	1.14E-01	1.96E-01	1.47E-01	0.94	OK			NA	OK

QC Summary

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R	MS % R	MS ND	Rep RPD	Rep ND
TH-228	1.51	69.38	2.18E-01	1.83E-01	4.50E-01	2.38E-01	1.03	OK			NA	OK
TH-230	1.14	64.44	1.33E-01	1.29E-01	2.60E-01	1.75E-01	1.12	OK			NA	OK
TH-232	0.96	60.84	1.04E-01	1.14E-01	1.96E-01	1.47E-01	0.94	OK			NA	OK

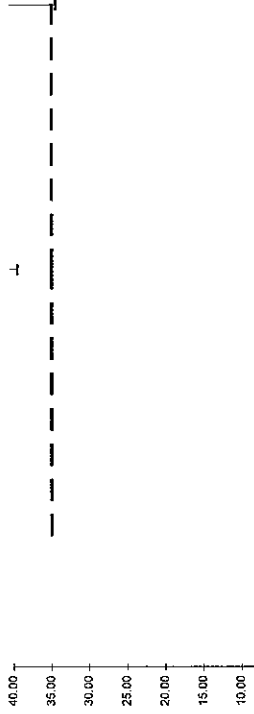
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
15-10152	ThISO	1	pCi	1	Auxier & Associates, Inc.

LCS % Recovery



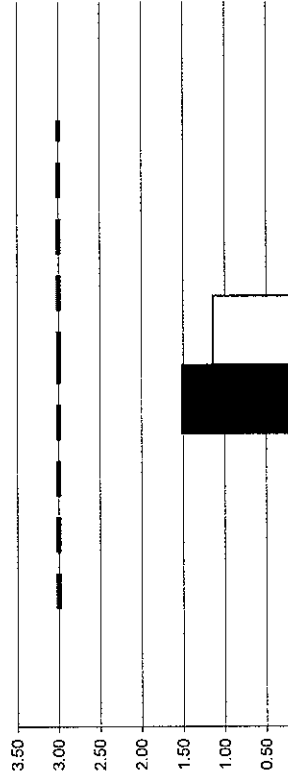
	TH-228	TH-230	TH-232
Lower Error	77.26	86.40	87.52
Upper Error	129.61	138.08	120.17
%R	103.44	112.24	93.85
LCL	75	75	75
Mean	100	100	100
UCL	125	125	125

Replicate Sample RPD



	TH-228	TH-230	TH-232
Lower Error	91.28	89.39	87.27
Upper Error	47.48	39.49	34.41
RPD	69.38	64.44	60.84
CL	35	35	35

Normalized Difference




	LCS ND	REP ND	MS ND
TH-228	0.00	1.51	0.00
TH-230	0.00	1.14	0.00
UCL	3	3	3

No Matrix Spike

SECTION VII
LABORATORY TECHNICIAN'S NOTES
& RUN LOGS

ISO U NOTES

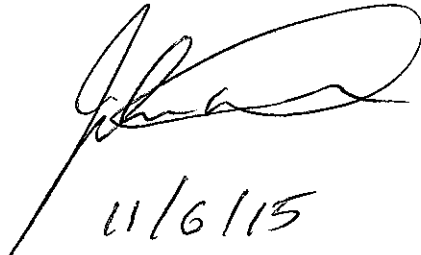
 EBERLINE SERVICES Work Order Analysis Notes	Oak Ridge Laboratory 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	15-10152
		Analysis Code	UUISO
		Run Number	1


#	Date	Dept	User	Notes
1	11/04/15 11:44	PREP	JWOLFE	ALIQOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED SAMPLES TO SEPARATIONS

JWOLFE
11/4/15

 EBERLINE <small>SERVICES</small> Work Order Analysis Notes	Oak Ridge Laboratory 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	15-10152
		Analysis Code	UUISO
		Run Number	1

#	Date	Dept	User	Notes
1	11/04/15 11:44	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED SAMPLES TO SEPARATIONS
2	11/06/15 17:15	CHEM	JDEMELAS	Added concentrated HCl to sample beakers and heated to dryness; Added 20 ml 8N HCL to samples and transferred to new, labeled C-Tubes, rinsing with 8N HCl to bring volume to ~35 ml; Preconditioned resin columns with 35 ml 8N HCl; Centrifuged samples and loaded onto columns; Rinsed C-Tubes with 20 ml 8N HCl, centrifuged as needed and loaded onto columns; Rinsed columns with 35 ml 8N HCl - 0.1N NH4I, 35 ml of 6.5N HCl - 0.04N HF, and 10 ml of 6.5N HCl; Eluted Uranium with 50 ml of 0.5N HCl into clean, labeled 100 ml beakers; Dried-down samples on hotplate; Dissolved samples in ~10 ml of concentrated HCl; Transferred to new, labeled C-Tubes with DI H2O. Set samples aside for later precipitation and filtering.


 11/6/15

 EBERLINE <small>SERVICES</small> Work Order Analysis Notes	Oak Ridge Laboratory 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	15-10152
		Analysis Code	UUISO
		Run Number	1

#	Date	Dept	User	Notes
1	11/04/15 11:44	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED SAMPLES TO SEPARATIONS
2	11/06/15 17:15	CHEM	JDEMELAS	Added concentrated HCl to sample beakers and heated to dryness; Added 20 ml 8N HCL to samples and transferred to new, labeled C-Tubes, rinsing with 8N HCl to bring volume to ~35 ml; Preconditioned resin columns with 35 ml 8N HCl; Centrifuged samples and loaded onto columns; Rinsed C-Tubes with 20 ml 8N HCl, centrifuged as needed and loaded onto columns; Rinsed columns with 35 ml 8N HCl - 0.1N NH4I, 35 ml of 6.5N HCl - 0.04N HF, and 10 ml of 6.5N HCl; Eluted Uranium with 50 ml of 0.5N HCl into clean, labeled 100-ml beakers; Dried-down samples on hotplate; Dissolved samples in ~10 ml of concentrated HCl; Transferred to new, labeled C-Tubes with DI H2O. Set samples aside for later precipitation and filtering.
3	11/09/15 05:05	CHEM	TSMITH	Followed steps 12.1.7 to 12.4.5 in AP-005 . (Precipitated and filtered samples for Uranium)

*11-9-15
JSM*



Reagents Used in an Analysis

Internal Work Order

15-10152

Analysis Code

Run

UUISO

1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
016519P	Nitric Acid	Reagent Grade	JWOLFE	11/4/2015
016963P	Anion Exchange Resin	Reagent Grade	JDEMELAS	11/6/2015
016966S	HCl - HF	6.5N - 0.04N	JDEMELAS	11/6/2015
016983S	HCl - NH4I	8N - 0.1M	JDEMELAS	11/6/2015
016874D03	Hydrochloric Acid	0.5N	JDEMELAS	11/6/2015
016904S	Hydrochloric Acid	6.5N	JDEMELAS	11/6/2015
016970S	Hydrochloric Acid	8N	JDEMELAS	11/6/2015
016796P	Hydrochloric Acid	Reagent Grade	JDEMELAS	11/6/2015
016968S	Carbon substrate	Solution	TSMITH	11/9/2015
016569P	Hydrofluoric Acid	Reagent Grade	TSMITH	11/9/2015
016583S	Neodymium Carrier	1 mg/ml	TSMITH	11/9/2015
016514P	Reagent Alcohol	Reagent Grade	TSMITH	11/9/2015
016606P	Titanous Chloride	Reagent Grade	TSMITH	11/9/2015

Alpha # 3


Photo	Sample #	Client	Function	CTD Time	Analysis	Other
1115	1510101A(1-6)	United	0829	2hr	Puriso	-
1115	1510092A(1-6)	Aucier	0829	2hr	Thiso	-
11/5/15	1510092A(3-16)	Aucier	1128	2hr50-	ISO-TH	KB
1115	1510170A(1-4)	STOPNO	1327	2hr	Lab	-
11/5/15	1510177A(1-4)	ND	1346	2hr50-	Lab	KB
11/5/15	1510167A(1-11)	TBE	1508	2hr50-	Lab	KB
11/5/15	Daily Puriso	AD	0452	1hr	NA	-
1116	SECCAL(23-48)	LAB	0510	2hr	MT	-
1116	SECCAL(45-60)	LAB	0831	2hr	NA	-
1116	1510169A(8-10)	Terra	0830	2hr	U4750	-
1116	1510176A(1-5)	DenMark	0832	2hr	U4750	-
1116	1510176A(1-5)	DenMark	0833	2hr	Puriso	-
1116	1510123A(1-7)	Ucon	0833	2hr	U4750	-
11/6/15	1510123A(4)	Ucon	1104	2hr50-	U4	KB
11/6/15	1510123A(4)	Ucon	1107	2hr50-	U4 NT	KB
11/6/15	1510123A(1-4)	Ucon	1107	2hr50-	Puriso	KB
11/6/15	1510107B(1-6)	EDA	1109	2hr50-	Lab	KB
11/6/15	1510123A(1-4)	Ucon	1130	2hr50-	Thiso	KB
11/6/15	1510136A(1-5)	United	1131	2hr50-	ISO-TH	KB
11/6/15	1510101A(1-5)	United	1131	2hr50-	U4	KB
11/6/15	1510176A(4)	DenMark	1144	2hr50-	U4750	KB
11/6/15	1510176A(1)	DenMark	1144	2hr50-	Puriso	KB
11/6/15	System Bkgnd	Lab	1447	16.46 hrs	-	KB
1118	Daily Puriso	AD	0100	1hr	NA	-
1118	1510177A(8-11)	Miss. Rpt.	0832	2hr	U4750	-
1118	1510178A(1-11)	Miss. Rpt.	0837	2hr	U4750	-
1119	1510152A(1-6)	Aucier	0838	2hr	U4750	-
1118	1510173B(1-4)	Ucon	0839	2hr	Thiso	-
1118	1510173A(1-7)	Miss. Rpt.	0838	2hr	Thiso	-

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	15-10152
		Analysis Code	ThISO
		Run Number	1

#	Date	Dept	User	Notes
1	11/04/15 11:44	PREP	JWOLFE	ALIUQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED SAMPLES TO SEPARATIONS

JWolfe
11/14/15

 EBERLINE <small>SERVICES</small> Work Order Analysis Notes	Oak Ridge Laboratory 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	15-10152
		Analysis Code	ThISO
		Run Number	1

#	Date	Dept	User	Notes
1	11/04/15 11:44	PREP	JWOLFE	ALIUQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED SAMPLES TO SEPARATIONS
2	11/09/15 17:19	CHEM	JDEMELAS	Added concentrated HNO3 to sample beakers and heated to dryness; Added 20 ml 8N HNO3 to samples and transferred to new, labeled C-Tubes, adding 8N HNO3 to bring volume to ~35 ml; Preconditioned resin columns with 50 ml 8N HNO3; Centrifuged samples as needed, and passed through columns; Rinsed C-Tubes with 20 ml 8N HNO3; Centrifuged rinsates and loaded onto columns; Rinsed columns with 40 ml 8N HNO3; Eluted Thorium with 50 ml of 8N HCl into clean, labeled 100-ml beakers; Dried-down samples on hotplate; Dissolved samples in ~10 ml of concentrated HCl; Transferred to new, labeled C-Tubes with deionized water, bringing volume to ~15ml. Set samples aside for later precipitation and filtering.

JDEMELAS
 11/9/15

 EBERLINE <small>SERVICES</small> Work Order Analysis Notes	Oak Ridge Laboratory 601 Scarboro Rd. Oak Ridge, TN 37830 Voice: 865.481.0683 www.eberlineservices.com	Internal Work Order	15-10152
		Analysis Code	ThISO
		Run Number	1

#	Date	Dept	User	Notes
1	11/04/15 11:44	PREP	JWOLFE	ALIUQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES- DRIED SAMPLES DOWN AND SUBMITTED SAMPLES TO SEPARATIONS
2	11/09/15 17:19	CHEM	JDEMELAS	Added concentrated HNO3 to sample beakers and heated to dryness; Added 20 ml 8N HNO3 to samples and transferred to new, labeled C-Tubes, adding 8N HNO3 to bring volume to ~35 ml; Preconditioned resin columns with 50 ml 8N HNO3; Centrifuged samples as needed, and passed through columns; Rinsed C-Tubes with 20 ml 8N HNO3; Centrifuged rinsates and loaded onto columns; Rinsed columns with 40 ml 8N HNO3; Eluted Thorium with 50 ml of 8N HCl into clean, labeled 100-ml beakers; Dried-down samples on hotplate; Dissolved samples in ~10 ml of concentrated HCl; Transferred to new, labeled C-Tubes with deionized water, bringing volume to ~15ml. Set samples aside for later precipitation and filtering.
3	11/10/15 05:08	CHEM	TSMITH	Followed steps 12.2.5 to 12.4.5 in AP-005 . (Precipitated and filtered samples for Thorium)

*11-10-15
TSM*



Reagents Used in an Analysis

Internal Work Order

15-10152

Analysis Code

Run

ThISO

1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
016519P	Nitric Acid	Reagent Grade	JWOLFE	11/4/2015
016963P	Anion Exchange Resin	Reagent Grade	JDEMELAS	11/9/2015
016984S	Hydrochloric Acid	8N	JDEMELAS	11/9/2015
016796P	Hydrochloric Acid	Reagent Grade	JDEMELAS	11/9/2015
016976S	Nitric Acid	8N	JDEMELAS	11/9/2015
016516P	Nitric Acid	Reagent Grade	JDEMELAS	11/9/2015
016972S	Carbon substrate	Solution	TSMITH	11/10/2015
016869S	Cerrium Carrier	0.1mg/ml	TSMITH	11/10/2015
016569P	Hydrofluoric Acid	Reagent Grade	TSMITH	11/10/2015
016514P	Reagent Alcohol	Reagent Grade	TSMITH	11/10/2015

Alpha #3

Date	Sample #	Client	Instr	Cl Time	Analysis	Vol
11/10/15	1511022A(3-11)	Lockheed Martin	0854	2hr50-	Uu	KB
11/10/15	1511024A(1-6)	Apex Labs.	0856	2hr50-	ISO-TL	KB
11/10/15	1510138A(1-4)	MDNR	0857	2hr50-	ISO-TL	KB
11/10/15	1510152A(1-2)	Auxin	0858	2hr50-	ISO-TL	KB

Alpha #3

109

Date	Sample #	Client	Location	Altitude	Sample	Tech
11/10/15	1511022A(3-11)	Lockheed Martin	0854	2hrs50-	UU	KB
11/10/15	1511024A(1-6)	Apex Labs.	0856	2hrs50-	ISO-TL	KB
11/10/15	1510138A(1-4)	MDNR	0857	2hrs50-	ISO-TL	KB
11/10/15	1510152A(1-2)	Auxier	0858	2hrs50-	ISO-TL	KB
11/10/15	1510152A(3-6)	Auxier	1153	2hrs50-	ISO-TL	KB
11/10/15	1511007A(1-4)	UCOR	1155	2hrs50-	Am241	KB
11/10/15	1511007A(1-4)	UCOR	1156	2hrs50-	Am243	KB
11/10/15	1510153A(1-7)	Weston	1157	2hrs50-	UU	KB

SECTION VIII
ANALYTICAL DATA (ISOTOPIC URANIUM)

