# **AUXIER & ASSOCIATES, INC.**

**PAP-KAN** 

1428

## STANDARD LEVEL IV REPORT OF ANALYSIS

**WORK ORDER #15-09136-OR** 

October 27, 2015

EBERLINE ANALYTICAL/OAK RIDGE LABORATORY OAK RIDGE, TN

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## STANDARD OPERATING PROCEDURE

Sample Receiving

MP-001, Rev. 13 Effective: 10/31/13 Page 14 of 15

: 00003

# Eberline Services – Oak Ridge Laboratory LABORATORY DATA SUPPORT CHECKLIST

MP-001-3

Eberline	Services Work Orde	er#	15-(	9136	<u> </u>	
The che	cklist items listed bel	ow are to be	initialed by	appropriate sta	aff upon completion	n/verification.
	Date for Partial	Initials	Date	Initials	Checklist Items	
			9-25-15	JEB	Sample Log-In	
			10/13/15	16	Data Compilation	n
			10-15-15	m LT	First Technical D	Data Review
			10 15 15	llet	Second Technic	al Data Review
			10/26/15	Eut	Data Entry/Elect	ronic Deliverable
			10/26/15	Eut	Case Narrative	
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Date pa	ckage approved by:	<u>\</u>		>	1	10216
		Laborato	ory Manager		Da	te
Copy No	)					Radiochemistry Services

**SECTION I** 

CHAIN OF CUSTODY & PH CHECK SHEET

Chain of Custody Record		٥Ŀ	1604	Eberline Services 601 Scarboro Roa Oak Ridge, TN 370 (865) 481-0683 Ph	Eberline Services 601 Scarboro Road Oak Ridge, TN 37830 (865) 481-0683 Phone • (865) 483-4621 Fax	EBERLINE S4621 Fax
Project Name: PAP/KAN	Project Number: 1억고용		3/	1/8/		32 F O U - / 3/4 /
Send Report To: Cecilia Green/Auxier & Assoc.	Sampler (Print Name):		17		/ /sr/i	
Address:	Sampler (Print Name):		?~??\ }	1/2////	\ \ ?!38	13/20 3 1500
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Knoxville, TN 37932	Airbili Number:		ISS :		<u></u>	
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Fax: 865-675-3677			(a) (b) (b) (b)		/	
ple ID	Sample Sample Sample Date Time Matrix	Number of /	风风	9 HIM	/ / /	Comments, Special Lab Sample ID Instructions, etc. (to be completed by lab)
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THE CHIEVE	るなど	1/2/	5 6,30pm	QA/QC Level	Turnaround	Sample Receipt
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Eberline Services 601 Scarboro Road Coak Ridge, TN 37830 References (865) 483-4621 Fax	1 / / / / / / / / / / / / / / / / / / /	13/41/16	3/ / 2/3/ / KEOD SEP 2 2 2015		Purchase	Order #	Comments, Special	TSTOCKOOLOGY, etc. (to be completed by any XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	X X Contact cealing	X X   RIter as directed	XX	XXX	Proceed as dilected							Sample Custodian Remarks (Completed By Laboratory):	QA/QC Level Turnaround Sample Receipt	Total # Containers Received?	Routine	C 24 Hour C	Level III C 1 Week C Received Containers Intact?
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y Record	Project Number: 1년구용	Sampler (Print Name):	Sampler (Print Name):	Shipment Method: Federal Express	Airbill Number:	Laboratory Receiving:	Sample Sample Nu	Time Matrix	10 44	24.91	51:11 51	T _		77/14						Received by: (Signature)	Too X	Becking by (Signature)	(	( Amer & Budley	sceived by: (Signature)
Chain of Custody Record	Project Name: PAP/KAN	Send Report To: Cecilia Green/Auxier & Assoc.	<del>ļ          </del>	9821 Cogdill Road, Suite 1		Phone; 865-675-3669	Fax: 865-675-3677	7 7 7 - 6 9 - 17 6 0 7	11 1/66/-1000	7-606-	2	Ke-185-4 30	ď							Relinguished by: (Sighature)	Will Without I	CONTROL OF	Schinquistied by Orginature)		Relinquished by: (Signature)



# Internal Chain of Custody

Work Order #	15-09136
Lab Deadline	10/16/2015
Analysis	UUISO - Level 4
Sample Matrix	Water

Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
04	35	U1.1
05	31	U1.1
06	37	U1.1
07	35	V1.1
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	A CAMPAIN OF THE PARTY OF THE P	
November 1997		A CONTRACTOR OF THE PROPERTY O
	Fraction  04  05  06	Fraction         Detector Activity           04         35           05         31           06         37

		Locati	ion (circle d	one)		Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	Wolfer	15/5-040
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	Wolperoll	150415
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Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	DUNN 10-	12-15 0905
Received by	Sample Storage	Rough Prep	Prep	Separations	COM ROOM	-210	MOTON
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	CUMIEROUM	-01	1/2/20
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Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		



# Internal Chain of Custody

Work Order #	15-09136
Lab Deadline	10/16/2015
Analysis	ThISO - Level 4
Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
	04	35	V1.1
	05	31	U1.1
	06	37	U1.1
RE-LOG of 15-09131, fractions 07, 08, 16 & 19	07	35	U1.1
			2 2 4 NO. 100
			- Assis Harrier Presser

		Locat	ion (circle a	ne)		Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	Wove of	6/15 07W
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JWOIP 10	16/15/04/15
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	She she 16	415 0415
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	2PD 10/7	115 1515
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	XB 10/2/	7 1230
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### Sample Receiving Report (Volumes, pH, & CPM)

	_
Internal Work Order	
15-09136	
Received By	
JBAILEY	

	Cliento	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
FR	ClientID		- Jonathan - January - Jan	WA	U1.1		
01	LCS	0		WA	U1.1		
02	BLANK	0					
03	DUP	0		WA	Ų1. <u>1</u>	3 76	35
	KC85-032-L	1		WA	U1.1	3.76	
04	KC85-U32-L		Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	35
				WA	U1.1	3.76	31
05	KC85-032-M		Container Number	pH Orig	pH Final	Volume (L)	CPM
			Container Number	7 7	7	3.7600	31
				WA	U1.1	3.76	37
06	KC94-199-U	1			pH Final	Volume (L)	CPM
			Container Number	pH Orig	7 pn rmai	3.7600	37
				WA	U1.1	3.76	35
07	KC97-209-ป	1				Volume (L)	CPM
1			Container Number	pH Orig	pH Final	3,7600	35
			1		<u> </u>	3.7000	

Received by: James Hauley

Date: 9-25-15

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

# SECTION II SAMPLE ACKNOWLEDGEMENT & CORRESPONDENCE

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## STANDARD OPERATING PROCEDURE

Sample Receiving

MP-001, Rev. 13 Effective: 10/31/13 Page 13 of 15

### Eberline Services - Oak Ridge Laboratory

SAMPLE RECEIPT CHECKLIST MP-001-2

AMPLE MATRIX/MATRICES:	(CIRCI	E ONE OF	R BOTH)
	AQUE		ON-AQUEOUS
VERE SAMPLES:	(CIRCI	E EIIHER	YES, NO, OR N/A
Received in good condition?	<b>8</b>	N	
If aqueous, properly preserved	$\bigcirc$	N	N/A
VERE CHAIN OF CUSTODY SEALS:			
Present on outside of package?	Ø	N	
Unbroken on outside of package?	$\bigcirc$	N	
Present on samples?	$\bigcirc$	N	
Unbroken on samples?	$\Theta$	N	
Was chain of custody present upon sample receipt?	<b>(A)</b>	N	
THE RESPONSE TO ANY OF THE ABOVE IS <b>NO</b> , A DISC DSR) HAS BEEN ISSUED.		AMPLE RE	ECEIPT REPORT
EMARKS:			
EMARKS:			
ELMARKS:			

Radiochemistry Services

### **Elizabeth Towery**

From:

Cecilia Greene <cgreene@auxier.com>

Sent:

Friday, September 25, 2015 12:47 PM

To:

Mike McDougall

Cc:

Elizabeth Towery

Subject:

additional analysis for 15-09131

Mike, the client has opted to analyze 4 samples for isotopic uranium and isotopic thorium. Mostly negative documentation.

KC85-032-M

KC85-032-L

KC97-209-U

KC94-199-U

Regards,

Cecilia Greene MPH, NRRPT Auxier and Associates 865-675-3669 phone 865-675-3677 fax cgreene@auxier.com SECTION III

CASE NARRATIVE



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

EBS-OR-39851

October 27, 2015

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

# CASE NARRATIVE Work Order# 15-09136-OR

#### SAMPLE RECEIPT

This work order contains four water samples received 09/22/2015 and re-logged at the client's request 09/25/2015. These samples were analyzed for Isotopic Uranium and Isotopic Thorium.