15-10152
UJISO
Run 1

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/27/15 00:00	1.0000E+00
02	MBL	BLANK		10/27/15 00:00	1.0000E+00
03	DUP	KC-90-137-U	33	09/26/15 12:05	5.0000E-01
04	TRG	KC91-159-L	36	09/26/15 09:25	5.0000E-01
05	TRG	KC91-159-U	37	09/26/15 10:10	5.0000E-01
06	DO	KC-90-137-U	33	09/26/15 12:05	5.0000E-01

Work Order	15-10152
Analysis Code	UJISO
Run	1
Date Received	10/26/2015
Lab Deadline	11/16/2015
Client	Auxier & Associates, Inc.
Project	PAP-KAN
Report Level	4
Activity Units	pCi
Aliquot Units	I
Matrix	WA
Method	EML U-02 Modified
Instrument Type	Alpha Spectroscopy
Radiometric Tracer	U-232
Radiometric Sol#	U-10a
Tracer Act (dpm/g)	18.63
Carrier	
Carrier Conc (mg/ml)	

00004

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

15-10152
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	0.6033	11.2		0.00								
02	MBL	0.6005	11.2		0.00								
03	DUP	0.6027	11.2		0.00								
04	TRG	0.5918	11.0		0.00								
05	TRG	0.5987	11.2		0.00								
06	DO	0.5962	11.1		0.00								

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



15-10152
UUISO
Run 1

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep 10 Date/Time	Sep 10 By	Sep 11 Date/Time	Sep 11 By
01	LCS			11/04/15 10:55	JWOLFE				
02	MBL			11/04/15 10:55	JWOLFE				
03	DUP			11/04/15 10:55	JWOLFE				
04	TRG			11/04/15 10:55	JWOLFE				
05	TRG			11/04/15 10:55	JWOLFE				
06	DO			11/04/15 10:55	JWOLFE				

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

15000

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	6.89E+00	1.05E+00	9.61E-02	8.08E+00	85.23	OK		OK	
02	U-234	MBL	BLANK	pCi/l	3.43E-02	5.84E-02	1.03E-01					OK	OK
03	U-234	DUP	KC-90-137-U	pCi/l	2.04E+00	6.21E-01	2.47E-01				OK	OK	
04	U-234	TRG	KC91-169-L	pCi/l	8.51E-01	3.55E-01	2.75E-01					OK	
05	U-234	TRG	KC91-169-U	pCi/l	7.83E-01	3.26E-01	1.86E-01					OK	
06	U-234	DO	KC-90-137-U	pCi/l	1.73E+00	5.20E-01	2.34E-01					OK	

	
1	UUISO
Run	Analysis Code
Eberline Services Work Order 15-10152	
Auxier & Associates, Inc.	
Client	

25000

	Run	1
	Analysis Code	UISO
Eberline Services Work Order	15-10152	
Client	Auxier & Associates, Inc.	

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	U-234	LCS	10/27/15 00:00	1.00E+00	97.28	0.00	0.00			
02	U-234	MBL	10/27/15 00:00	1.00E+00	101.43	0.00	0.00			
03	U-234	DUP	09/26/15 12:05	5.00E-01	94.82	0.00	0.00			
04	U-234	TRG	09/26/15 09:25	5.00E-01	111.05	0.00	0.00			
05	U-234	TRG	09/26/15 10:10	5.00E-01	106.12	0.00	0.00			
06	U-234	DO	09/26/15 12:05	5.00E-01	110.83	0.00	0.00			

85000

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-UUISO-1

	15-10152	UUISO	1
Eberline Services Work Order	Analysis Code	Run	
Auxier & Associates, Inc.		Client	

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff	A to B, Cor
01	U-234	LCS	11/09/15 08:38		A_Spec	Alpha_048	170	4.29 E+02	5.00 E-03	17	
02	U-234	MBL	11/09/15 08:38		A_Spec	Alpha_049	170	2.00 E+00	0.00 E+00	15.3	
03	U-234	DUP	11/09/15 08:38		A_Spec	Alpha_050	170	5.20 E+01	6.00 E-03	14.3	
04	U-234	TRG	11/09/15 08:38		A_Spec	Alpha_051	170	2.71 E+01	1.70 E-02	15.2	
05	U-234	TRG	11/09/15 08:38		A_Spec	Alpha_052	170	2.51 E+01	5.00 E-03	16.1	
06	U-234	DO	11/09/15 08:38		A_Spec	Alpha_053	170	5.25 E+01	9.00 E-03	14.6	

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-UUISO-1

Eberline Services
Oak Ridge Laboratory

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	7.07E+00	1.07E+00	9.57E-02	7.88E+00	89.70	OK		OK	
02	U-238	MBL	BLANK	pCi/l	1.96E-02	4.91E-02	1.02E-01					OK	OK
03	U-238	DUP	KC-90-137-U	pCi/l	1.37E+00	4.93E-01	2.34E-01				NA	OK	
04	U-238	TRG	KC91-159-L	pCi/l	7.96E-01	3.27E-01	1.64E-01					OK	
05	U-238	TRG	KC91-159-U	pCi/l	6.66E-01	2.96E-01	1.63E-01					OK	
06	U-238	DO	KC-90-137-U	pCi/l	1.10E+00	4.04E-01	2.25E-01					OK	

	Run	1
Analysis Code	UUISO	15-10152
Eberline Services Work Order	Auxier & Associates, Inc.	Client



Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-UUISO-1

Eberline Services
Oak Ridge Laboratory

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff	A to B, Cor
01	U-238	LCS	11/09/15 08:38		A_Spec	Alpha_048	170	4.42 E+02	5.00 E-03	17	
02	U-238	MBL	11/09/15 08:38		A_Spec	Alpha_049	170	1.15 E+00	5.00 E-03	15.3	
03	U-238	DUP	11/09/15 08:38		A_Spec	Alpha_050	170	3.50 E+01	0.00 E+00	14.3	
04	U-238	TRG	11/09/15 08:38		A_Spec	Alpha_051	170	2.55 E+01	3.00 E-03	15.2	
05	U-238	TRG	11/09/15 08:38		A_Spec	Alpha_052	170	2.15 E+01	3.00 E-03	16.1	
06	U-238	DO	11/09/15 08:38		A_Spec	Alpha_053	170	3.36 E+01	8.00 E-03	14.6	

	Run	1
	Analysis Code	UUISO
Eberline Services Work Order	15-10152	
Client	Auxier & Associates, Inc.	

	Run	1
	Analysis Code	UUISO
	Eberline Services Work Order	15-10152
Client	Auxier & Associates, Inc.	

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	4.29E-01	1.89E-01	9.47E-02					OK	
02	U-235	MBL	BLANK	pCi/l	4.23E-02	7.21E-02	1.27E-01					OK	OK
03	U-235	DUP	KC-90-137-U	pCi/l	3.14E-01	2.56E-01	2.54E-01				NA	OK	
04	U-235	TRG	KC91-159-L	pCi/l	7.66E-02	1.35E-01	2.44E-01					OK	
05	U-235	TRG	KC91-159-U	pCi/l	6.38E-02	1.08E-01	1.84E-01					OK	
06	U-235	DO	KC-90-137-U	pCi/l	2.30E-01	1.98E-01	1.94E-01					OK	

39000

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	U-235	LCS	10/27/15 00:00	1.00E+00	97.28	0.00	0.00			
02	U-235	MBL	10/27/15 00:00	1.00E+00	101.43	0.00	0.00			
03	U-235	DUP	09/26/15 12:05	5.00E-01	94.82	0.00	0.00			
04	U-235	TRG	09/26/15 09:25	5.00E-01	111.05	0.00	0.00			
05	U-235	TRG	09/26/15 10:10	5.00E-01	106.12	0.00	0.00			
06	U-235	DO	09/26/15 12:05	5.00E-01	110.83	0.00	0.00			

	1	Run
	UUIISO	
15-10152		Analysis Code
Eberline Services Work Order		
Auxier & Associates, Inc.		Client

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-UUIISO-1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff	A to B, Cor
01	U-235	LCS	11/09/15 08:38		A_Spec	Alpha_048	170	2.17 E+01	2.00 E-03	17	
02	U-235	MBL	11/09/15 08:38		A_Spec	Alpha_049	170	2.00 E+00	0.00 E+00	15.3	
03	U-235	DUP	11/09/15 08:38		A_Spec	Alpha_050	170	6.49 E+00	3.00 E-03	14.3	
04	U-235	TRG	11/09/15 08:38		A_Spec	Alpha_051	170	1.98 E+00	6.00 E-03	15.2	
05	U-235	TRG	11/09/15 08:38		A_Spec	Alpha_052	170	1.66 E+00	2.00 E-03	16.1	
06	U-235	DO	11/09/15 08:38		A_Spec	Alpha_053	170	5.66 E+00	2.00 E-03	14.6	

	1
Run	Analysis Code
UUIISO	
15-10152	
Eberline Services Work Order	
Auxier & Associates, Inc.	
Client	

Handwritten: 2.5

Handwritten: 48, 17, 08/20, 5

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	10/27/15 00:00	1.0000	0.6033	11.2395		0.00		
02	MBL	BLANK	10/27/15 00:00	1.0000	0.6005	11.1873		0.00		
03	DUP	KC-90-137-U	09/26/15 12:05	0.5000	0.6027	11.2283		0.00		
04	TRG	KC91-159-L	09/26/15 09:25	0.5000	0.5918	11.0252		0.00		
05	TRG	KC91-159-U	09/26/15 10:10	0.5000	0.5987	11.1538		0.00		
06	DO	KC-90-137-U	09/26/15 12:05	0.5000	0.5962	11.1072		0.00		

Internal Work Order		Run	Analysis Code		Date		Technician		Technician Initials		Witness Initials	
15-10152		1	UJISO		11/4/2015 10:50		JWOLFE					
LCS & Matrix Spikes												
Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	LCS Volume Used (g)	MS Volume Used (g)	LCSD Volume Used (g)	MSD Volume Used (g)	LCS Known pCi	MS Error Estimate	LCSD Error Estimate	MSD Error Estimate
U-234	U-8a	35.240	11/4/2015	0.500	0.5091				8.08	0.291	0.000	0.000
U-238	U-8a	34.350	11/4/2015	0.500	0.5091				7.88	0.284	0.000	0.000

Balance Printer Tapes													
Tracers													
fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition	Tracer						LCS
01	U-232	U-10a	18.630	11/4/2015	0.6033	0.6500	0.6033 g						
02	U-232	U-10a	18.630	11/4/2015	0.6005	0.6500	0.6005 g						
03	U-232	U-10a	18.630	11/4/2015	0.6027	0.6500	-0.6027 g						
04	U-232	U-10a	18.630	11/4/2015	0.5918	0.6500	-0.5918 g						
05	U-232	U-10a	18.630	11/4/2015	0.5987	0.6500	-0.5987 g						
06	U-232	U-10a	18.630	11/4/2015	0.5962	0.6500	-0.5962 g						
							0.5091 g						
							Matrix Spike						

Aliquot Worksheet

Work Order 15-10152		Run 1	Analysis Code UUISO	Rpt Units liters	Lab Deadline 11/16/2015	Technician JWOLFE	
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Lab Fraction	Auxier & Associates, Inc. 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 Alig	
01	LCS	LCS						1.0000E+00	1.0000E+00				
02	BLANK	MBL						1.0000E+00	1.0000E+00				
03	KC-90-137-J	DUP						5.0000E-01	5.0000E-01				
04	KC91-159-L	TRG						5.0000E-01	5.0000E-01				
05	KC91-159-U	TRG						5.0000E-01	5.0000E-01				
06	KC-90-137-J	DO						5.0000E-01	5.0000E-01				

Comments

ref
11/9/15

Apex-Alpha™

Sample Description: SPIKE
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001335
 Batch Identification: 1510152A-UU
 Sample Identification: 01
 Sample Geometry: Shelf 2
 Procedure Description: U iso

Detector Name: Alpha_048
 Chamber Serial Number: 02030596B
 Detector Serial Number: 83111
 Env. Background: System Bkgd 133945
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
 Sample Date/Time: 11/9/2015 6:27:15 AM
 Acquisition Date/Time: 11/9/2015 8:38:26 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: 0.1654 +/- 0.0101
 Counting Efficiency: 0.1700 +/- 0.0030 on 10/25/2014 3:27:02 PM
 Chem. Recovery Factor: 0.9728 +/- 0.0618

Control Certificate Name: NatU_U-8A
 Chem. Recov. of Control: U-238 0.874436 +/- 0.072603
 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 5.283	313.98	11.08	1.02	0.00E+000	8.7
U-234	4.731	429.15	9.47	0.85	0.00E+000	20.8
U-235	4.373	21.66	42.50	0.34	0.00E+000	3.0
U-238	4.151	442.15	9.33	0.85	0.00E+000	8.2

T = Tracer Peak used for Effective Efficiency

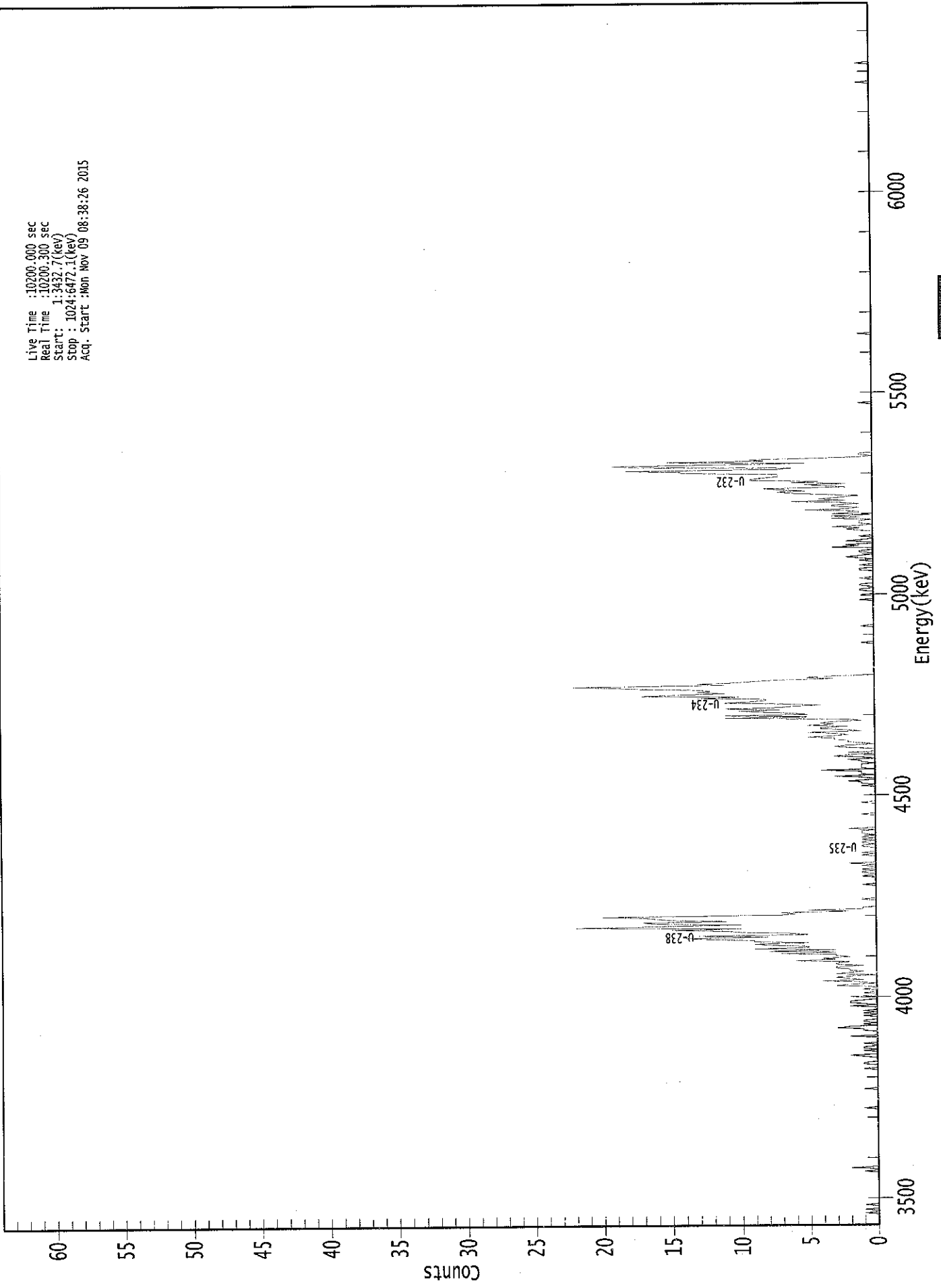
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.997	5302.50*	5.04E+000 +/- 6.03E-001	1.01E-001 +/- 1.21E-002
U-234	0.993	4761.50*	6.89E+000 +/- 1.05E+000	9.61E-002 +/- 1.15E-002
U-235	0.999	4385.50*	4.29E-001 +/- 1.89E-001	9.47E-002 +/- 1.13E-002
U-238	0.992	4184.40*	7.07E+000 +/- 1.07E+000	9.57E-002 +/- 1.14E-002

AG
 11/9/15

0000133512.CNF

Live Time :10200.000 sec
Real Time :10200.300 sec
Start : 1:3432.7(kev)
Stop : 1024:6472.1(kev)
Acq. Start : Mon Nov 09 08:38:26 2015



: 00070

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: 01

Elapsed Live time: 10200

Elapsed Real Time: 10200

Channel									
1:	0	0	0	0	0	0	0	0	0
9:	0	0	1	0	0	1	0	0	0
17:	0	1	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	1	0	0	0
49:	2	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0	0
97:	0	0	1	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0	0
113:	0	0	1	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0	0
129:	0	0	0	1	0	0	0	0	1
137:	1	0	0	0	0	1	2	0	0
145:	0	0	1	0	1	1	0	0	0
153:	1	0	0	0	0	0	2	0	0
161:	0	0	0	1	1	3	2	0	0
169:	1	0	1	1	0	0	0	0	1
177:	0	1	0	1	0	0	0	0	2
185:	0	1	2	2	1	0	0	0	2
193:	0	0	1	0	0	1	0	0	0
201:	3	2	0	1	4	1	2	2	3
209:	2	0	3	2	1	2	2	2	3
217:	3	1	3	3	2	6	3	3	4
225:	2	3	3	7	3	8	3	3	9
233:	5	5	8	9	5	9	9	9	12
241:	14	8	13	5	6	10	11	11	15
249:	10	22	17	10	16	17	11	11	15
257:	16	17	20	7	6	7	2	2	5
265:	1	1	0	0	0	0	0	0	0
273:	1	0	0	0	0	0	0	0	0
281:	0	0	0	0	1	0	0	0	0
289:	0	0	0	1	0	0	1	1	1
297:	0	1	0	0	1	0	2	0	0
305:	0	0	0	0	0	1	0	0	1
313:	0	0	0	0	1	1	0	0	1
321:	1	0	1	0	1	0	0	0	1
329:	1	1	0	2	0	0	0	0	0
337:	0	0	0	0	0	0	0	0	1
345:	0	0	0	0	0	0	0	0	0
353:	0	1	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0	1

369: 0 1 1 2 0 0 1 3

Sample Title: 01

Channel	1	2	3	4	5	6	7	8
377:	0	1	1	1	4	0	1	1
385:	1	1	0	1	1	2	0	1
393:	3	2	0	2	0	0	0	2
401:	3	2	0	1	2	2	3	3
409:	5	3	2	3	5	1	2	4
417:	4	2	5	3	4	3	1	2
425:	11	5	11	5	6	8	10	7
433:	11	7	6	4	7	11	9	8
441:	8	13	10	17	14	11	13	12
449:	13	17	19	22	11	13	10	9
457:	7	3	5	3	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	1
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	0
521:	0	0	0	1	0	0	0	1
529:	0	0	0	1	1	0	0	1
537:	1	0	0	0	0	1	0	0
545:	0	0	0	0	1	1	0	0
553:	1	0	0	0	1	0	1	2
561:	1	0	0	1	1	0	0	3
569:	1	2	0	0	2	1	0	0
577:	1	0	0	0	0	1	2	1
585:	3	1	0	1	1	1	0	3
593:	1	3	0	3	1	1	5	2
601:	1	3	3	1	2	6	2	4
609:	3	2	1	4	6	7	5	7
617:	8	2	3	5	2	6	4	9
625:	9	8	7	7	7	14	14	18
633:	7	6	17	19	11	5	15	8
641:	9	5	1	0	1	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	0	0	0	0	0
681:	0	0	0	0	0	0	0	1
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	1	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 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	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	1	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

KCS
11/9/15

Apex-Alpha™

Sample Description: BLANK
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001334
 Batch Identification: 1510152A-UU
 Sample Identification: 02
 Sample Geometry: Shelf 2
 Procedure Description: U iso

Detector Name: Alpha_049
 Chamber Serial Number: 10006121A
 Detector Serial Number: 49
 Env. Background: System Bkgd 133946
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
 Sample Date/Time: 11/9/2015 6:27:15 AM
 Acquisition Date/Time: 11/9/2015 8:38:34 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
 Tracer Quantity: 0.600 mL
 Effective Efficiency: 0.1547 +/- 0.0097
 Counting Efficiency: 0.1525 +/- 0.0027 on 12/13/2014 2:45:02 PM
 Chem. Recovery Factor: 1.0143 +/- 0.0664

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 5.289	292.32	11.48	0.68	0.00E+000	20.2
U-234	4.717	2.00	169.74	0.00	0.00E+000	3.0
U-235	4.402	2.00	169.74	0.00	0.00E+000	3.0
U-238	4.178	1.15	249.59	0.85	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

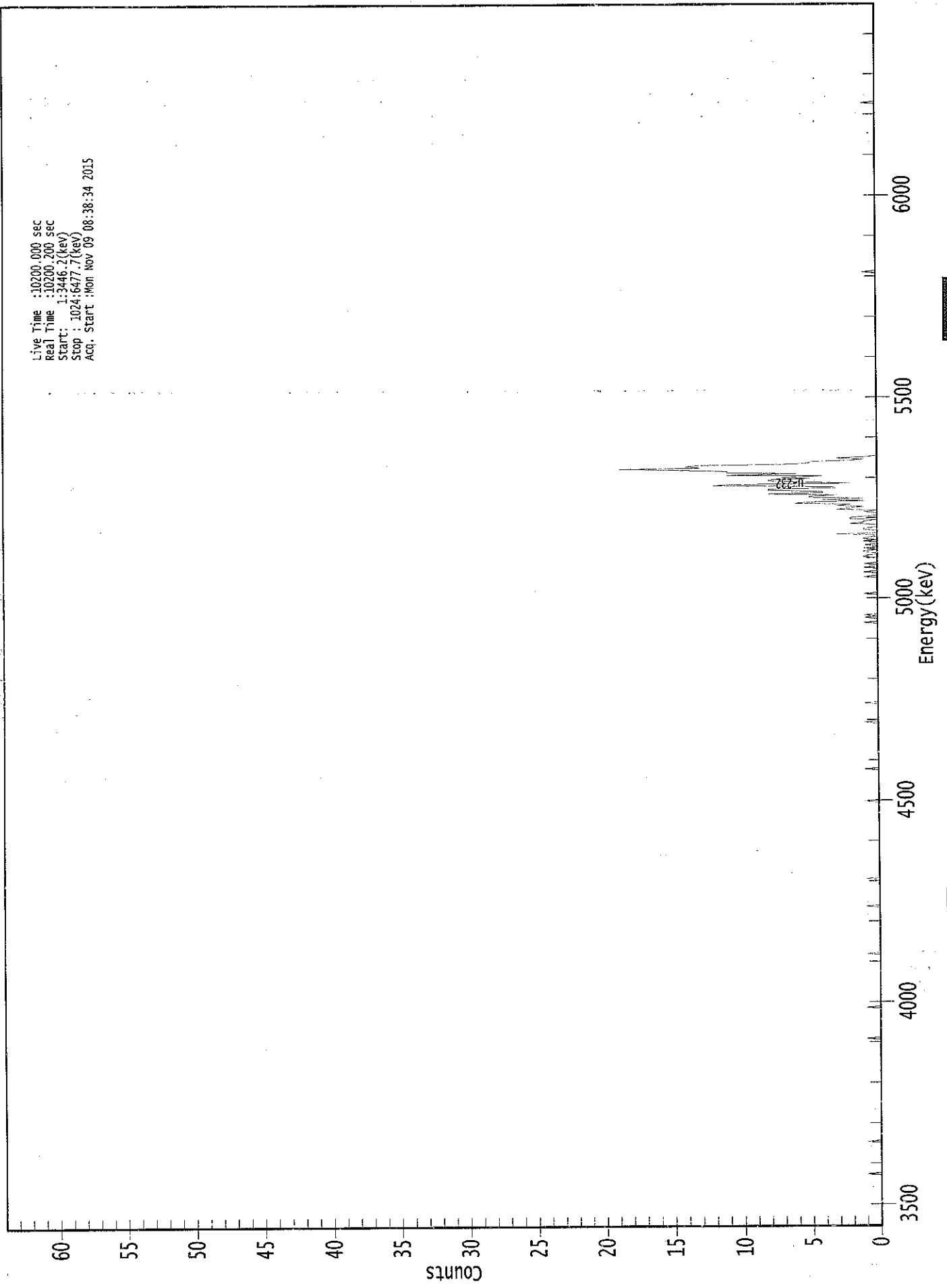
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.999	5302.50*	5.02E+000 +/- 6.19E-001	9.68E-002 +/- 1.19E-002
U-234	0.986	4761.50*	3.43E-002 +/- 5.84E-002	1.03E-001 +/- 1.27E-002
U-235	0.998	4385.50*	4.23E-002 +/- 7.21E-002	1.27E-001 +/- 1.57E-002
U-238	1.000	4184.40*	1.96E-002 +/- 4.91E-002	1.02E-001 +/- 1.26E-002

AG
11/9/15

0000133499.CNF

Live Time : 10200.000 sec
Real Time : 10200.200 sec
Start : 1:34:46.2 (keV)
Stop : 1024:6477.7 (keV)
Acq. Start : Mon Nov 09 08:38:34 2015



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: 10200
 Elapsed Real Time: 10200

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

369: 0 0 0 0 0 0 0 0 0


Sample Title: 02

Channel								
377:	0	0	0	0	0	0	1	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	1	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	1	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	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:	1	0	0	0	1	0	1	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	1	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	1	0
545:	0	0	1	0	0	0	1	0
553:	0	1	0	0	0	0	0	1
561:	1	0	0	1	1	0	1	0
569:	0	1	0	0	1	0	1	1
577:	0	0	3	0	0	0	1	1
585:	0	0	0	2	1	1	0	2
593:	2	1	0	0	0	1	0	3
601:	2	1	3	2	6	5	1	4
609:	1	5	5	3	8	4	4	8
617:	8	3	3	12	11	2	5	8
625:	8	5	7	4	11	6	11	11
633:	14	19	13	14	13	6	5	5
641:	2	1	3	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	1	0

801: 0 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	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	1	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™

VCB
11/9/15

Sample Description: KC-90-137-U-DUP
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001335
 Batch Identification: 1510152A-UU
 Sample Identification: 03
 Sample Geometry: Shelf 2
 Procedure Description: U iso

Detector Name: Alpha_050
 Chamber Serial Number: 10006121B
 Detector Serial Number: 50
 Env. Background: System Bkgd 133947
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 6:27:15 AM
 Acquisition Date/Time: 11/9/2015 8:38:37 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: 0.1354 +/- 0.0090
 Counting Efficiency: 0.1428 +/- 0.0026 on 12/13/2014 2:43:59 PM
 Chem. Recovery Factor: 0.9482 +/- 0.0654

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 5.290	256.66	12.24	0.34	0.00E+000	17.3
U-234	4.740	51.98	27.50	1.02	0.00E+000	4.0
U-235	4.387	6.49	80.40	0.51	0.00E+000	3.0
U-238	4.164	35.00	33.60	0.00	0.00E+000	8.9

T = Tracer Peak used for Effective Efficiency

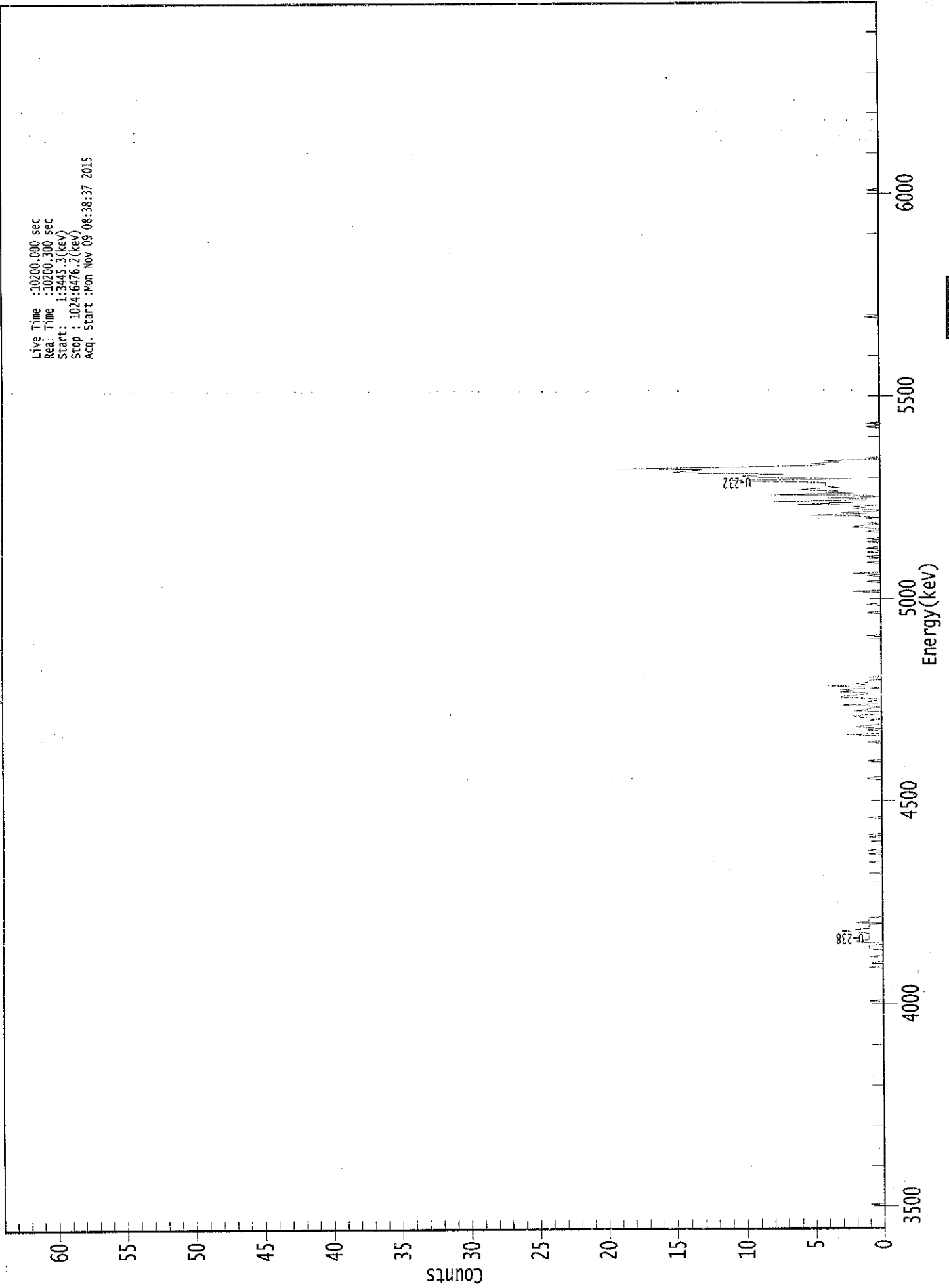
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.999	5302.50*	1.01E+001 +/- 1.32E+000	1.88E-001 +/- 2.45E-002
U-234	0.997	4761.50*	2.04E+000 +/- 6.21E-001	2.47E-001 +/- 3.23E-002
U-235	1.000	4385.50*	3.14E-001 +/- 2.56E-001	2.54E-001 +/- 3.31E-002
U-238	0.997	4184.40*	1.37E+000 +/- 4.93E-001	2.34E-001 +/- 3.06E-002