CLIENT ID	<u>LAB ID</u>
KC85-032-L	15-09136-04
KC85-032-M	15-09136-05
KC94-199-U	15-09136-06
KC97-209-U	15-09136-07

#### **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 <u>URANIUM</u>

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

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, Uranium-235 and Uranium-238 duplicate demonstrated a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. Results for the Uranium-234 and Uranium-238 laboratory control sample demonstrated an acceptable percent recovery.

#### ISOTOPIC THORIUM

Samples were prepared by removing a representative aliquot 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 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the 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: 10/27/2015

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

# SECTION IV ANALYTICAL RESULTS SUMMARY

Printed: 10/27/2015 3:00 PM

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	1	I COLTAIN V	Cecilia Green	·				SDG:	15-(	15-09136				
EDE		EDECIME AMAINCAL	Auxier & Ass	& Associ	ociates, Inc.			Purchase Order:	PAP-KAN	KAN				
Fina	Rep	Final Report of Analysis	9821 Cogdill		Road, Suite	_		Analysis Category:	ENV	<b>ENVIRONMENTAL</b>	NTAL			
			Knoxville, TN		37830			Sample Matrix:	WA					
Lab	Sample	Client	Sample	Receipt	Analysis	Batch	Analyte	Method	Result	no	csn	MDA	5	Report
₽	Type	QJ	Date	Date	Date	2							-	1
15-09136-01	SOT	KNOWN	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-228	EML Th-01 Modified	4.86E+00	1.75E-01		***************************************		2
15-09136-01	SOT	SPIKE	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-228	EML Th-01 Modified	5.65E+00	8.98E-01	1.04E+00	1.44E-01	6.21E-02	NO E
15-09136-02	MBL	BLANK	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-228	EML Th-01 Modified	3.00E-02	4.49E-02	4.50E-02	7.29E-02	9.83E-03	ই
15 00136-03	<u>a</u>	KC85-032-L	09/21/15 14:42	9/25/2015	10/7/2015	15-09136	Thorium-228	EML Th-01 Modified	1.03E-01	1.22E-01	1.22E-01	1.77E-01	3.38E-02	DG.
15-09136-04	2	KC85-032-L	09/21/15 14:42	9/25/2015	10/7/2015	15-09136	Thorium-228	EML Th-01 Modified	8.45E-02	1.10E-01	1.10E-01	1.52E-01	1.32E-02	pCiA
15 00138 OF	TBG	KC85-032-M	09/21/15 13:25	9/25/2015	10/7/2015	15-09136	Thorium-228	EML Th-01 Modified	-4.53E-03	5.12E-02	5.12E-02	1.57E-01	2.98E-02	PCil
45 00138 08	2 2	KC94-199-1	09/18/15 09:56	9/25/2015	10/7/2015	15-09136	Thorium-228	EML Th-01 Modified	2.01E-01	1.50E-01	1.51E-01	1.26E-01	1.09E-02	DCi/I
45 00498 07	5 0	KC97.209.11	09/19/15 11:15	9/25/2015	107//2015	15-09136	Thorium-228	EML Th-01 Modified	3.54E-01	3.56E-01	3.58E-01	4.89E-01	1.38E-01	Diod
0-00:00-01	2		e de la company de la comp											
15.09136.01	S	NWOWN	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-230	EML Th-01 Modified	5.37E+00	1,45E-01			***************************************	bČil
45 00438 04	200	NOKE	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-230	EML Th-01 Modified	6.58E+00	1.01E+00	1.30E+00	1.12E-01	1.06E-01	PCi/I
15-05-150-01	MPI	BI ANK	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-230	EML Th-01 Modified	9.05E-02	7.31E-02	7.39E-02	7.75E-02	6.91E-02	PČi
20-00-00-01	3 2	KC85_039_1	09/21/15 14:42	9/25/2015	10/7/2015	15-09136	Thorium-230	EML Th-01 Modified	1.58E-01	1.52E-01	1.54E-01	2.07E-01	1.97E-01	ρÖ
20-02130-01	3 2	KC85-032-1	09/21/15 14:42	9/25/2015	107/2015	15-09136	Thorium-230	EML Th-01 Modified	2.35E-01	1.79E-01	1.81E-01	1.64E-01	1.83E-01	Σ
10-08130-04	3 5	KC85-032-M	09/21/15 13:25	9/25/2015	10/7/2015	15-09136	Thorium-230	EML Th-01 Modified	7.40E-02	9.44E-02	9.48E-02	1.41E-01	1.46E-01	pCiv
15-03150-05 45 00436 06	2 2	KC94-199-1	09/18/15 09:56	9/25/2015	10/7/2015	15-09136	Thorium-230	EML Th-01 Modified	1.81E-01	1,46E-01	1.48E-01	1.55E-01	1.38E-01	Z.
15-09136-07	TRG	KC97-209-U	09/19/15 11:15	9/25/2015	10/7/2015	15-09136	Thorium-230	EML Th-01 Modified	5.20E-01	3.74E-01	3.80E-01	2.87E-01	3.42E-01	Į.
								***************************************						
15-09136-01	SOT	KNOWN	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thonum-232	EML Th-01 Modified	4.86E+00	1,75E-01				S S
15-09136-01	SOT	SPIKE	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-232	EML Th-01 Modified	5.80E+00	9.16E-01	1.05E+00	1.35E-01	5.22E-02	3
15-09136-02	MBL	BLANK	09/25/15 00:00	9/25/2015	10/7/2015	15-09136	Thorium-232	EML Th-01 Modified	2.58E-02	4.40E-02	4.41E-02	7.74E-02	9.18E-04	Sc.
15-09136-03	and	KC85-032-L	09/21/15 14:42	9/25/2015	10/7/2015	15-09136	Thorium-232	EML Th-01 Modified	-3.66E-02	6.18E-02	6.19E-02	2.17E-01	6.50E-02	2
15-09136-04	20	KC85-032-L	09/21/15 14:42	9/25/2015	10/7/2015	15-09136	Thorium-232	EML Th-01 Modified	9.32E-02	1.26E-01	1.26E-01	1.97E-01	3.41E-02	Ja l
15.09138-05	TRG	KC85-032-M	09/21/15 13:25	9/25/2015	10/7/2015	15-09136	Thorium-232	EML Th-01 Modified	-1.99E-02	4.93E-02	4.93E-02	1.40E-01	2.16E-02	PCE
15-09136-06	TRG	KC94-199-U	09/18/15 09:56	9/25/2015	10/7/2015	15-09136	Thorium-232	EML Th-01 Modified	1.70E-02	5.20E-02	5.20E-02	1,23E-01	1.06E-02	bCil.
15-09136-07	TRG	KC97-209-U	09/19/15 11:15	9/25/2015	10/7/2015	15-09136	Thorium-232	EML Th-01 Modified	2.82E-02	1.77E-01	1.77E-01	4.26E-01	9.61E-02	S S
20010000	2													