ACG
11/9/15

0000133500.CNF

Live Time : 10200.000 sec
Real Time : 10200.300 sec
Start : 1:34:53.3 (kev)
Stop : 1024:04:76.2 (kev)
Acq. Start : Mon Nov 09 08:38:37 2015



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: 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	1	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	1	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	1	0	0	0	1	0
225:	0	0	0	1	0	0	0	0
233:	0	1	1	1	1	0	0	2
241:	2	1	1	1	1	1	1	2
249:	3	2	1	1	1	1	0	2
257:	1	1	1	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:	1	0	0	0	0	0	0	0
305:	0	1	0	0	0	0	0	0
313:	1	0	0	1	0	0	0	0
321:	0	0	0	0	0	0	1	0
329:	1	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 1 1

Sample Title: 03

Channel	1	2	3	4	5	6	7	8
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:	0	0	0	0	0	1	0	0
409:	0	0	0	3	0	0	0	1
417:	0	1	2	1	0	0	0	0
425:	0	1	2	2	0	0	0	2
433:	1	1	0	1	3	0	0	1
441:	0	0	3	3	2	1	1	3
449:	2	3	0	1	4	1	2	1
457:	1	0	0	1	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	1	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	1	0	0	0	0	0	0
521:	1	0	0	0	0	0	0	0
529:	0	0	0	2	0	0	0	0
537:	0	0	0	1	0	0	0	0
545:	1	0	2	0	0	0	0	0
553:	0	0	0	1	0	0	0	0
561:	1	0	0	0	1	0	0	1
569:	0	0	0	0	1	0	0	1
577:	0	0	0	0	0	1	0	0
585:	1	2	1	0	1	0	0	0
593:	1	0	2	5	1	3	0	0
601:	2	1	2	0	6	2	8	1
609:	1	4	0	1	8	2	4	3
617:	6	5	3	4	4	4	4	9
625:	11	2	7	10	10	7	13	15
633:	14	13	19	11	5	4	5	3
641:	4	0	1	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	1
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	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: 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	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	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

11/9/15

Apex-Alpha™

Sample Description: KC91-159-L
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001335
 Batch Identification: 1510152A-UU
 Sample Identification: 04
 Sample Geometry: Shelf 2
 Procedure Description: U iso

Detector Name: Alpha_051
 Chamber Serial Number: 10006123A
 Detector Serial Number: 51
 Env. Background: System Bkgd 133948
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 6:27:15 AM
 Acquisition Date/Time: 11/9/2015 8:38:39 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
 Tracer Quantity: 0.592 mL
 Effective Efficiency: 0.1692 +/- 0.0103
 Counting Efficiency: 0.1524 +/- 0.0027 on 12/13/2014 2:42:37 PM
 Chem. Recovery Factor: 1.1105 +/- 0.0707

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	315.11	11.10	2.89	0.00E+000	32.8
U-234	4.730	27.11	39.92	2.89	0.00E+000	5.9
U-235	4.407	1.98	176.34	1.02	0.00E+000	3.0
U-238	4.160	25.49	39.27	0.51	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

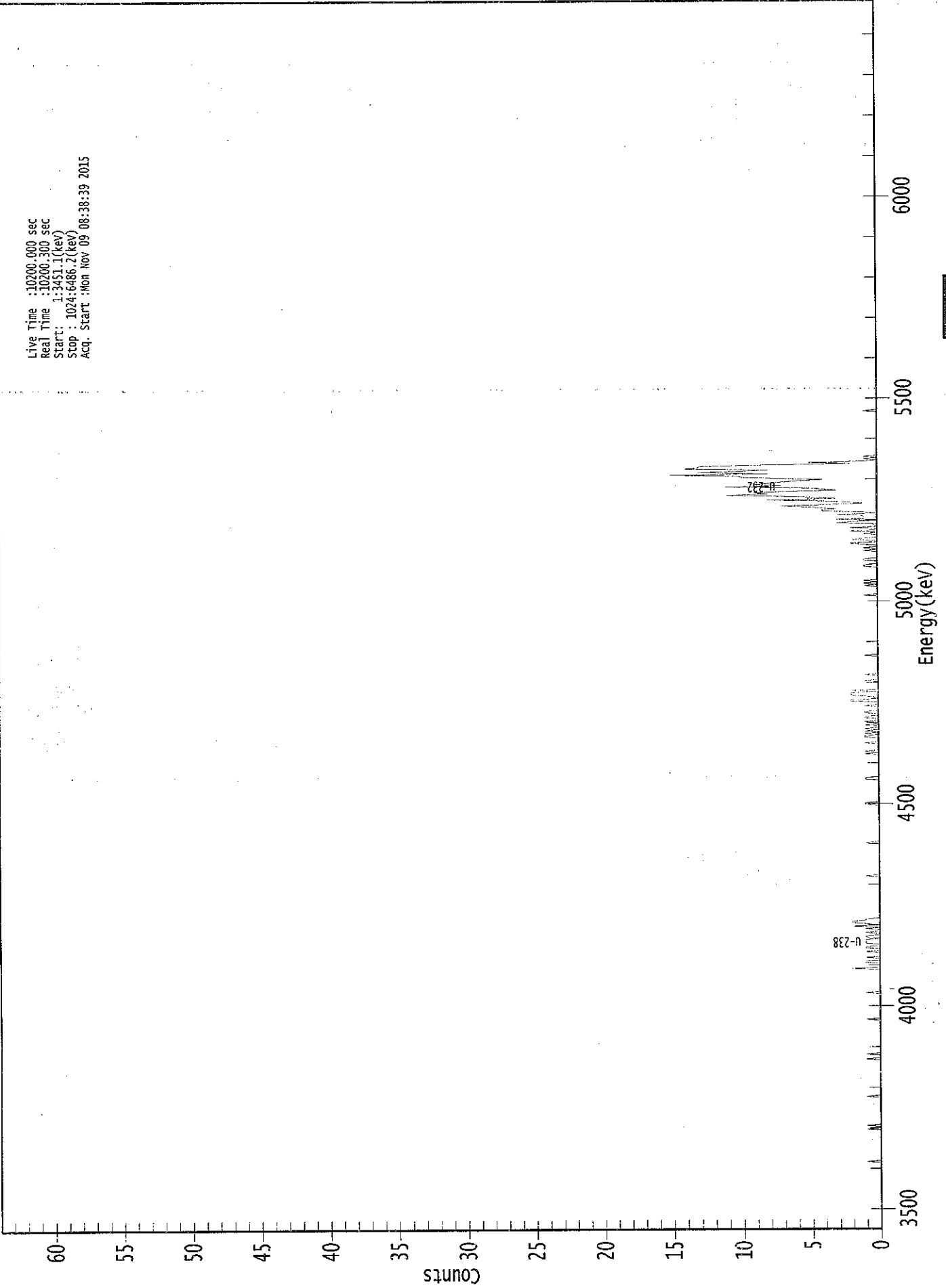
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.998	5302.50*	9.90E+000 +/- 1.19E+000	2.75E-001 +/- 3.30E-002
U-234	0.993	4761.50*	8.51E-001 +/- 3.55E-001	2.75E-001 +/- 3.29E-002
U-235	0.997	4385.50*	7.66E-002 +/- 1.35E-001	2.44E-001 +/- 2.92E-002
U-238	0.996	4184.40*	7.96E-001 +/- 3.27E-001	1.64E-001 +/- 1.96E-002

AG
 11/9/15

0000133501.CNF

Live Time :10200.000 sec
Real Time :10200.300 sec
Start: 1:3451.1(kev)
Stop : 1024:6486.2(kev)
Acq. Start :Mon Nov 09 08:38:39 2015



ROI Type: 1

ROI Type: 3

0000133501

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

369: 0 0 0 0 0 0 0 1 1

Sample Title: 04

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

801: 0 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



Apex-Alpha™

KB
11/9/15

Sample Description: KC91-159-U
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001335
 Batch Identification: 1510152A-UU
 Sample Identification: 05
 Sample Geometry: Shelf 2
 Procedure Description: U iso

Detector Name: Alpha_052
 Chamber Serial Number: 10006123B
 Detector Serial Number: 52
 Env. Background: System Bkgd 133949
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 6:27:15 AM
 Acquisition Date/Time: 11/9/2015 8:38:40 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
 Tracer Quantity: 0.599 mL
 Effective Efficiency: 0.1705 +/- 0.0103
 Counting Efficiency: 0.1607 +/- 0.0029 on 12/13/2014 2:40:57 PM
 Chem. Recovery Factor: 1.0612 +/- 0.0669

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	5.283	321.15	10.95	0.85	0.00E+000	15.2
U-234	4.743	25.15	39.85	0.85	0.00E+000	3.7
U-235	4.373	1.66	169.38	0.34	0.00E+000	2.9
U-238	4.155	21.49	42.86	0.51	0.00E+000	4.4

T = Tracer Peak used for Effective Efficiency

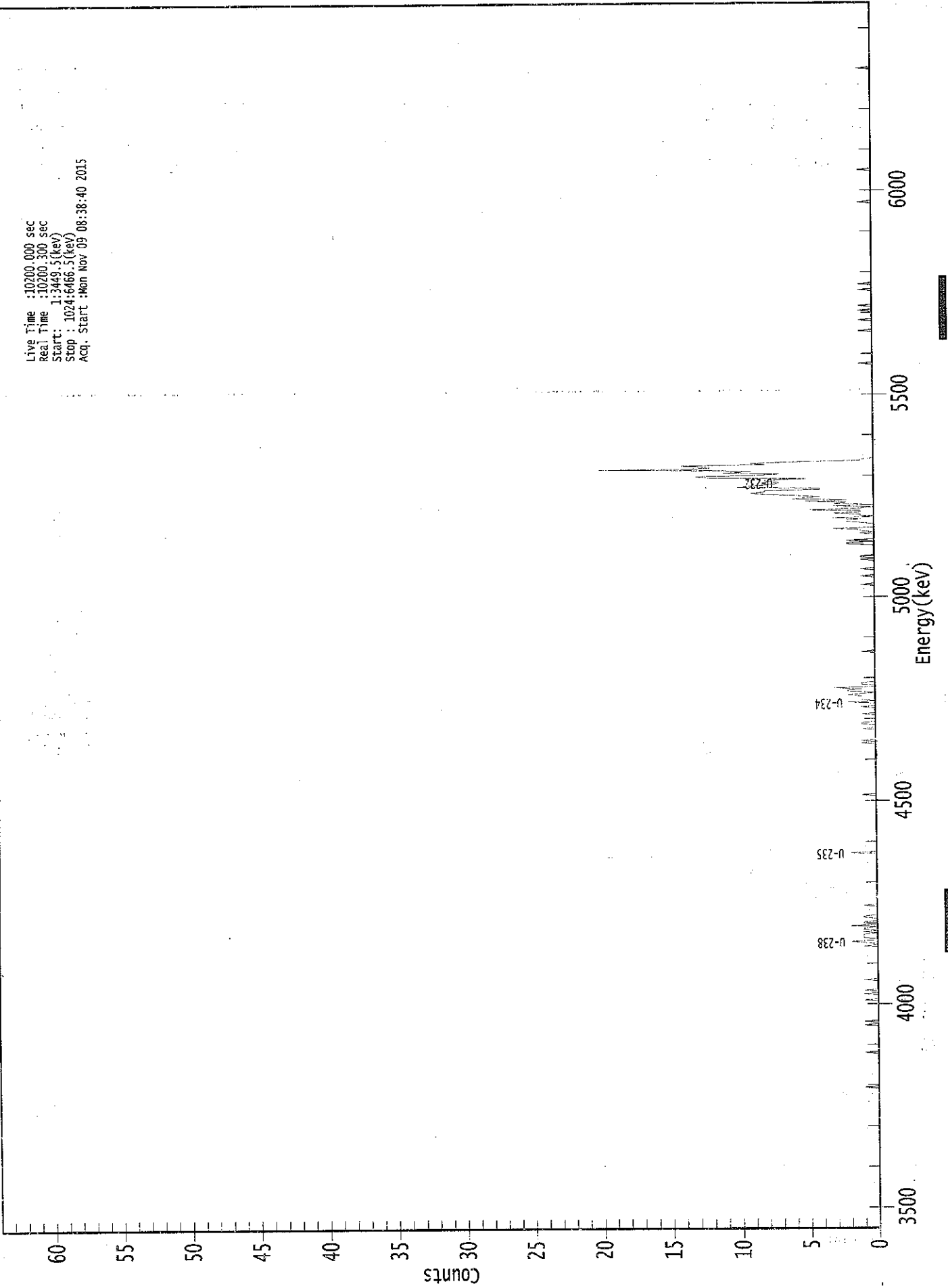
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.997	5302.50*	1.00E+001 +/- 1.19E+000	1.87E-001 +/- 2.21E-002
U-234	0.997	4761.50*	7.83E-001 +/- 3.26E-001	1.86E-001 +/- 2.21E-002
U-235	0.999	4385.50*	6.38E-002 +/- 1.08E-001	1.84E-001 +/- 2.18E-002
U-238	0.994	4184.40*	6.66E-001 +/- 2.96E-001	1.63E-001 +/- 1.93E-002

AG
11/9/15

0000133502.CNF

Live Time :10200.000 sec
Real Time :10200.300 sec
Start : 1:3449.5(kev)
Stop : 1024:6466.5(kev)
Acq. Start :Mon Nov 09 08:38:40 2015



ROI Type: 3

ROI Type: 1

060000

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

369: 0 0 0 0 0 0 0 0 0

Sample Title: 05

Channel	1	2	3	4	5	6	7	8	9
377:	0	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0	0
401:	0	0	0	0	1	0	1	0	0
409:	0	0	0	0	0	0	0	0	0
417:	1	0	0	0	1	1	0	0	0
425:	0	0	0	0	1	0	0	0	0
433:	0	0	1	0	0	0	2	0	0
441:	1	1	1	1	2	1	0	2	2
449:	2	1	3	0	0	1	1	0	0
457:	0	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0	0
481:	1	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0	0
537:	1	0	0	0	0	0	0	0	1
545:	0	0	0	0	0	1	0	0	0
553:	0	0	0	0	0	1	0	0	1
561:	1	0	0	0	0	0	0	0	0
569:	0	0	2	2	0	2	0	0	0
577:	0	0	0	1	0	1	1	3	3
585:	0	0	0	0	1	2	2	1	1
593:	3	0	1	1	3	1	1	5	5
601:	1	0	3	0	3	2	5	2	2
609:	6	5	4	6	8	9	8	8	8
617:	4	4	10	9	8	7	7	8	8
625:	8	5	12	13	9	7	11	9	9
633:	11	20	12	12	14	8	9	6	6
641:	1	1	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0	0
721:	0	1	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0	0
745:	0	0	0	0	1	0	0	0	0
753:	0	0	0	0	0	1	0	0	0
761:	0	0	0	0	0	1	0	0	0
769:	0	1	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	1	0	0
785:	0	0	0	1	0	0	0	0	0
793:	0	0	0	0	0	0	0	0	0

801: 0 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	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	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	0	0	0	0
961:	0	0	0	0	0	0	0	1
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
11/9/15

Sample Description: KC-90-137-U
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001335
 Batch Identification: 1510152A-UU
 Sample Identification: 06
 Sample Geometry: Shelf 2
 Procedure Description: U iso

Detector Name: Alpha_053
 Chamber Serial Number: 10006122A
 Detector Serial Number: 53
 Env. Background: System Bkgd 133950
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 6:27:15 AM
 Acquisition Date/Time: 11/9/2015 8:38:30 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: U232_UU-10A
 Tracer Quantity: 0.596 mL
 Effective Efficiency: 0.1613 +/- 0.0100
 Counting Efficiency: 0.1455 +/- 0.0026 on 12/13/2014 2:39:33 PM
 Chem. Recovery Factor: 1.1083 +/- 0.0715

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 5.289	302.49	11.28	0.51	0.00E+000	14.5
U-234	4.738	52.47	27.52	1.53	0.00E+000	4.5
U-235	4.420	5.66	85.23	0.34	0.00E+000	3.0
U-238	4.155	33.64	34.58	1.36	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

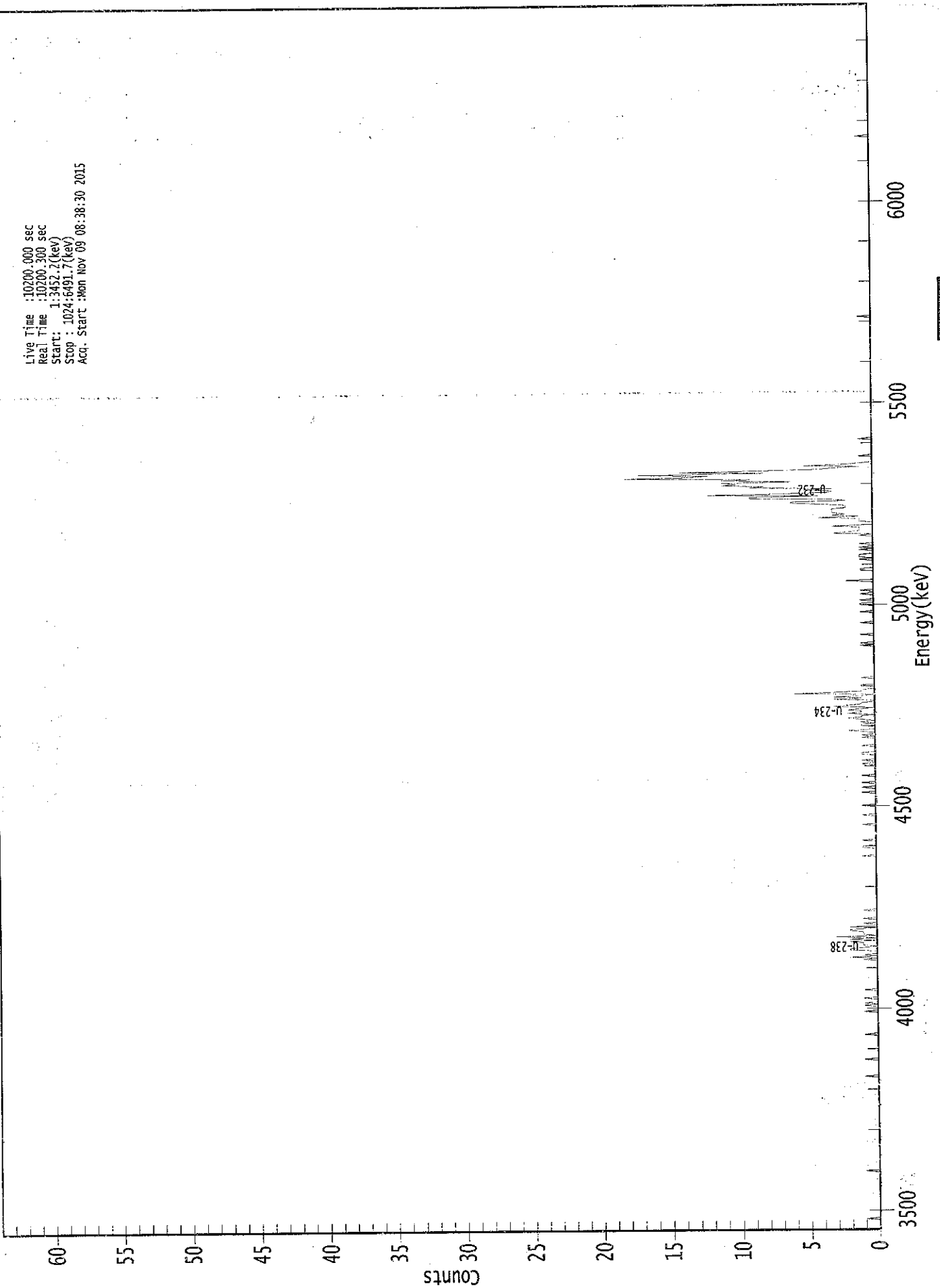
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
U-232	0.999	5302.50*	9.97E+000 +/- 1.21E+000	1.73E-001 +/- 2.10E-002
U-234	0.996	4761.50*	1.73E+000 +/- 5.20E-001	2.34E-001 +/- 2.84E-002
U-235	0.992	4385.50*	2.30E-001 +/- 1.98E-001	1.94E-001 +/- 2.36E-002
U-238	0.994	4184.40*	1.10E+000 +/- 4.04E-001	2.25E-001 +/- 2.73E-002

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0000133513.CNF

Live Time : 10200.000 sec
Real Time : 10200.300 sec
Start : 1.3452.2(keV)
Stop : 1024.6491.7(keV)
Acq. Start : Mon Nov 09 08:38:30 2015



ROI Type: 3

ROI Type: 1

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

369: 1 0 0 0 1 0 0 0

Sample Title: 06

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

801: 0 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:	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	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



QA SUMMARY REPORT

Review Of QA Results - Pulser Check

Date : 11/9/2015
Time : 5:41:28 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Passed	11/9/2015 5:22:42 AM
Alpha 004	21f	ALL	Passed	11/9/2015 5:22:43 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	11/9/2015 5:22:44 AM
Alpha 011	21f	ALL	Passed	11/9/2015 5:22:45 AM
Alpha 012	21f	ALL	Passed	11/9/2015 5:22:46 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Passed	11/9/2015 5:22:47 AM
Alpha 015	21f	ALL	Passed	11/9/2015 5:22:48 AM
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:22:49 AM
Alpha 034	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:22:50 AM
Alpha 035	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:22:52 AM
Alpha 036	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:22:53 AM
Alpha 037	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:22:55 AM
Alpha 038	Alpha Analyst100DC	Peak Energy	Action	11/9/2015 5:22:57 AM
Alpha 039	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:22:58 AM
Alpha 040	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:00 AM
Alpha 041	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:02 AM
Alpha 042	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:04 AM
Alpha 043	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:06 AM
Alpha 044	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:08 AM
Alpha 045	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:11 AM
Alpha 046	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:14 AM
Alpha 047	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:16 AM
Alpha 048	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:18 AM
Alpha 049	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:21 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:23 AM
Alpha 051	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:26 AM
Alpha 052	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:29 AM
Alpha 053	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:32 AM
Alpha 054	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:35 AM
Alpha 055	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:38 AM
Alpha 056	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:41 AM
Alpha 057	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:44 AM
Alpha 058	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:47 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 059	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:51 AM
Alpha 060	Alpha Analyst100DC	ALL	Passed	11/9/2015 5:23:54 AM

APPROVED BY: _____

APPROVAL DATE: 11/9

***** LIBRARY LISTING REPORT *****

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)

Work Order	15-10152
Analysis Code	ThISO
Run	1
Date Received	10/26/2015
Lab Deadline	11/16/2015
Client	Auxier & Associates, Inc.
Project	PAP-KAN
Report Level	4
Activity Units	pCi
Aliquot Units	I
Matrix	WA
Method	EML Th-01 Modified
Instrument Type	Alpha Spectroscopy
Radiometric Tracer	Th-229
Radiometric Sol#	Th-18a
Tracer Act (dpm/g)	22.46
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/27/15 00:00	1.0000E+00
02	MBL	BLANK		10/27/15 00:00	1.0000E+00
03	DUP	KC-90-137-U	33	09/26/15 12:05	5.0000E-01
04	TRG	KC91-159-L	36	09/26/15 09:25	5.0000E-01
05	TRG	KC91-159-U	37	09/26/15 10:10	5.0000E-01
06	DO	KC-90-137-U	33	09/26/15 12:05	5.0000E-01

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

15-10152
THISO
Run 1

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

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	0.4670	10.5		0.00								
02	MBL	0.2342	5.3		0.00								
03	DUP	0.2318	5.2		0.00								
04	TRG	0.2293	5.2		0.00								
05	TRG	0.2310	5.2		0.00								
06	DO	0.2292	5.1		0.00								

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

15-10152

THISO

Run 1

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep 10 Date/Time	Sep 10 By	Sep 11 Date/Time	Sep 11 By
01	LCS			11/04/15 10:48	JWOLFE				
02	MBL			11/04/15 10:48	JWOLFE				
03	DUP			11/04/15 10:48	JWOLFE				
04	TRG			11/04/15 10:48	JWOLFE				
05	TRG			11/04/15 10:48	JWOLFE				
06	DO			11/04/15 10:48	JWOLFE				

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

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-THISO-1


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	5.05E+00	1.04E+00	1.60E-01	4.88E+00	103.44	OK		OK	
02	TH-228	MBL	BLANK	pCi/l	8.59E-03	5.39E-02	1.30E-01					OK	OK
03	TH-228	DUP	KC90-137-U	pCi/l	4.50E-01	2.35E-01	1.76E-01				NA	OK	
04	TH-228	TRG	KC91-159-L	pCi/l	2.79E-01	1.82E-01	1.70E-01					OK	
05	TH-228	TRG	KC91-159-U	pCi/l	2.97E-01	1.88E-01	1.59E-01					OK	
06	TH-228	DO	KC90-137-U	pCi/l	2.18E-01	1.82E-01	2.19E-01					OK	

		Run	1
		Analysis Code	THISO
Eberline Services Work Order		15-10152	
Client		Auxier & Associates, Inc.	

98102

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-THISO-1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	TH-228	LCS	10/27/15 00:00	1.00E+00	63.58	0.00	0.00			
02	TH-228	MBL	10/27/15 00:00	1.00E+00	93.98	0.00	0.00			
03	TH-228	DUP	09/26/15 12:05	5.00E-01	114.87	0.00	0.00			
04	TH-228	TRG	09/26/15 09:25	5.00E-01	119.94	0.00	0.00			
05	TH-228	TRG	09/26/15 10:10	5.00E-01	126.51	0.00	0.00			
06	TH-228	DO	09/26/15 12:05	5.00E-01	102.82	0.00	0.00			

	1	THISO	15-10152	Auxier & Associates, Inc.	Client
Run	Analysis Code	Eberline Services Work Order			

Eberline Services
Oak Ridge Laboratory

Printed: 11/11/2015 12:07 PM
Page 3 of 3

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-THISO-1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	TH-228	LCS	11/10/15 08:57		A_Spec	Alpha_059	170	2.08 E+02	7.00 E-03	17.2
02	TH-228	MBL	11/10/15 08:57		A_Spec	Alpha_060	170	4.70 E-01	9.00 E-03	15.4
03	TH-228	DUP	11/10/15 11:54		A_Spec	Alpha_033	170	1.68 E+01	7.00 E-03	18
04	TH-228	TRG	11/10/15 11:54		A_Spec	Alpha_034	170	1.08 E+01	7.00 E-03	17.9
05	TH-228	TRG	11/10/15 11:53		A_Spec	Alpha_035	170	1.11 E+01	5.00 E-03	16.5
06	TH-228	DO	11/10/15 11:54		A_Spec	Alpha_036	170	7.30 E+00	1.00 E-02	18.1

	1	THISO	15-10152	Auxier & Associates, Inc.
Run		Analysis Code	Eberline Services Work Order	Client

80102

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-THISO-1

	Run	1
Eberline Services Work Order	Analysis Code	THISO
Client	15-10152	
Auxier & Associates, Inc.		

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	TH-230	LCS	10/27/15 00:00	1.00E+00	63.58	0.00	0.00			
02	TH-230	MBL	10/27/15 00:00	1.00E+00	93.98	0.00	0.00			
03	TH-230	DUP	09/26/15 12:05	5.00E-01	114.87	0.00	0.00			
04	TH-230	TRG	09/26/15 09:25	5.00E-01	119.94	0.00	0.00			
05	TH-230	TRG	09/26/15 10:10	5.00E-01	126.51	0.00	0.00			
06	TH-230	DO	09/26/15 12:05	5.00E-01	102.82	0.00	0.00			


Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-THISO-1

		1	
Run		Analysis Code	
Eberline Services Work Order		15-10152	
Client		Auxier & Associates, Inc.	

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Half-life (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	TH-230	LCS	11/10/15 08:57		A_Spec	Alpha_059	170	2.61 E+02	0.00 E+00	17.2
02	TH-230	MBL	11/10/15 08:57		A_Spec	Alpha_060	170	1.32 E+00	4.00 E-03	15.4
03	TH-230	DUP	11/10/15 11:54		A_Spec	Alpha_033	170	1.01 E+01	5.00 E-03	18
04	TH-230	TRG	11/10/15 11:54		A_Spec	Alpha_034	170	1.50 E+01	0.00 E+00	17.9
05	TH-230	TRG	11/10/15 11:53		A_Spec	Alpha_035	170	1.00 E+01	0.00 E+00	16.5
06	TH-230	DO	11/10/15 11:54		A_Spec	Alpha_036	170	4.66 E+00	2.00 E-03	18.1

Preliminary Data Report & Analytical Calculations
Work Order: 15-10152-THISO-1

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	4.58E+00	9.59E-01	1.16E-01	4.88E+00	93.85	OK		OK	
02	TH-232	MBL	BLANK	pCi/l	5.17E-02	6.31E-02	7.63E-02					OK	OK
03	TH-232	DUP	KC90-137-U	pCi/l	1.96E-01	1.46E-01	1.22E-01				NA	OK	
04	TH-232	TRG	KC91-159-L	pCi/l	1.03E-01	1.11E-01	1.48E-01					OK	
05	TH-232	TRG	KC91-159-U	pCi/l	2.71E-01	1.71E-01	1.22E-01					OK	
06	TH-232	DO	KC90-137-U	pCi/l	1.04E-01	1.14E-01	1.36E-01					OK	



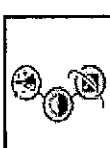
Run **1**

Analysis Code **THISO**

Eberline Services Work Order **15-10152**

Client **Auxier & Associates, Inc.**

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep 10 Date/Time	Sep 11 Date/Time
01	TH-232	LCS	10/27/15 00:00	1.00E+00	63.58	0.00	0.00			
02	TH-232	MBL	10/27/15 00:00	1.00E+00	93.98	0.00	0.00			
03	TH-232	DUP	09/26/15 12:05	5.00E-01	114.87	0.00	0.00			
04	TH-232	TRG	09/26/15 09:25	5.00E-01	119.94	0.00	0.00			
05	TH-232	TRG	09/26/15 10:10	5.00E-01	126.51	0.00	0.00			
06	TH-232	DO	09/26/15 12:05	5.00E-01	102.82	0.00	0.00			



Run 1

THISO Analysis Code

15-10152 Eberline Services Work Order

Auxier & Associates, Inc. Client

3100

Count Room Report
Client: Auxier Associates, Inc.