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

Printed: 10/27/2015 3:00 PM

				Re	Report To.					Work Order Details:	Jetails:			
i L	() :: :: ::		Cecilia Green					SDG:	15-(	15-09136				
EDE		EDELINE ANAIYUCAI	Auxier	& Associ	Auxier & Associates, Inc.			Purchase Order:	PAP.	PAP-KAN				
Fina	Rep	Final Report of Analysis	9821 Cc	adill Ro	9821 Cogdill Road, Suite	-		Analysis Category:	ENV	ENVIRONMENTAL	NTAL	***************************************	***************************************	
			Knoxville, TN	lle, TN 37	37830			Sample Matrix:	WA					
Lab	Sample	Client	Sample Date	Receipt	Analysis Date	Batch	Analyte	Method	Result	CO	csn	MDA	ઠ	Report Units
15 00438 04	عراد	NACINA	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-234	EMt. U-02 Modified	8.08E+00	2.91E-01				PCiv
19-09130-01	3 2	SUKE	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-234	EML U-02 Modified	6.99E+00	1.12E+00	1.22E+00	1.08E-01	2.64E-03	pCi/l
15-03130-01	MBI	BLANK	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-234	EML U-02 Modified	1.33E-02	3.19E-02	3.19E-02	6.69E-02	5.05E-03	pCi/l
15.00136.03	<u>a</u> 10	KC85-032-I.	09/21/15 14:42	9/25/2015	10/12/2015	15-09136	Uranium-234	EML U-02 Modified	1.90E-01	1.90E-01	1.90E-01	2.79E-01	1.10E-01	Į, Į
15-03130-03	5 2	KC85-032-1	09/21/15 14:42	9/25/2015	10/12/2015	15-09136	Uranium-234	EML U-02 Modified	3.98E-01	2.48E-01	2.49E-01	2.48E-01	6.58E-02	PĢ//
15-09136-05	TRG	KC85-032-M	09/21/15 13:25	9/25/2015	10/12/2015	15-09136	Uranium-234	EML U-02 Modified	7.97E-01	3.25E-01	3.30E-01	1.49E-01	1.50E-02	PCi/I
45 00136 OB	201	KC94-199-1	09/18/15 09:56	9/25/2015	10/12/2015	15-09136	Uranium-234	EML U-02 Modified	2.31E-01	1.78E-01	1.79E-01	1,41E-01	1.07E-02	ğ
15-09130-00	183	KC97-209-U	09/19/15 11:15	9/25/2015	10/12/2015	15-09136	Uranium-234	EML U-02 Modified	2.08E-01	1.85E-01	1.85E-01	2.20E-01	4.07E-02	DÇ!
15_09138-01	I CS	SPIKE	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-235	EML U-02 Modified	4.90E-01	2,18E-01	2.21E-01	1.34E-01	1.21E-03	Į į
16 00136-02	MBi	B. ANK	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-235	EML U-02 Modified	5.26E-02	6.80E-02	6.81E-02	9.45E-02	6.50E-03	PCIN
15-03 150-02 45 00436 03	315	KC85-032-I	09/21/15 14:42	9/25/2015	10/12/2015	15-09136	Uranium-235	EML U-02 Modified	1.21E-01	1.46E-01	1,46E-01	2.06E-01	2.21E-02	ğ
50-06160-61	3 2	KC85_030_1	09/21/15 14:42	9/25/2015	10/12/2015	15-09136	Uranium-235	EML U-02 Modified	1.29E-02	8.37E-02	8.37E-02	2.28E-01	2.44E-02	ğ
10-09130-04	3 5	KC05-032-M	09/21/15 13:25	9/25/2015		15-09136	Uranium-235	EML U-02 Modified	1.85E-01	1.70E-01	1.70E-01	1.60E-01	7.34E-03	PCiA
15-09135-05	מבי ל	KC94-199-1	09/18/15 09:56	9/25/2015	┿	15-09136	Uranium-235	EML U-02 Modified	1,25E-01	1.64E-01	1.64E-01	2.50E-01	2.27E-03	pCid
15-03136-07	TRG	KC97-209-U	09/19/15 11:15	9/25/2015	10/12/2015	15-09136	Uranium-235	EML U-02 Modified	1.29E-01	1.69E-01	1.70E-01	2.58E-01	2.35E-03	pCik
	)		***************************************											į
15-09136-01	SOT	KNOWN	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-238	EML U-02 Modified	7.87E+00	2.83E-01		L	20 100 1	2
15-09136-01	SOT	SPIKE	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-238	EML U-02 Modified	7.06E+00	1.13E+00	1.245+00	1.081-01	1.28E-U3	2 2
15-09136-02	MBL	BLANK	09/25/15 00:00	9/25/2015	10/12/2015	15-09136	Uranium-238	EML U-02 Modified	2.92E-02	4.47E-02	4.47E-02	6.66E-02	3.85E-03	
15.00136-03	alid	KC85-032-L	09/21/15 14:42	9/25/2015	10/12/2015	15-09136	Uranium-238	EML U-02 Modified	1.32E-01	1.31E-01	1.31E-01	1.54E-01	1.72E-02	2
15 09136-04	2	KC85-032-L	09/21/15 14:42	9/25/2015	10/12/2015	15-09136	Uranium-238	EML U-02 Modified	2.56E-01	1.84E-01	1.85E-01	1.36E-01	7.88E-03	2
15.09136.01	TRG	KC85-032-M	09/21/15 13:25	9/25/2015	10/12/2015	15-09136	Uranium-238	EML U-02 Modified	3.14E-01	2.06E-01	2.07E-01	1.85E-01	2.85E-02	Ja i
15-09136-06	TRG	KC94-199-U	09/18/15 09:56	9/25/2015	10/12/2015	15-09136	Uranium-238	EML U-02 Modified	2.58E-01	1.90E-01	1.91E-01	1.61E-01	1.39E-02	2 2
15-09136-07	TRG	KC97-209-U	09/19/15 11:15	9/25/2015	9/25/2015 10/12/2015	15-09136	Uranium-238	EML U-02 Modified	1.62E-01	1.54E-01	1.55E-01	1.662-01	1.43E-UZ	3

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 STANDARDS

# Date 1/16/95 Initials 199

## QA/QC REVIEWED | CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Radionuclide:

U-238NAT

Customer:

TMA EBERLINE

Half Life:

 $(4.468 \pm 0.005) \times 10^9$  years

P.O.No.:

OR2778

Catalog No.:

7338

Reference Date:

January 1 1995

12:00 PST.

Source No.: 479-50 Contained Radioactivity: (Total U) 8.016  $\mu$ 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:

Approximately 1.3202

g/ml @ 20°C.

d. Density: Radioimpurities

Refer to attached technical data sheet

Radioactive Daughters

Refer to attached technical data sheet

Radionuclide Concentration

(Total U) 0.1228

μCi/g.

Method of Calibration

Activity calculations are based upon known specific activity and mass.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:

 $\pm 3.0\%$ 

b. Random uncertainty in assay:

+0.0%

c. Random uncertainty in weighing(s):

 $\pm 2.0\%$ 

d. Total uncertainty at the 99% confidence level:

+3.6%

#### **NIST Traceability**

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

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).

29 DECEMBER Date Signed



ISOTOPE PRODUCTS LABORATORIES

3017 N. San Fernando Blvd. Burbank, California 91504

818 • 843 • 7000 Fax 818 • 843 • 6168



### **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 REF	ERENCE #[PL 479R	50	CURRENT DAT	
Principal Radionuclide	Half Life			Half Life, Days
234, 235, 238		BE+09		1.632E+12
Radionuclide Certified Activity Certified Concentration	234,235,238 8 016E+00 μCi μCi per (	gram	Reference Dat	te 1/1/1995 0:00
	Ampoule /Solution ( Empty Am Solution Total Activity in Am	poule 32.502 n Net 65.138	Weight, Grams  Weight, Grams  Weight, Grams  μCi	· · · · · · · · · · · · · · · · · · ·
Chemical Com	position of Standard	d Solution		
Uranyl nitrate ir	The state of the s			
A LIVE BOTTOM PRODUCTION OF THE PARTY OF THE	91 S. 113 (1905 1945 1946 1946 1946 1946 1946 1946 1946 1946 1946 1946 194	territoria (1 a.		
Dilution Instructions:		Dilution Solv	rent Used	1M HNO <sub>3</sub>
Dilute to a	a volume of1000	00 milliliters		
Certified Total Activity of		Which Equals tion is 1.77955E+0	This active depm/mreference to the da	of dpm at the date listed above  wity concentration is based on the original a date listed above. All activities are corrected the and time of analysis by the laboratory data and software.
			Expiration Dat	e: July 27, 2016
Verified & Approved By _ QC Approval (		2005	Da	11.6



# QUALITY CONTROL PROGRAM MP-009

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

# **EBERLINE SERVICES - OAK RIDGE LABORATORY**

RADIOACTIVE REFERENCE STANDARD SOLUTIONS  SECONDARY DILUTION RECERTIFICATION								
525,121,117, 5125								
MP-00 Solution Reference # IPL 479-50								
Principal Radionuclide Half Life, Y								
234, 235, 238 U 4, 468E+	09 1.632E+12							
Radionuclide of Interest	Reference Date 1/1/1995 0:00							
Parent Solution Conc. 1.7796E+04 dpm/ml								
	••							
Chemical Composition of Standard So	iution							
Uranly Nitrate in 1M HNO <sub>3</sub>	COLOT							
orany mudic management								
Dilution Instructions:	Dilution Solvent Used 1M HNO₃							
	Constitution of the state of th							
SECONDARY VOL	UMETRIC 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	That Activity Concentration.							
That Volumer [1500000000]								
	This activity concentration is based on the original							
NOTES:	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 = 34.34								
U-235 Atom % = 2.25 U-235 = 71.182 dpm/ml X 0.0225 = 1.602 U-234 Atom % = 49.501 U-238 = 71.182 dpm/ml X 0.49501 = 35.23								
All values +/- 3.6%								
Isotopic ratios from manufacturer's data sheet	Expiration Date: July 27, 2016							
isotopio isoto il alli Malalabaro C dalla citoc								
	λ							
Verified & Approved By	Date: 10/1/2015 0:00							
QC Approval	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

which is equivalent to

6.739E+03 becquerels per gram of solution 1.821E-01 microcuries per gram of solution

Mass of solution Volume of solution Total activity of U-232 5,35€ grams 5.035 millilitres

3.61E+04 becquerels

which is equivalent to

9.76E-01 microcuries

Method of measurement (see reverse of this certificate)

Accuracy

Random uncertainty is:  $\pm 0.7\%$ 

Systematic uncertainty: ± 0.5%

Overall uncertainty in the radioactive concentration quoted above:  $\pm 1.7\%$ 

Overall uncertainty is defined on the reverse of this certificate.