15-10152-ThISO-1 (pCi/l) in WA
Tracer ID: Th-18a

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	10/27/15 00:00	1.0000	0.4670	10.4888		0.00		
02	MBL	BLANK	10/27/15 00:00	1.0000	0.2342	5.2601		0.00		
03	DUP	KC-90-137-U	09/26/15 12:05	0.5000	0.2318	5.2062		0.00		
04	TRG	KC91-159-L	09/26/15 09:25	0.5000	0.2293	5.1501		0.00		
05	TRG	KC91-159-U	09/26/15 10:10	0.5000	0.2310	5.1883		0.00		
06	DO	KC-90-137-U	09/26/15 12:05	0.5000	0.2292	5.1478		0.00		

396
#33-36

Internal Work Order		Run	Date		Technician		Technician Initials		Witness Initials	
15-10152		1	11/4/2015 10:44		JWOLFE					
Analysis Code		Date		Technician		Technician Initials		Witness Initials		
THISO		11/4/2015 10:44		JWOLFE						

Isotope	Sol #	Activity dpm/g	Solution Date	Approx Addition	LCS		MS		LCS		MS		LCS		MS		
					Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Known pCi	Error Estimate	Known pCi	Error Estimate	Known pCi	Error Estimate	
Th-228	Th-8b	103.560	11/4/2015	0.100	0.1046			4.88	0.176	4.88	0.176	0.00	0.000	0.00	0.000	0.00	0.000
Th-230	Th-1b	23.520	11/4/2015	0.500	0.5337			5.65	0.153	5.65	0.153	0.00	0.000	0.00	0.000	0.00	0.000
Th-232	Th-8b	103.560	11/4/2015	0.100	0.1046			4.88	0.176	4.88	0.176	0.00	0.000	0.00	0.000	0.00	0.000

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition	Tracer		LCS	
							Volume Used (g)	Approx Addition	Volume Used (g)	Approx Addition
01	Th-229	Th-18a	22.460	11/4/2015	0.4670	0.2200				
02	Th-229	Th-18a	22.460	11/4/2015	0.2342	0.2200				
03	Th-229	Th-18a	22.460	11/4/2015	0.2318	0.2200				
04	Th-229	Th-18a	22.460	11/4/2015	0.2293	0.2200				
05	Th-229	Th-18a	22.460	11/4/2015	0.2310	0.2200				
06	Th-229	Th-18a	22.460	11/4/2015	0.2292	0.2200				

0.5337 g
0.1046 g

0.4670 g
0.2342 g
0.2318 g
0.2293 g
0.2310 g
0.2292 g

Matrix Spike

Aliquot Worksheet

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
15-10152	1	THISO	liters	11/16/2015	JWOLFE

Lab Fraction	Auxier & Associates, Inc.		Sample Type	Muffle Data		Dilution Data			Aliquot Data			MS Aliquot Data		H-3 Solids Only	
	Client ID	LCS		Ratio Post/Pre	No of Dilis	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Alig		
01	LCS	LCS	LCS				1.0000E+00	1.0000E+00							
02	BLANK	MBL	MBL				1.0000E+00	1.0000E+00							
03	KC-90-137-U	DUP	DUP				5.0000E-01	5.0000E-01							
04	KC91-159-L	TRG	TRG				5.0000E-01	5.0000E-01							
05	KC91-159-U	TRG	TRG				5.0000E-01	5.0000E-01							
06	KC-90-137-U	DO	DO				5.0000E-01	5.0000E-01							

Comments



Sample Description: SPIKE
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001337
 Batch Identification: 1510152A-TH
 Sample Identification: 01
 Sample Geometry: Shelf 2
 Procedure Description: Th iso

Detector Name: Alpha_059
 Chamber Serial Number: 10006125A
 Detector Serial Number: 59
 Env. Background: System Bkgd 133956
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
 Sample Date/Time: 11/10/2015 8:47:15 AM
 Acquisition Date/Time: 11/10/2015 8:57:40 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_S_TH-18A
 Tracer Quantity: 0.467 mL
 Effective Efficiency: 0.1092 +/- 0.0085
 Counting Efficiency: 0.1717 +/- 0.0030 on 12/13/2014 2:24:23 PM
 Chem. Recovery Factor: 0.6358 +/- 0.0509

Control Certificate Name: NatTh_Th-8
 Chem. Recov. of Control: TH-232 0.938467 +/- 0.104167
 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	5.774	7.32	76.28	0.68	0.00E+000	3.0
TH-228	5.344	207.81	13.64	1.19	0.00E+000	17.4
TH-229 T	4.861	194.66	14.06	0.34	0.00E+000	4.7
TH-230	4.611	261.00	12.16	0.00	0.00E+000	4.1
TH-232	3.938	188.66	14.28	0.34	0.00E+000	6.9

T = Tracer Peak used for Effective Efficiency

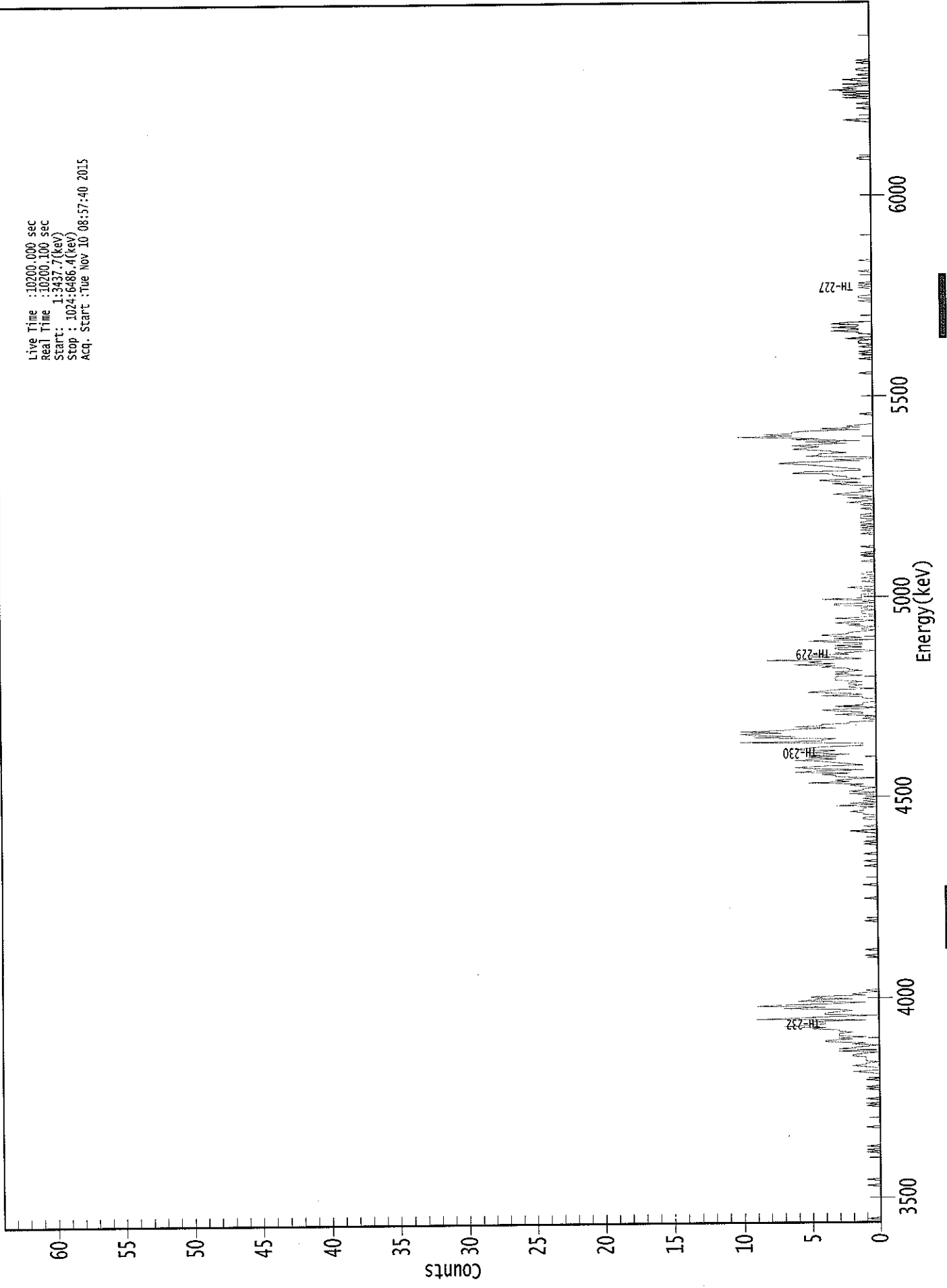
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.971	5850.00*	1.82E-001 +/- 1.42E-001	1.40E-001 +/- 2.15E-002
TH-228	0.984	5400.00*	5.05E+000 +/- 1.04E+000	1.60E-001 +/- 2.45E-002
TH-229	0.999	4872.00*	4.75E+000 +/- 7.27E-001	1.17E-001 +/- 1.79E-002
TH-230	0.981	4672.00*	6.35E+000 +/- 1.24E+000	1.46E-001 +/- 2.23E-002
TH-232	0.982	3997.00*	4.58E+000 +/- 9.59E-001	1.16E-001 +/- 1.78E-002

AG
 11/10/15

0000133713.CNF

Live Time : 10200.000 sec
Real Time : 10200.100 sec
Start : 1:3437.7(kev)
Stop : 1024:0486.4(kev)
Acq. Start : Tue Nov 10 08:57:40 2015



ROI Type: 3

ROI Type: 1

: 00110

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

369: 5 2 3 2 0 3 3 4

Sample Title: 01

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

801: 0 0 0 0 0 1 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	1	1	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	1	2	0	0	0	0
929:	0	0	0	0	0	1	0	0
937:	0	1	0	0	0	0	2	0
945:	2	0	2	0	3	1	2	1
953:	0	2	0	0	1	2	0	0
961:	0	1	0	0	0	1	1	0
969:	0	0	0	1	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



Sample Description: BLANK
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001337
 Batch Identification: 1510152A-TH
 Sample Identification: 02
 Sample Geometry: Shelf 2
 Procedure Description: Th iso

Detector Name: Alpha_060
 Chamber Serial Number: 10006125B
 Detector Serial Number: 60
 Env. Background: System Bkgd 133957
 Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
 Sample Date/Time: 11/10/2015 8:47:15 AM
 Acquisition Date/Time: 11/10/2015 8:57:42 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_S_TH-18A
 Tracer Quantity: 0.234 mL
 Effective Efficiency: 0.1450 +/- 0.0135
 Counting Efficiency: 0.1543 +/- 0.0028 on 12/13/2014 2:22:05 PM
 Chem. Recovery Factor: 0.9398 +/- 0.0892

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	5.812	6.32	82.73	0.68	0.00E+000	3.0
TH-228	5.405	0.47	626.93	1.53	0.00E+000	3.0
TH-229 T	4.873	129.66	17.24	0.34	0.00E+000	5.9
TH-230	4.613	1.32	215.97	0.68	0.00E+000	3.0
TH-232	3.909	2.83	120.53	0.17	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

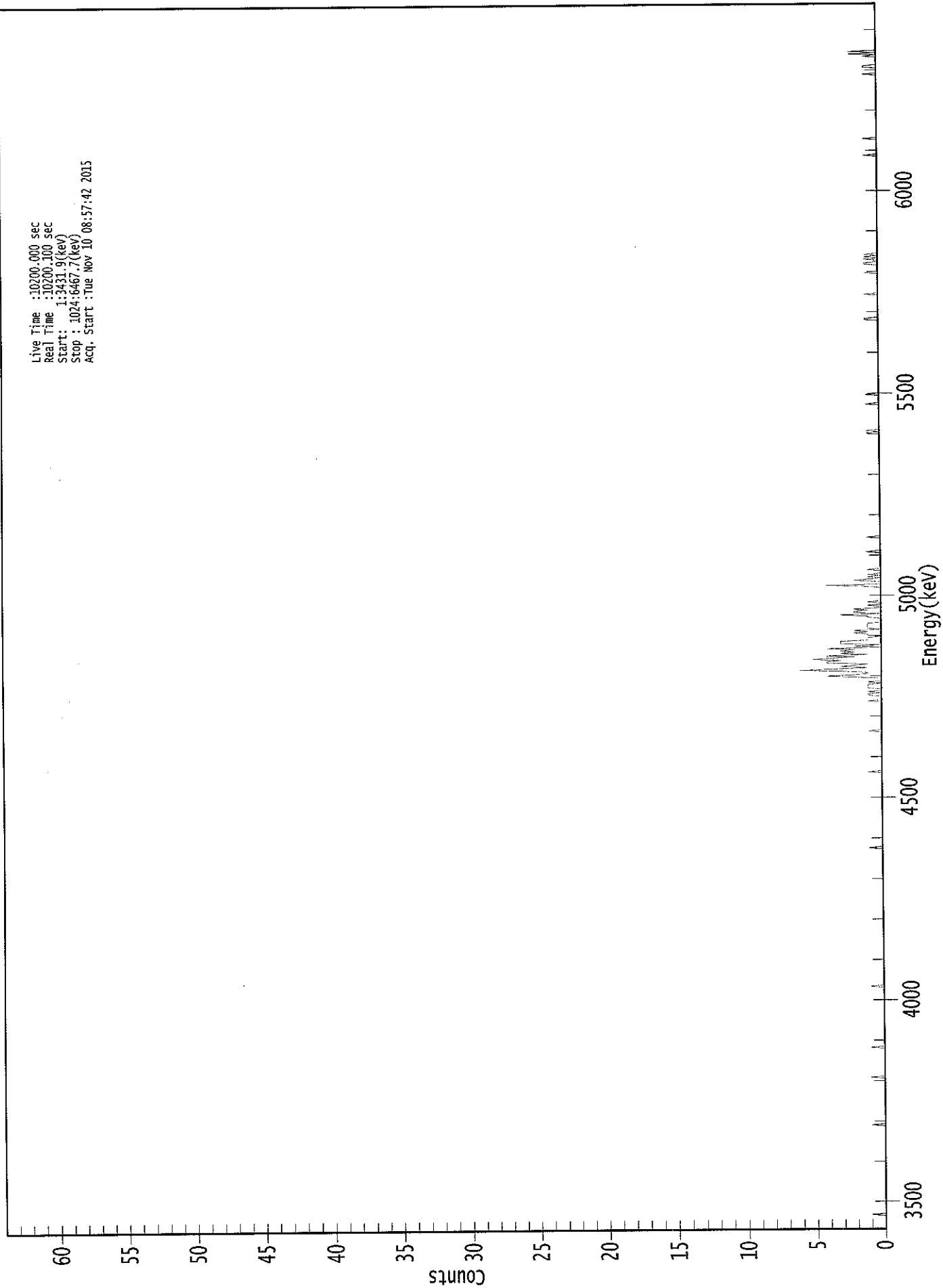
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.993	5850.00*	1.18E-001 +/- 1.00E-001	1.06E-001 +/- 1.93E-002
TH-228	1.000	5400.00*	8.59E-003 +/- 5.39E-002	1.30E-001 +/- 2.38E-002
TH-229	1.000	4872.00*	2.38E+000 +/- 4.35E-001	8.78E-002 +/- 1.60E-002
TH-230	0.982	4672.00*	2.42E-002 +/- 5.24E-002	1.03E-001 +/- 1.89E-002
TH-232	0.960	3997.00*	5.17E-002 +/- 6.31E-002	7.63E-002 +/- 1.39E-002

AG
 11/11/15

0000133714.CNF

Live Time : 10200.000 sec
Real Time : 10200.100 sec
Start : 1:3431.9(kev)
Stop : 1024:6467.7(kev)
Acq. Start : Tue Nov 10 08:57:42 2015



12100

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: 10200
 Elapsed Real Time: 10200

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

369: 0 0 0 0 0 0 0 0 0

Sample Title: 02

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

801: 0 0 0 0 1 1 0 0

Sample Title: 02

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	1	0	1	0	1	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	1
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	1	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	1	0	0	0	0
969:	0	1	1	0	0	0	0	0
977:	0	0	1	0	2	0	2	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



Sample Description: KC-90-137-U DUP
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001337
 Batch Identification: 1510152A-TH
 Sample Identification: 03
 Sample Geometry: Shelf 2
 Procedure Description: Th iso

Detector Name: Alpha_033
 Chamber Serial Number: 04026479A
 Detector Serial Number: 91132
 Env. Background: System Bkgd 133930
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 8:47:15 AM
 Acquisition Date/Time: 11/10/2015 11:54:02 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_S_TH-18A
 Tracer Quantity: 0.232 mL
 Effective Efficiency: 0.2073 +/- 0.0166
 Counting Efficiency: 0.1805 +/- 0.0032 on 10/25/2014 2:26:39 PM
 Chem. Recovery Factor: 1.1487 +/- 0.0943

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	5.809	3.32	119.77	0.68	0.00E+000	3.0
TH-228	5.357	16.81	49.75	1.19	0.00E+000	3.0
TH-229 T	4.857	183.49	14.49	0.51	0.00E+000	9.4
TH-230	4.667	10.15	64.46	0.85	0.00E+000	3.0
TH-232	3.996	7.66	72.63	0.34	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

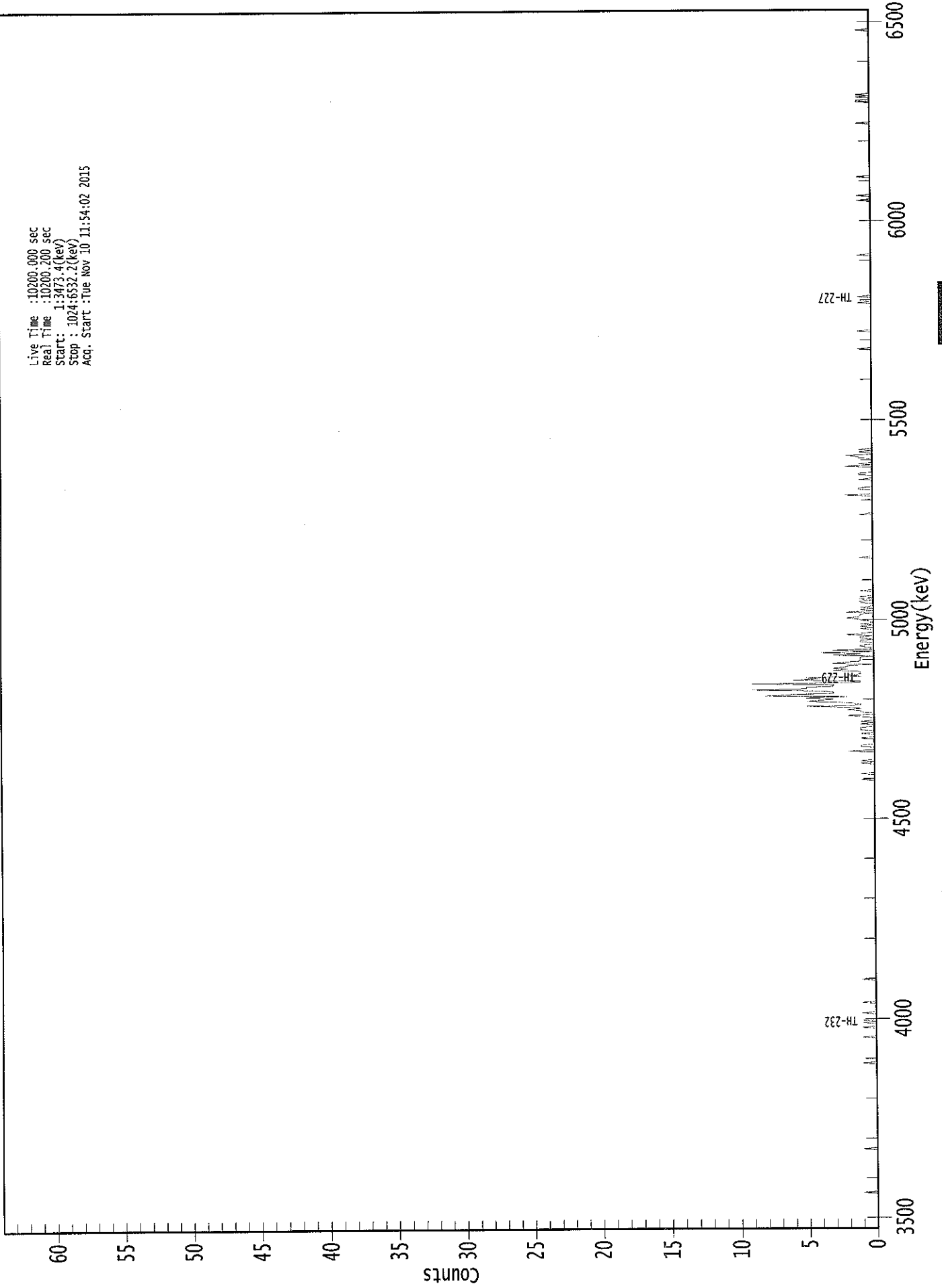
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.991	5850.00*	8.74E-002 +/- 1.06E-001	1.48E-001 +/- 2.33E-002
TH-228	0.990	5400.00*	4.50E-001 +/- 2.35E-001	1.76E-001 +/- 2.77E-002
TH-229	0.999	4872.00*	4.71E+000 +/- 7.41E-001	1.35E-001 +/- 2.12E-002
TH-230	1.000	4672.00*	2.60E-001 +/- 1.72E-001	1.53E-001 +/- 2.41E-002
TH-232	1.000	3997.00*	1.96E-001 +/- 1.46E-001	1.22E-001 +/- 1.92E-002

AG
 11/10/15

0000133715.CNF

Live Time : 10200.000 sec
Real Time : 10200.200 sec
Start : 1:3473.4(kev)
Stop : 1024:5532.2(kev)
Acq. Start : Tue Nov 10 11:54:02 2015



00129

369: 0 0 0 0 0 0 0 0 0

Sample Title: 03

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	1	0	0	0	0	1	0	0
385:	0	0	0	0	0	0	1	0
393:	1	0	0	0	0	0	0	0
401:	2	0	0	0	1	1	0	0
409:	0	0	0	1	0	0	0	1
417:	0	0	1	1	1	0	0	1
425:	0	1	0	0	0	1	2	0
433:	0	1	1	2	1	2	5	1
441:	1	2	5	4	3	5	2	8
449:	6	3	3	4	9	5	5	3
457:	3	9	1	1	6	4	5	1
465:	2	1	1	1	3	2	3	2
473:	2	0	3	2	1	1	1	1
481:	0	3	1	4	0	3	0	0
489:	1	1	0	0	1	1	0	1
497:	1	0	2	1	0	0	0	1
505:	0	1	0	1	0	0	1	1
513:	2	1	1	1	0	2	0	1
521:	0	1	0	0	0	1	1	0
529:	1	0	1	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	1	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	2
617:	0	0	0	0	1	1	0	0
625:	0	0	0	0	1	0	0	0
633:	1	1	0	0	0	0	0	2
641:	0	1	0	0	0	0	1	1
649:	2	0	0	1	0	1	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:	1	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:	1	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 0

Sample Title: 03

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	1	0
865:	0	0	1	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	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	1
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	1	1	0	0	1	0	1
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	1	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



Sample Description: KC91-159-L
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001337
 Batch Identification: 1510152A-TH
 Sample Identification: 04
 Sample Geometry: Shelf 2
 Procedure Description: Th iso

Detector Name: Alpha_034
 Chamber Serial Number: 04026479B
 Detector Serial Number: 91136
 Env. Background: System Bkgd 133931
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 8:47:15 AM
 Acquisition Date/Time: 11/10/2015 11:54:03 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_S_TH-18A
 Tracer Quantity: 0.229 mL
 Effective Efficiency: 0.2145 +/- 0.0170
 Counting Efficiency: 0.1789 +/- 0.0031 on 10/25/2014 2:30:05 PM
 Chem. Recovery Factor: 1.1994 +/- 0.0974

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	5.753	1.98	176.34	1.02	0.00E+000	3.0
TH-228	5.358	10.81	63.34	1.19	0.00E+000	3.7
TH-229 T	4.863	187.83	14.31	0.17	0.00E+000	5.0
TH-230	4.604	15.00	52.27	0.00	0.00E+000	3.0
TH-232	3.983	4.15	107.12	0.85	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

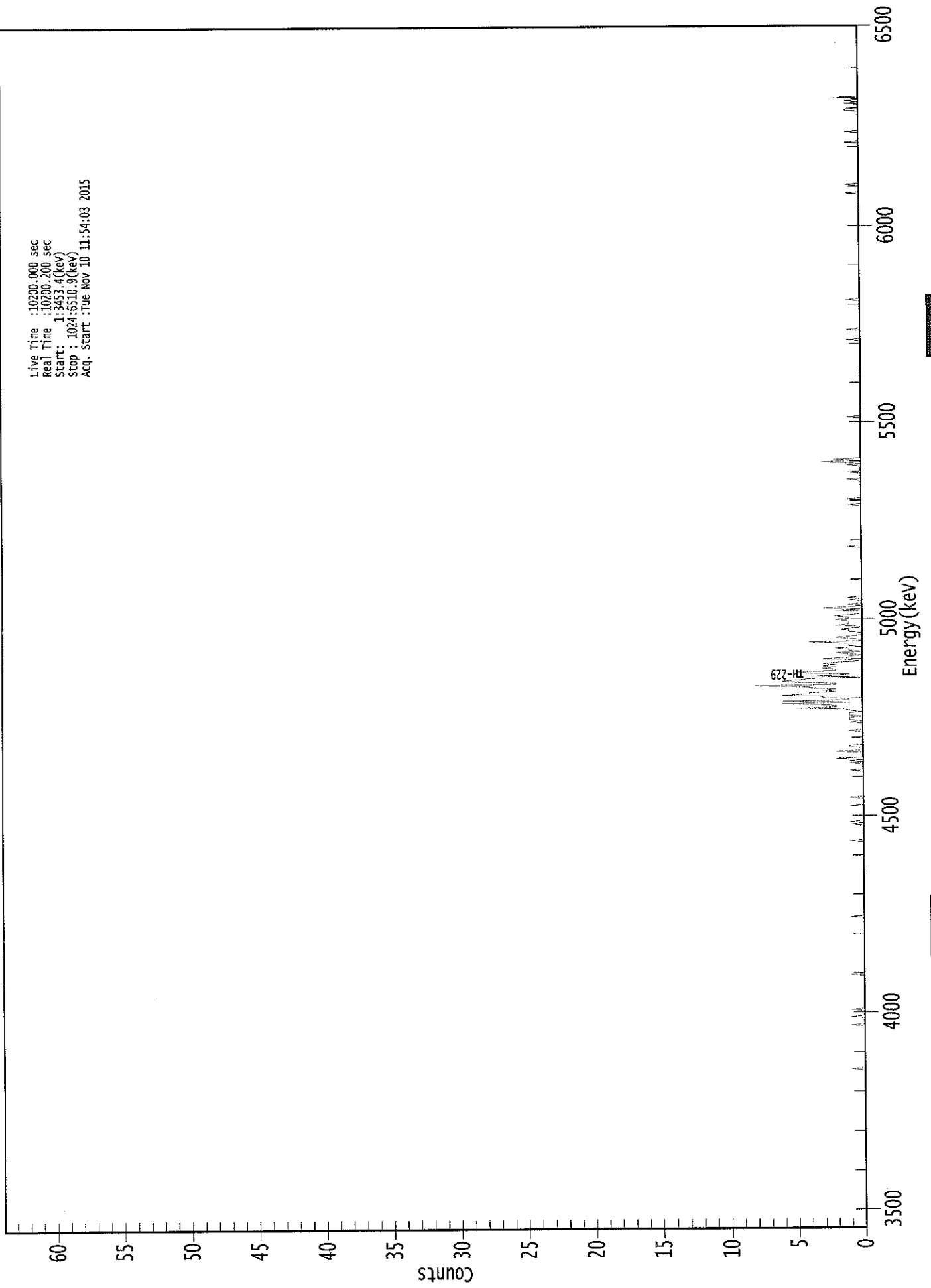
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.952	5850.00*	5.04E-002 +/- 8.92E-002	1.60E-001 +/- 2.49E-002
TH-228	0.991	5400.00*	2.79E-001 +/- 1.82E-001	1.70E-001 +/- 2.65E-002
TH-229	1.000	4872.00*	4.66E+000 +/- 7.25E-001	1.04E-001 +/- 1.61E-002
TH-230	0.976	4672.00*	3.71E-001 +/- 2.02E-001	1.48E-001 +/- 2.31E-002
TH-232	0.999	3997.00*	1.03E-001 +/- 1.11E-001	1.48E-001 +/- 2.30E-002

AG
 11/10/15

0000133716.CNF

Live Time :10200.000 sec
Real Time :10200.200 sec
Start : 1:3453.4(kev)
Stop : 1024:6510.9(kev)
Acq. Start : Tue Nov 10 11:54:03 2015



10100

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: 04

Elapsed Live time: 10200
 Elapsed Real Time: 10200

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

369: 0 0 0 0 0 0 0 0 0

Sample Title: 04

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

801: 0 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:	1	0	0	0	0	0	0	1
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	1	0	0	0	0
929:	0	0	0	0	1	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	0	1	1
953:	0	0	0	0	1	0	1	0
961:	0	2	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: KC91-159-U
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001337
 Batch Identification: 1510152A-TH
 Sample Identification: 05
 Sample Geometry: Shelf 2
 Procedure Description: Th iso