Radionuclidic Purity

Any radioactive impurities measured are listed below, expressed as percentages

of the activity of the principle radionuclide at the reference date.

Th-228 and daughter activity removed 2 Feb 2000

U-232 daughters activity will increase with time. By alpha 88% U-232, 12% daughters on 1/3/00

Isotopic

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

Purity

Not measured

Chemical Composition Calculated weight of U-232, 4.42E-08 grams, as 2M HNO3 solution in a flame sealed glass yial.

This Tracer solution has been produced 'carrier free'.

**Physical** 

Recommended half life of uranium 232: 6.980E+01 years

Data

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

Trkcert.wps 10/03/00

Project Ref. AE2315

Roger Wiltshire

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



### **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

MP 009
CURRENT DATE 11/11/2014 0:00
SOLUTION REFERENCE # AEA/Amersham 92/232/67 SOLUTION # U-10
Principal Radionuclide Half Life, Years Half Life, Days  232  7.200E+01  2.630E+04
Radionuclide 232U Reference Date 3/1/2000 0:00  Certified Activity 9.760Ε-01 μCi  Certified Concentration μCi per gram
Ampoule /Solution Gross  Empty Ampoule  Solution Net  Weight, Grams  Weight, Grams  Total Activity in Ampoule  0.9760  µCi
Chemical Composition of Standard Solution  232U(NO <sub>3</sub> ) <sub>6</sub> in 2M HNO <sub>3</sub>
Dilution Instructions: Dilution Solvent Used 2M HNO <sub>3</sub>
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: November 4, 2015
Verified & Approved By Date: 11/11/2014 0:00
QC Approval Date: 11/13/14



# QUALITY CONTROL PROGRAM MP-009

Rev.8; 11/01/03

Title: Radioactive Reference Standards Solutions & Records

## **EBERLINE SERVICES - OAK RIDGE LABORATORY** RADIOACTIVE REFERENCE STANDARD SOLUTIONS

SECONDARY	DILUTION RECERTIFICATION
Solution Reference # AEA/A	## Date 11/11/2014 0:00 mersham 92/232/67 Solution # U-10a
	ife, Years Half Life, Days 00E+01 2.630E+04
Radionuclide of Interest Parent Solution Conc. 2:167E+03 dpm/r	Reference Date 3/1/2000 0:00
Chemical Composition of Standar <sup>232</sup> U(NO₃) <sub>6</sub> in 2M HNO₃	d Solution
Dilution Instructions:	Dilution Solvent Used 2M HNO <sub>3</sub>
SECONDARY	VOLUMETRIC DILUTION
Vol. Parent Solution: 10.0000 ml Total Activity: 2.1670E+04 dpm Final Volume: 1000.00 ml	Final Activity Concentration: 2.1670E+01 dpm/ml
NOTES:	This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.
	Expiration Date: November 4, 2015
Verified & Approved By  QC Approva	Date: 11/11/2014 0:00  CLULL Date: 11/13/1-1

# REVIEWE ERTIFICATE OF CALIBRAT TMA EBERLAND TT494 a 19/19/11 ALPHA STANDARD SOLUTION

Radionuclide

Th-230

Customer:

Half Life:

 $(7.54 \pm 0.03) \times 10^{4} \text{ years}$ 

P.O.No.:

Catalog No.:

7230

Reference Date:

November 1 1991

12:00 PST.

Source No.:

388-116

Contained Radioactivity:

1.036

μCì,

Description of Solution

a. Mass of solution:

5.0042

grams.

b. Chemical form: c. Carrier content:

Th(NO3)4 in 0.1N HNO3 None added

d. Density:

1.0016

gram/ml @ 20°C.

Radioimpurities

See attached technical data sheet

Radioactive Daughters

See attached technical data sheet

Radionuclide Concentration

0.207

μCi/gram.

Method of Calibration

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

#### Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:

 $\pm 2.0\%$ 

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)

QUALITY CO

ISOTOPE PRODUCTS LABORATORIES

1800 No. Keystone Street., Burbank, California 91504

(818) 843 - 7000



## **QUALITY CONTROL PROGRAM**

MP-009

Rev.14; 10/10/2012

Title: Radioactive Reference Standards Solutions & Records

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

	MP 009		1
	CUR	RENT DATE	4/15/2015 0:00
SOLUTION REFERENCE #		SOLUTION#	www.complete.com
Principal Radionuclide	Half Life, Years		Half Life, Days
<sup>230</sup> Th	7.540E+04		2.754E+07
Radionuclide 230 Thorium Certified Activity 1.036E+00 Certified Concentration		erence Date	11/1/1991 0:00
	Solution Gross 9.2660 Wei	<del>-</del> '	
E	* * * *	ght, Grams	
Taéal Aaéisi	Solution Net 4.6442 Wei ty in Ampoule 1.0360 μCi	gnt, Grams	•
TOTAL ACTIVI	ty is Asspoule [ 1.0000][to		
Chemical Composition of <sup>230</sup> Th(NO <sub>3</sub> ) <sub>4</sub> in 0.1N HNO <sub>3</sub>	Standard Solution		
Dilution Instructions:	Dilution Solven	t Used	0.1N HNO <sub>3</sub>
Dilute to a volume of	1000.00 milliliters		'
Certified Total Activity of 1.0360	μCi Which Equals		dpm at the date listed above
And after dilution the activity of t	his solution is 2.300E+03 dpn	n/ml referenc to the da	ivity concentration is based on the original se date listed above. All activities are corrected ate and time of analysis by the laboratory data ing software.
	Ехр	iration Date:	February 12, 2016
Recertified By  QC Approval	(Same	Date:	ulad a



# 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 DILUTI	ON RECERTIFICATION
MP-009 Solution Reference # IPL 388-116	Solution # Th-1b
Principal Radionuclide Half Life, Ye 230 Th 7.540E+0	ars Half Life, Days
Radionuclide of Interest 230 Thorium Parent Solution Conc. 2.30 E+03 dpm/ml	Reference Date 11/1/1991 0:00
Chemical Composition of Standard Solu	ition
Dilution Instructions:	Dilution Solvent Used 0.1N HNO <sub>3</sub>
SECONDARY VOLU	METRIC DILUTION
Vol. Parent Solution: 10.0000 ml  Total Activity: 2.2999E+04 dpm  Final Volume: 1000.00 ml	Final Activity Concentration: 2.2999E+01 dpm/ml
NOTES:	This activity concentration is based on the original reference date listed above. All activities are corrected to the date and time of analysis by the laboratory data processing software.
	Expiration Date: February 12, 2016
Recertified By	Date: 4/15/2015 0:00
QC Approval Albert	Date: 4/15/15

## 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.:

(Th-232)

Catalog No.:

7232

Reference Date:

VH1632 November 1 1993

Source No.:

435-104-2

Contained Radioactivity:

(Th-232) 0.0933

μCi.

Contained Radioactivity:

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 None added

c. Carrier content:

Approx. 1.21

g/ml @ 20°C.

3.45

d. Density:

None detected (other than daughters).

Radioimpurities

Radioactive Daughters Ra-228, Ac-228, Th-228, Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Po-212, Ti-208

Radionuclide Concentration

(Th-232) 0.00779

μCi/g.

Method of Calibration

Activity calculations are based upon known specific activity and mass.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:

 $\pm 3.0\%$ 

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:

±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).