Detector Name: Alpha_035
 Chamber Serial Number: 04026477A
 Detector Serial Number: 58771
 Env. Background: System Bkgd 133932
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 8:47:15 AM
 Acquisition Date/Time: 11/10/2015 11:53:58 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_S_TH-18A
 Tracer Quantity: 0.231 mL
 Effective Efficiency: 0.2084 +/- 0.0167
 Counting Efficiency: 0.1647 +/- 0.0029 on 10/25/2014 2:34:10 PM
 Chem. Recovery Factor: 1.2651 +/- 0.1037

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	5.837	5.32	91.11	0.68	0.00E+000	3.0
TH-228	5.395	11.15	61.26	0.85	0.00E+000	3.0
TH-229 T	4.898	183.83	14.46	0.17	0.00E+000	8.4
TH-230	4.607	10.00	65.01	0.00	0.00E+000	3.0
TH-232	3.953	10.66	61.14	0.34	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

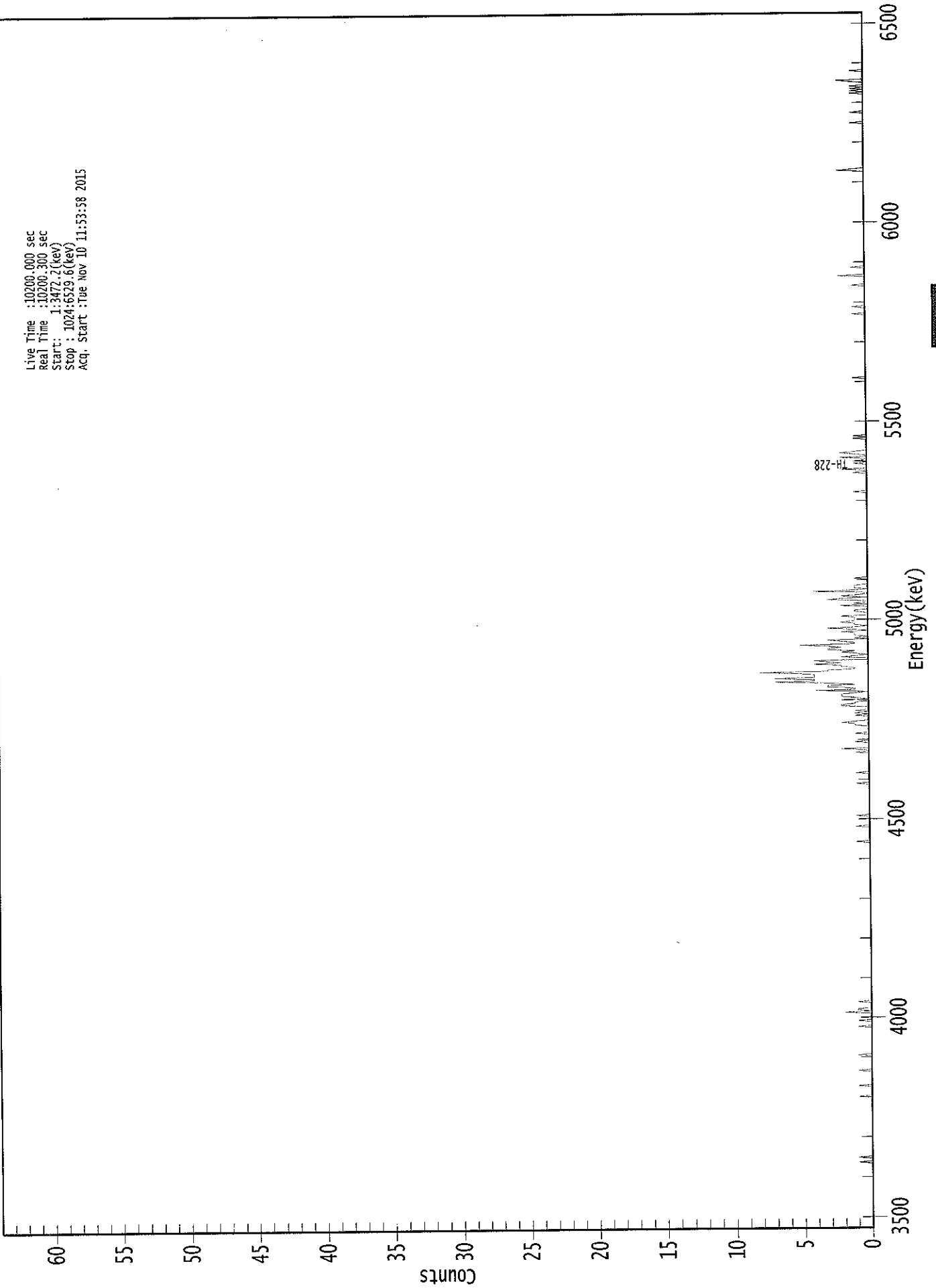
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.999	5850.00*	1.39E-001 +/- 1.29E-001	1.48E-001 +/- 2.32E-002
TH-228	1.000	5400.00*	2.97E-001 +/- 1.88E-001	1.59E-001 +/- 2.50E-002
TH-229	0.996	4872.00*	4.70E+000 +/- 7.37E-001	1.07E-001 +/- 1.67E-002
TH-230	0.978	4672.00*	2.55E-001 +/- 1.70E-001	1.53E-001 +/- 2.40E-002
TH-232	0.990	3997.00*	2.71E-001 +/- 1.71E-001	1.22E-001 +/- 1.91E-002

AG
 11/10/15

0000133717.CNF

Live Time :10200.000 sec
Real Time :10200.300 sec
Start: 1:3472.2(kev)
Stop : 1024:6529.6(kev)
Acq. Start :Tue Nov 10 11:53:38 2015



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: 05

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

369: 0 0 0 0 0 0 0 1 0

Sample Title: 05

Channel	-----	-----	-----	-----	-----	-----	-----	-----
377:	0	0	0	0	0	0	0	1
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	1	0	0	2	0	0	0	0
409:	0	1	0	0	0	0	0	0
417:	1	0	0	0	0	0	0	1
425:	1	2	1	0	0	0	0	1
433:	0	1	0	1	0	0	0	2
441:	2	1	1	0	2	0	1	2
449:	2	2	1	0	4	1	1	3
457:	3	1	3	7	4	4	7	4
465:	4	4	5	8	3	3	1	1
473:	2	2	4	2	3	4	0	0
481:	2	1	0	1	2	1	3	3
489:	2	3	5	1	1	2	3	0
497:	1	0	1	1	1	2	0	1
505:	3	1	0	1	1	2	1	1
513:	1	1	2	0	0	0	1	1
521:	0	0	0	2	0	1	0	0
529:	3	2	0	2	1	0	0	4
537:	1	0	1	1	1	0	0	0
545:	0	0	1	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	1	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	1	0	0	2	0
641:	0	0	0	1	0	1	0	0
649:	2	0	0	1	2	1	0	0
657:	0	0	0	0	0	0	0	0
665:	1	0	1	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	1	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	1	0	0	0	0	0	1
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	1	0	0	0	0	0	0

801: 0 2 0 0 0 0 0 0

Sample Title: 05

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



Sample Description: KC-90-137-U
 Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001337
 Batch Identification: 1510152A-TH
 Sample Identification: 06
 Sample Geometry: Shelf 2
 Procedure Description: Th iso

Detector Name: Alpha_036
 Chamber Serial Number: 04026477B
 Detector Serial Number: 84167
 Env. Background: System Bkgd 133933
 Reagent Blank: <not performed>

Sample Size: 5.000E-001 +/- 0.000E+000 liter
 Sample Date/Time: 9/26/2015 8:47:15 AM
 Acquisition Date/Time: 11/10/2015 11:54:00 AM
 Acquisition Live Time: 170.0 minutes
 Acquisition Real Time: 170.0 minutes

Tracer Certificate: Th229_S_TH-18A
 Tracer Quantity: 0.229 mL
 Effective Efficiency: 0.1857 +/- 0.0157
 Counting Efficiency: 0.1806 +/- 0.0032 on 10/25/2014 2:38:17 PM
 Chem. Recovery Factor: 1.0282 +/- 0.0887

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	5.754	6.66	78.18	0.34	0.00E+000	3.0
TH-228	5.412	7.30	81.83	1.70	0.00E+000	4.5
TH-229 T	4.881	162.49	15.40	0.51	0.00E+000	4.7
TH-230	4.593	4.66	94.59	0.34	0.00E+000	3.0
TH-232	3.968	3.66	107.87	0.34	0.00E+000	3.0

T = Tracer Peak used for Effective Efficiency

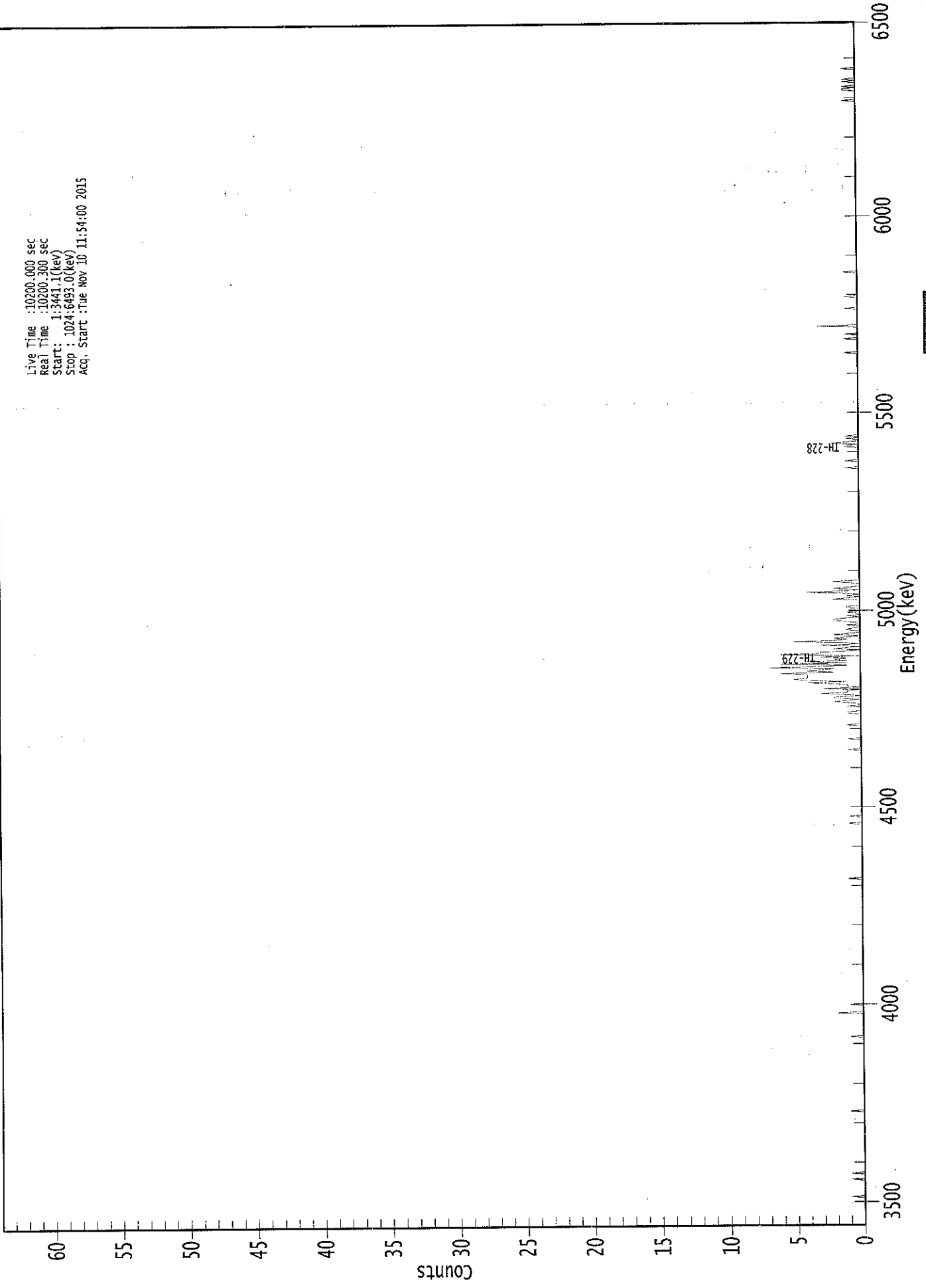
 NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
TH-227	0.953	5850.00*	1.96E-001 +/- 1.56E-001	1.41E-001 +/- 2.33E-002
TH-228	0.999	5400.00*	2.18E-001 +/- 1.82E-001	2.19E-001 +/- 3.63E-002
TH-229	1.000	4872.00*	4.66E+000 +/- 7.72E-001	1.50E-001 +/- 2.49E-002
TH-230	0.968	4672.00*	1.33E-001 +/- 1.28E-001	1.37E-001 +/- 2.26E-002
TH-232	0.996	3997.00*	1.04E-001 +/- 1.14E-001	1.36E-001 +/- 2.26E-002

AG
 11/11/15

0000133718.CNF

Live Time : 10200.000 sec
Real Time : 10200.300 sec
Start : 1:3441.1(kev)
Stop : 1024:6493.0(kev)
Acq. Start : Tue Nov 10 11:54:00 2015



ROI Type: 3

ROI Type: 1

100 100

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

369: 0 0 0 0 0 0 0 0 0

Sample Title: 06

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

801: 0 0 0 0 0 0 0 0

Sample Title: 06

Channel	-----	-----	-----	-----	-----	-----	-----	-----
809:	0	0	1	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	1	0	0	0
961:	0	0	0	0	0	1	1	0
969:	1	0	0	0	1	0	1	0
977:	0	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:	0	0	0	0	0	0	0	0



QA SUMMARY REPORT

Review Of QA Results - Pulser Check

Date : 11/10/2015
Time : 6:32:15 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Passed	11/10/2015 6:10:03 AM
Alpha 004	21f	ALL	Passed	11/10/2015 6:10:04 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	11/10/2015 6:10:05 AM
Alpha 011	21f	ALL	Passed	11/10/2015 6:10:06 AM
Alpha 012	21f	ALL	Passed	11/10/2015 6:10:07 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Passed	11/10/2015 6:10:07 AM
Alpha 015	21f	ALL	Passed	11/10/2015 6:10:08 AM
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:09 AM
Alpha 034	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:11 AM
Alpha 035	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:13 AM
Alpha 036	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:15 AM
Alpha 037	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:17 AM
Alpha 038	Alpha Analyst100DC	Peak Energy	Action	11/10/2015 6:10:19 AM
Alpha 039	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:22 AM
Alpha 040	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:25 AM
Alpha 041	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:29 AM
Alpha 042	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:32 AM
Alpha 043	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:36 AM
Alpha 044	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:40 AM
Alpha 045	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:44 AM
Alpha 046	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:48 AM
Alpha 047	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:52 AM
Alpha 048	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:10:56 AM
Alpha 049	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:00 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:05 AM
Alpha 051	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:11 AM
Alpha 052	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:15 AM
Alpha 053	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:20 AM
Alpha 054	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:24 AM
Alpha 055	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:28 AM
Alpha 056	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:33 AM
Alpha 057	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:38 AM
Alpha 058	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:42 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 059	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:48 AM
Alpha 060	Alpha Analyst100DC	ALL	Passed	11/10/2015 6:11:52 AM

APPROVED BY: AGAPPROVAL DATE: 11/10/15

 ***** LIBRARY LISTING REPORT *****

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