QUALITY CONTROL

*Nov. 8, 1993*Date Signed

ISOTOPE PRODUCTS LABORATORIES

1800 North Keystone Street

Burbank, California 91504

(818) 843 - 7000



#### **QUALITY CONTROL PROGRAM** MP-009

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

## **EBERLINE SERVICES - OAK RIDGE LABORATORY** RADIOACTIVE REFERENCE SOLUTIONS

MP 009	IFICATION
CUR	RENT DATE 9/29/2015 0:00
	OLUTION # Th-8
Principal Radionuclide Half Life, Years	Half Life, Days
<sup>232</sup> Th, <sup>228</sup> Th 1:405E+10	5.132E+12
Radionuclide 232 & 228 Th Refe Certified Activity 9.330E-02 μCi Certified Concentration μCi per gram	erence Date 11/1/1993 0:00
Ampoule /Solution Gross 18.8415 Weig Empty Ampoule 6.9296 Weig	ght, Grams
Solution Net 11.9119 Weig Total Activity in Ampoule 0.0933 μCi	gnt, Grams
Chemical Composition of Standard Solution	
Th(NO <sub>3</sub> ) <sub>4</sub> in H2O	
Dilution Instructions: Dilution Solvent	Used 1% Nitric Acid
Dilute to a volume of 1000.00 milliliters	
Certified Total Activity of 0.0933 µCi Which Equals	2,071E+05 dpm at the date listed above
And after dilution the activity of this solution is 2.071E+02 dpm	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.
Expi	ration Date: August 25, 2016
Verified & Approved By	Date: 9/29/2015 0:00
QC Approval	Date: 9/30/15



# QUALITY CONTROL PROGRAM MP-009

TO A COLOR OF THE COLOR OF THE

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

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

<i>3</i> !	ECONDAN'I DILOTTON NEGEN	INTOMINON				
	MP-009 nce # IPL 435-104-2	Date Solution #				
Principal Radionuclide 228 8 232Th	Half Life, Years		Half Life, Days			
Radionuclide of Interest 226 & 23 Parent Solution Conc. 2.07E		Reference Date	5:132E+12			
Chemical Composition of Standard Solution Th(NO <sub>3</sub> ) <sub>4</sub> in 1% HNO <sub>3</sub>						
Dilution Instructions:	Dilution \$	Solvent Used	1% Nitric Acid			
SECONDARY VOLUMETRIC DILUTION						
Total Activity: 1.035	0.0000 ml 5E+05 dpm Final Ac 000.00 ml	tivity 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  QC Approval	horas	Date	Nate			



24937 Avenue Tibbitts Valencia, California 91355

Tel 661·309·1010

An Eckert & Ziegler Company

Fax 661-257-8303

# CERTIFICATE OF CALIBRATION ALPHA STANDARD SOLUTION

Radionuclide:

Th-229

Half-life:

Catalog No.:

Source No.:

7340 ± 160 years

7229

867-54

Customer: P.O. No.:

**EBERLINE SERVICES** 

00009633

Reference Date:

Contained Radioactivity: 1.013

15-Jan-02 12:00 PST 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<sub>3</sub>)<sub>4</sub> in 0.1M HNO<sub>3</sub>

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/q

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.

IPL Ref. No.:

867-54

- ISO 9001 CERTIFIED



## QUALITY CONTROL PROGRAM

Rev.8; 1/10/03

Title: Radioactive Reference Standards Solutions & Records

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

WP 009						
	RENCE # IPL 867-54	deren men de animental de la	JTION # Th-18			
Principal Radionuclide	Half Life, Years 7.340E+03		Half Life, Day: 2.68	s 1E+06		
Radionuclide Certified Activity 1 Certified Concentration	<sup>229</sup> Th 013E+00 μCi μCi per gram	Referenc				
Ampoule /Solution Gross 8.7752 Weight, Grams Empty Ampoule 3.7591 Weight, Grams Solution Net 5.0161 Weight, Grams Total Activity in Ampoule 1.0130 µCi						
Chemical Comp  229 Th(NO <sub>3</sub> ) <sub>4</sub> in 0	osition of Standard Solut M HNO <sub>3</sub>	ion				
Dilution Instructions:		Dilution Solvent Use	d 0.1 M HNO <sub>3</sub>			
Dilute to a v	olume of 1000.00	milliliters				
Certified Total Activity of And after dilution the a	1.0130]μCi Whic					
		Explration	n Date: August 24, 2	016		
Verified & Approved ByQC Approval	Shugarit		Date: 9/29/201  Date: 9/30/1	<u>5 0:00</u>		



# 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 # IPL 867		Date 9/29/2015 0:00 olution # Th-18a				
Principal Radionuclide Half Life,  229 Th 7.340	·	Half Life, Days 2.681E+06				
Radionuclide of Interest 228 Th Parent Solution Conc. 2.25E+03 dpm/ml	Refere	nce Date 1/15/2002 0:00				
Chemical Composition of Standard Solution  TH(NQ <sub>3</sub> ) <sub>4</sub> in 0.1M HNQ <sub>3</sub>						
Dilution Instructions:	Dilution Solvent Used	0.1M HNO <sub>3</sub>				
SECONDARY VOLUMETRIC DILUTION						
Vol. Parent Solution: 10:0000 ml Total Activity: 2.2490E+04 dpm Final Volume: 1000.00 ml	Final Activity Conce	ntration: 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.					
	Expirati	on Date: August 24, 2016				
Verified & Approved By  QC Approval	w	Date: 9/29/2015 0:00  Date: 9/30/15				

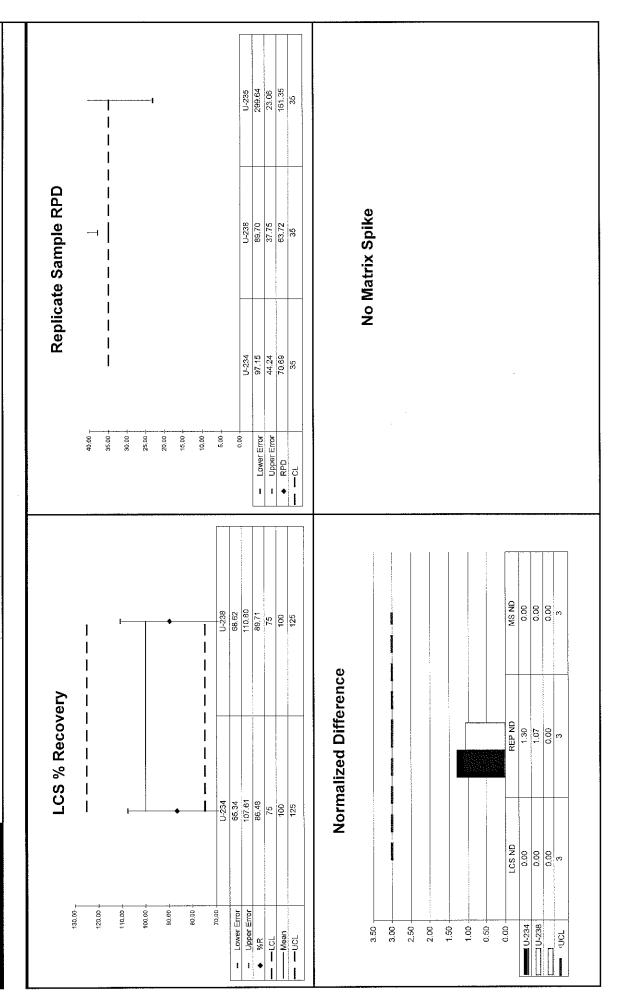
# SECTION VI QUALITY CONTROL SAMPLE RESULTS SUMMARY

Printed: 10/13/2015 8:01 AM Page 1 of 2

WO	Analysis		Run	Activity	Activity Units	Aliquot Units	: Units			Client Name		
15-09136	OSINN		_	pCi	5	_		,	Auxier 8	Associa	Auxier & Associates, Inc.	
			Labo	ratory C	Laboratory Control Sample	Sample			:			
Analyte	LCS Measured	CSU	LCS	Uncert. Expected	Known	Known Error	Result	nso	Standard ID	Standard ACT (dpm)	Standard	Standard Added (g)
U-234	86.48%	17.53%	100.00%	3.60%	8.08E+00	2.91E-01	6.99E+00	1.22E+00	U-8a	3.52E+01	3.60E+00	5.09E-01
U-238	89.71%	17.49%	100.00%	3.60%	7.87E+00	2.83E-01	7.06E+00	1.24E+00	U-8a	3.44E+01	3.60E+00	5.09E-01
						and the second s						
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1	ſ		<u> </u>	 T			:	
	Standard Added (g)				Rep ND	OK X	ð	ŏ
	Standard Error %				Rep RPD	ΝΑ	NA	NA
	Standard ACT (dpm)			ary	MS ND			
	Standard ID	,		QC Summary	MS % R			
	Sample Aliquot			QC				
	Sample CSU				LCS % R	OK	ò	OK
de marce de la constante de la	Sample Result		, , , , , , , , , , , , , , , , , , , ,		LCS Relative Bias	0.86	0.90	
<i>Матпх </i>	Actual MS CSU				Replicate CSU	1.90E-01	1.31E-01	1.46E-01
Matri	Actual MS Result				Replicate Result	1.90E-01	1.32E-01	1.21E-01
	Expected MS Uncert				Original CSU	2.49E-01	1.85E-01	8.37E-02
	Expected MS Result			ample	Original Result	3.98E-01	2.56E-01	1.29E-02
	MS Actual % Rec			Replicate Sample	RPD	70.69	63.72	161.35
	Normalized Difference			Rep	Normalized Difference	1.30	1.07	1.26
	Analyte				Analyte	U-234	U-238	U-235

Printed: 10/13/2015 8:01 AM Page 2 of 2 Auxier & Associates, Inc. Client Name Aliquot Units Activity Units pĊi Run OSINO 15-09136



Printed: 10/8/2015 9:14 AM Page 2 of 2

Auxier & Associates, Inc. TH-232 1221.13 -304.36 458.39 35 Client Name Replicate Sample RPD No Matrix Spike 55.49 22.30 38.90 35 TH-228 31.30 7.34 19.32 35 Aliquot Units Upper Етог◆ RPD 40.00 35.00 30,00 25.00 15.00 10,00 9.00 0.00 Lower Error ე | | Activity Units pCi I NC | |-| |-| 97.76 141.14 119.45 75 100 Run 0.00 0.00 3  $\overline{\phantom{a}}$ I ļ ļ **Normalized Difference** ı LCS % Recovery ThISO 100.07 145.01 122.64 75 100 125 REP ND 0.22 ĺ I 94.31 138.45 116.38 76 100 TH-228 0.00 0.00 3 15-09136 - Lower Error
- Upper Error
- W.R
- LC.L
- LC.L
- Mean 110.00 100,00 90.00 80.00 70.00 130.00 120,00 TH-228 3.50 ¬ 2,50 1.50 1.00 0.50 3.00 2.00 0.00

Analysis

				Labo	ratory (	Laboratory Control Sample	Sample						
Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Кпоwп	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
TH-228		116.38%	18.47%	100.00%	3.60%	4.86E+00	1.75E-01	5.65E+00	1.04E+00	Th-8b	1.04E+02	3.60E+00	1.04E-01
TH-230		122.54%	19.77%	100.00%	2.70%	5.37E+00	1.45E-01	6.58E+00	1.30E+00	Th-1b	2.35E+01	2.70E+00	5.07E-01
ТН-232		119.45%	18.09%	100.00%	3.60%	4.86E+00	1.75E-01	5.80E+00	1.05E+00	Th-8b	1.04E+02	3.60E+00	1.04E-01
					Matri	Matrix Spike							
Analyte	Normalized Difference	MS Actual % Rec	Expected MS Result	Expected MS Uncert	Actual MS Result	Actual MS CSU	Sample Resuft	Sample CSU	Sample Aliquot	Standard ID	Standard ACT (dpm)	Standard Error %	Standard Added (g)
	Professional Policy carbon char.												
	For Principles			The said place of the said pla	d add to consider had debroard describe to any						Administration of the first back of the first ba		
	Rep	Replicate Sample	ample						OC	QC Summary	ary		
Analyte	Normalized Difference	RPD	Original Result	Original CSU	Replicate Result	Replicate CSU	LCS Relative Bias	LCS % R		MS%R	GN SW	Rep RPD	Rep ND
ТН-228	0.22	19.32	8.45E-02	1.10E-01	1.03E-01	1.22E-01	1.16	ŏ				NA	OK
ТН-230	0.63	38.90	2.35E-01	1.81E-01	1.58E-01	1.54E-01	1.23	¥				NA	Ą
TH-232	1.81	458.39	9.32E-02	1.26E-01	-3,66E-02	6.19E-02	1.19	Ą				ΝΑ	OK

# **SECTION VII**

# LABORATORY TECHNICIAN'S NOTES & RUNLOGS

ISO U NOTES

Printed: 10/5/2015 7:54 AM Page 1 of 1



**Work Order Analysis Notes** 

Oak Ridge Laboratory

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

Internal Work Order	15-09136
Analysis Code	UUISO
Run Number	1

#	Date	Dept	User	Notes
. 1	10/05/15 07:54	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HN03 TO ACIDIFY SAMPLES AND DRIED SAMPLES DOWN- SUBMITTED SAMPLES TO SEPARATIONS

JNOIZE 1015/5



**Work Order Analysis Notes** 

### Oak Ridge Laboratory

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

internal Work Order	15-09136
Analysis Code	UUISO
Run Number	

10/2/15

#	Date	Dept	User	Notes
1	10/05/15 07:54	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES AND DRIED SAMPLES DOWN- SUBMITTED SAMPLES TO SEPARATIONS
2	10/09/15 18:00	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.

Page 1 of 1

Printed: 10/12/2015 8:52 AM



**Work Order Analysis Notes** 

### Oak Ridge Laboratory

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

Internal Work Order	15-09136
Analysis Code	UUISO
Run Number	1

#	Date	Dept	User	Notes
1	10/05/15 07:54	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES AND DRIED SAMPLES DOWN- SUBMITTED SAMPLES TO SEPARATIONS
2	10/09/15 18:00	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 NH4l, 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 Dl H2O. Set samples aside for later precipitation and filtering.
3	10/12/15 08:52	CHEM	TSMITH	Followed steps 12.1.7 to 12.4.5 in AP-005 . ( Precipitated and filtered samples for Uranium )

10-12-18

e Te		Internal	Work Order	and the control of the first transfer of the same afternoon and
Ø FRI	ERLINE	15-(	09136	
	SERVICES	Analysis Cod	e	Run
	nts Used in an Analysis	UUIS	O	1
Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
016519P	Nitric Acid	Reagent Grade	JWOLFE	10/5/2015
016798P	Anion Exchange Resin	Reagent Grade	JDEMELAS	10/9/2015
016828S	HCI - HF	6.5N - 0.04N	JDEMELAS	10/9/2015
016889S	HCI - NH4I	8N - 0.1M	JDEMELAS	10/9/2015
016128D05	Hydrochloric Acid	0.5N	JDEMELAS	10/9/2015
016803S	Hydrochloric Acid	6.5N	JDEMELAS	10/9/2015
0168725	Hydrochloric Acid	8N	JDEMELAS	10/9/2015
016128P	Hydrochloric Acid	Reagent Grade	JDEMELAS	10/9/2015
0168435	Carbon substrate	Solution	TSMITH	10/12/2015
016569P	Hydrofluoric Acid	Reagent Grade	TSMITH	10/12/2015
016583S	Neodymium Carrier	1 mg/ml	TSMITH	10/12/2015
016514P	Reagent Alcohol	Reagent Grade	TSMITH	10/12/2015
016606P	Titanous Chloride	Reagent Grade	TSMITH	10/12/2015

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	:	1510020ACC-4)	ucor.	1000	24000-	750-Th	LEB
	10/1/10	à I	MDNL	1000	2h50-	ISO-Th	MO
		(2-1) 40200151	uan	1147	2h50-	Ne	166
		12000M (1-4)	PCL	1148	2h-00-	Do-Th-	143
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		12021214(1-1-10)	uwr	1724	2hr00-	IS0-P4	W
1		1010073A(14)	USA	1724	21-50-	Reile	rs.
1		1510035A(1-2)	USA	174	2400-	Per	KB
1		SystemBkyl	- Labo	YUB 10/9/10	16,40 hu	us	
		System Blad	Lab	1721	16:10 hm >	_ <u> </u>	143
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1	, ,	150915146-4,6)	<u>non</u>	5959	2hr00-	エダークム	KB.
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+	10/12/15	10091014 (1~4)	uar	<u> Poot</u>	2/ws0 -	Amz43	145
		1510049A(1-4)	uan	1004	2h-50-	ISO-UU	KB
		1510007A(1-4)	<u>u</u> con	1005.	shoo-	Iso-uy	KB
1		1509136A(1-7)	Auxie	1004	2hr50 -	Iso-uu	ICB .
1	1. 1	120 91214-(4)	UCOK	1006		PHUNT	143
1		12001214(1-1)	ycon	1007	2hr50-	TSO-UY	KB
+	Y. Y.	15091514(1-4)	Ucon	1300	2 huso in	Puric	Pes -
1		15100074 (44)	uon	1301	2hr50-	Puzze	100
1	1	1509151AU-4)	uur	1301	2hrouni	Thry	KO
1	4 . F	15 10007A-(14)	<u>us</u>	1362	2h-50-	Thera	KB
1	10/2/10	1509136A (1)	Auxie	1744	2h-50-	uu	1CB
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ISO TH NOTES

Page 1 of 1



**Work Order Analysis Notes** 

## Oak Ridge Laboratory

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

internal Work Order	15-09136
Analysis Code	ThISO
Run Number	1

#	Date	Dept	User	Notes
1	10/05/15 07:54	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES AND DRIED SAMPLES DOWN- SUBMITTED SAMPLES TO SEPARATIONS

JNOIP-1015/5 Printed: 10/6/2015 4:46 PM Page 1 of 1



**Work Order Analysis Notes** 

### **Oak Ridge Laboratory**

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

Internal Work Order	15-09136
Analysis Code	ThISO
Run Number	1

/hl/h 10/6/15

#	Date	Dept	User	Notes
1	10/05/15 07:54	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES AND DRIED SAMPLES DOWN- SUBMITTED SAMPLES TO SEPARATIONS
2	10/06/15 16:45	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 deiononized water, bringing volume to ~15ml. Set samples aside for later precipitation and filtering.



Work Order Analysis Notes

## **Oak Ridge Laboratory**

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

Internal Work Order	15-09136
Analysis Code	ThISO
Run Number	1

#	Date	Dept	User	Notes Notes
1	10/05/15 07:54	PREP	JWOLFE	ALIQUOTED AND ADDED SPIKES AND TRACERS- ADDED HNO3 TO ACIDIFY SAMPLES AND DRIED SAMPLES DOWN- SUBMITTED SAMPLES TO SEPARATIONS
2	10/06/15 16:45	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 deiononized water, bringing volume to ~15ml. Set samples aside for later precipitation and filtering.
3	10/07/15 12:48	CHEM	JDEMELAS	Added 0.75 ml of 0.1 mg/ml Cerium Carrier and 1 ml HF to samples in C-Tubes and mixed; Immersed sample set in ice bath for minimum one hour; Setup filters by adding Alcohol and Carbon Substrate, then added samples; When samples were filtered, added 10 ml Dl H2O rinses from C-Tubes; When rinsates were filtered, removed filters and placed in new, labeled Petri Dishes; and Set T-0. Completed documentation, and sent set to the Count Room.

Printed: 10/7/2015 3:08 PM Page 1 of 1

ATS.		Interna	l Work Order							
	ERLINE	15-	09136							
	SERVICES	Analysis Co	de	Run						
Reag	ents Used in an Analysis	ThIS	ThISO							
Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded						
016519P	Nitric Acid	Reagent Grade	JWOLFE	10/5/2015						
016843S	Carbon substrate	Solution	JDEMELAS	10/7/2015						
016557S	Cerrium Carrier	0.1mg/ml	JDEMELAS	10/7/2015						
016569P	Hydrofluoric Acid	Reagent Grade	JDEMELAS	10/7/2015						
016514P	Reagent Alcohol	Reagent Grade	JDEMELAS	10/7/2015						

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	Date		Olient	Toal Vin	Collins.	Suise	That	
-	2.4	15091214(1-5)	Accurest	162	21/00-	Rib	KB	THE REAL PROPERTY.
	E	1809 HZA(1-5)	Texas Brine Co.	1622	2h-00=	Rule	RB	
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		10091410(1-4)	Access	1624	2 horomini	Pale	VB	2. <sub>1</sub>
		Saly Purs	1A13	orzz		w		9. U v
-		1509179AC1-4)	Utility Serv.	1107	2 h/50-	Perk	KB.	
- American		1509140A(44)	whility Seev.	1127	2450=	Pale:	KB.	
in the second		16001004C1-4)	Accutest	1220	2hr00=	Pale	ICB:	
-		100913844-7	Test America	1991	22-50=	Rale	140	
1		1609124AC1-4)	<u>ucor</u>		2hroso -	Np_	KB.	
		1569124A(1-4)	_uon	W37	3 Kr20 -	Am 24	JEB .	
		15100ma(1-5)	uniter	1439	2 haso -	±30-UU	IRB .	
Charles Control		1200 1044 (141)	ycod	1439	2hr50-	#50-P4	KB.	
1	. ii		Brydges Envi	1050	2/400-1	ISOUL	)CB .	
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-		1509104A(1-5,7)	DOE	1731	_	I50-PU	KB.	- 1
+		1809136A(1-4)	Brydges-Env.	1750	2450-	FSO-Th	VCD_	Weigh.
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1	1 1	1509 MMA (1-4)	ucor	1752	2hr50-	Amzes	145	The second second
1	10/4/17	1509176A(1-7)	Auxin	1814	2 hrs0 -	-N-02I	13	31
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# SECTION VIII ANALYTICAL DATA (ISOTOPIC URANIUM)

Eberline Services Oak Ridge Laboratory Analysis Sheet

15-09136 UUISO Run 1

Printed: 10/12/2015 8:59 AM Page 1 of 3

	30,30	Internal	Sample	Client	Login	Sample	Sample
Work Order	15-09150	Fraction	Desc	QI	CPM	Date	Aliquot
Analysis Code	OSINN	01	SOT	SOT		09/25/15 00:00	1.0000E+00
Run		02	MBL	BLANK		09/25/15 00:00	1.0000E+00
Date Received	9/25/2015	03	DUP	KC85-032-L	35	09/21/15 14:42	5.0000E-01
Lab Deadline	10/16/2015	94	00	KC85-032-L	35	09/21/15 14:42	5.0000E-01
Client	Auxier & Associates, Inc.	05	TRG	KC85-032-M	31	09/21/15 13:25	5.0000E-01
Project	PAP-KAN	90	TRG	KC94-199-U	37	09/18/15 09:56	5.0000E-01
Report Level	7	20	TRG	KC97-209-U	35	09/19/15 11:15	5.0000E-01
Activity Units	pCi						
Aliquot Units					a hayan ya ya maran a		:
Matrix	WA						
Method	EML U-02 Modified						
Instrument Type	Alpha Spectroscopy						
Radiometric Tracer	U-232						:
Radiometric Sol#	U-10a		:		The state of the s	and a state of the	
Tracer Act (dpm/g)	18.65						
Carrier			marks of Physics of the Control of t			3,3,4	
Carrier Conc (mg/ml)							
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	TO COMMITTEE TO CO						

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

Eberline Services Oak Ridge Laboratory Analysis Sheet

**15-09136** UUISO Run 1

Printed: 10/12/2015 8:59 AM Page 2 of 3

SAF SAF 1* 2*																	
Mean % Rec												5	-				
Grav % Rec																	
Grav Filter Net (g)																	
Grav Filter Final (g)																	
Grav Filter Tare (g)																The state of the s	
Grav Carrier Added (ml)											December 175 and 67 May 1970 W						
Radiometric % Rec	00.00	00:0	00.0	00.0	00.00	00.00	00.0										
Radiometric Tracer (pCi)																	
Tracer Total ACT (dpm)	11.3	11.3	11.3	11.3	11.2	11.2	11.2										
Tracer Aliquot (g)	0.6082	0.6069	0.6039	0.6052	0.6006	0.5994	0.5991	Ye Asimira a car a car	-	Analysis of the property of th							
Sample Desc	rcs	MBL	DOP	00	TRG	TRG	TRG	U									
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\*SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. A Indicates estimated SAF value. \*\*Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Eberline Services Oak Ridge Laboratory Analysis Sheet

15-09136 UUISO Run 1

Printed: 10/12/2015 8:59 AM Page 3 of 3

Prep Prep Sep to Date By Date/Time 10/05/15,07-30 IM/OI EE
10/05/15 07:39 JWOLFE

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

Eberline Services Oak Ridge Laboratory

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Page 1 of 3

Work Order: 15-09136-UUISO-1 Preliminary Data Report & Analytical Calculations

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Error Estimate	1.12E+00	3.19E-02	1.90E-01	2.48E-01	3.25E-01	1.78E-01	1.85E-01		7			}				100		-
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Activity Units	pCi/I	DCI/I	pCi//	pCi/I	pCi/I	pCi/I	pCi/I						47					
Client Identification	SOT	BLANK	KC85-032-L	KC85-032-L	KC85-032-M	KC94-199-U	KC97-209-U			Para Milandia				777	77.			
Sample Desc	SO7	MBL	DUP	DO	TRG	TRG	TRG											
Nuclide	U-234	U-234	U-234	U-234	U-234	U-234	U-234	7				), mill (A.)	The state of the s				- Annual -	:
Lab Fraction	01	02	03	04	05	90	07											

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Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Alfquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
70	U-234	SOT	09/25/15 00:00	1.00E+00	93.27	0.00	0.00			
02	U-234	MBL	09/25/15 00:00	1.00E+00	116.08	0.00	0.00			Tiped.
03	U-234	DUP	09/21/15 14:42	5.00E-01	117.95	0.00	0.00			
40	U-234	00	09/21/15 14:42	5.00E-01	100.82	0.00	0.00		THE	
02	U-234	TRG	09/21/15 13:25	5.00E-01	117.44	00.00	0.00			THE PARTY OF THE P
90	U-234	TRG	09/18/15 09:56	5.00E-01	108.26	0.00	0.00			
20	U-234	TRG	09/19/15 11:15	5.00E-01	97.39	0.00	0.00		To constitute the same of the	appears to the same state of t
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Sample Desc	rcs	MBL	DUP	00	TRG	TRG	TRG											
Nuclide	U-234	U-234	U-234	U-234	U-234	U-234	U-234	THE STATE OF THE S	7 - 7 O. J.		, John State Company	7.77	THEN				*****	
Lab Fraction	2	07	03	04	05	90	07											

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Eberline Services Work Order

Auxier & Associates, Inc.

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Eberline Services Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 15-09136-UUISO-1

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Error Estimate	1.13E+00	4.47E-02	1.31E-01	1.84E-01	2.06E-01	1.90E-01	1.54E-01													
Results	7.06E+00	2.92E-02	1.32E-01	2.56E-01	3.14E-01	2.58E-01	1.62E-01												-	
Activity Units	pCi/(	pCi/I	pCi/I	pCi/I	pCi/I	pCi/I	pCi/I								,			11	17/06	
Client Identification	TCS	BLANK	KC85-032-L	KC85-032-L	KC85-032-M	KC94-199-U	KC97-209-U			The state of the s		The control of the co			To a control of the c	The state of the s			The state of the s	
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Lab Fraction	5	02	03	40	05	90	20					, , , , , ,								

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Preliminary Data Report & Analytical Calculations

Work Order: 15-09136-UUISO-1

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Radiometric % Rec	93.27	116.08	117.95	100.82	117.44	108.26	97.39									PANADAM AND STREET STRE
Sample Aliquot	1.00E+00	1.00E+00	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01									
Sample Date	09/25/15 00:00	09/25/15 00:00	09/21/15 14:42	09/21/15 14:42	09/21/15 13:25	09/18/15 09:56	09/19/15 11:15								The state of the s	
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Lab Fraction	04	02	03	04	05	90	07		KIR BY							

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# Eberline Services Oak Ridge Laboratory

# Work Order: 15-09136-UUISO-1

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Bkg CPM	0.00 E+00	1.00 E-03	3.00 E-03	1.00 E-03	5.00 E-03	2.00 E-03	2.00 E-03							
Counts	3.93 E+02	170 1.83 E+00	170 4.49 E+00	170 7.83 E+00	170 1.01 E+01	170 7.66 E+00	170 4.66 E+00					-		
Count	170	170	170	170	170	170	170							
Carrier	Alpha_057	Alpha_050	Alpha_051	Alpha_052	Alpha_053	Alpha_054	Alpha_055							
Defect	A Spec	A_Spec	A_Spec	A_Spec	A_Spec	A_Spec	A_Spec							
Halfilfe (days)														
Counting Date/Time	10/12/15 13:43	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05	18.00						
Sample Desc	SOT	MBL	DUP	OD D	TRG	TRG	TRG				***************************************			
Nuclide	U-238													
Lab Fraction	2	02	03	04	05	90	07							

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Eberline Services Work Order

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Eberline Services Oak Ridge Laboratory

Preliminary Data Report & Analytical Calculations

Work Order: 15-09136-UUISO-1

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MDA	1.34E-01	9.45E-02	2.06E-01	2.28E-01	1.60E-01	2.50E-01	2.58E-01												
Error Estimate	2.18E-01	6.80E-02	1.46E-01	8.37E-02	1.70E-01	1.64E-01	1.69E-01	The state of the s											
Results	4.90E-01	5.26E-02	1.21E-01	1.29E-02	1.85E-01	1,25E-01	1.29E-01												
Activity Units	pCi/I	pCI/I	pCi/I	pCI/I	pCi/l	pCi/I	pCi/I	1000											
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Page 2 of 3 Printed: 10/13/2015 8:00 AM

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Eberline Services Oak Ridge Laboratory

01         U-235         LCS         696/25/15 00:20         1,000E-40         116,00E         0.00         0.0	Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
U-236         DUP         09/24/15 14/42         5.00E-01         116.08         0.00         0.00           U-236         DD         09/24/15 14/42         5.00E-01         117.36         0.00         0.00           U-236         TRG         09/24/15 14/42         5.00E-01         117.44         0.00         0.00           U-236         TRG         09/24/15 14/42         5.00E-01         147.74         0.00         0.00           U-236         TRG         09/18/15 09:86         5.00E-01         177.44         0.00         0.00           U-236         TRG         09/18/15 09:86         5.00E-01         97.39         0.00         0.00           U-236         TRG         09/18/15 11:15         5.00E-01         97.39         0.00         0.00		U-235	rcs	09/25/15 00:00	1.00E+00	93.27	0.00	00.00			
U-235         DD         0962/1/15 14:42         5.00E-01         117.58         0.00         0.00           U-235         TRO         0962/1/15 14:42         5.00E-01         117.44         0.00         0.00           U-235         TRO         0952/1/15 13:25         5.00E-01         117.74         0.00         0.00           U-235         TRG         09/18/15 03:56         5.00E-01         117.74         0.00         0.00           U-235         TRG         09/18/15 03:56         5.00E-01         117.74         0.00         0.00           U-235         TRG         09/18/15 03:66         5.00E-01         117.74         0.00         0.00           U-236         TRG         09/18/15 03:66         5.00E-01         117.74         0.00         0.00           U-236         TRG         09/18/15 03:66         5.00E-01         117.74         0.00         0.00           U-236         TRG         09/18/15 03:66         5.00E-01         197.39         0.00         0.00           U-237         TRG         09/18/15 03:67         10.70         0.00         0.00         0.00           U-238         TRG         09/18/15 03:67         0.00E-01         0.00         0.00	7	U-235	MBL	09/25/15 00:00	1.00E+00	116.08	0.00	·			
U-235         TRG         09/24/15 13:25         5.00E-01         10.02         0.00         0.00           U-235         TRG         09/18/15 09:56         5.00E-01         117.44         0.00         0.00           U-235         TRG         09/18/15 09:56         5.00E-01         108.28         0.00         0.00           U-235         TRG         09/18/15 11:15         5.00E-01         97.39         0.00         0.00           U-236         TRG         09/18/15 11:15         5.00E-01         97.39         0.00         0.00           U-236         TRG         09/18/15 11:15         5.00E-01         97.39         0.00         0.00	3	U-235	DUP	09/21/15 14:42	5.00E-01	117.95	0.00				THE TRANSPORT TO THE TR
10-235 TRG 09/11/15 13:25 5.00E-01 117.44 0.00 0.00 0.00 10-235 TRG 09/19/15 11:15 5.00E-01 97.39 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0	4	U-235	DO	09/21/15 14:42	5.00E-01	100.82	0.00		A CONTRACTOR AND A CONT		
U-235         TRG         09/19/16 11:15         5.00E-01         108.28         0.00         0.00         0.00           U-235         TRG         09/19/16 11:15         5.00E-01         97.39         0.00         0.00         0.00           U-235         TRG         09/19/16 11:15         5.00E-01         97.39         0.00         0.00         0.00           U-235         TRG         09/19/16 11:15         10.00         0.00	5	U-235	TRG	09/21/15 13:25	5.00E-01	117,44	0.00	Activities and activities activiti			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1   1   1   1   1   1   1   1   1   1	9	U-235	TRG	09/18/15 09:56	5.00E-01	108.26	0.00				
	7	U-235	TRG		5.00E-01	97.39	0.00				
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Eberline Services Work Order

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Analysis Code

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Auxier & Associates, Inc.

Client

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: VOOSE

盂	15.8	14.3	15.2	16.1	14.6	14.5	15.6								
Bkg CPM	0.00 E+00	2.00 E-03	4.00 E-03	4.00 E-03	1.00 E-03	0.00 E+00	0.00 E+00								
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Detect	A_Spec		E:												
Halflife (days)															
Counting Date/Time	10/12/15 13:43	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05	10/12/15 10:05								
Sample	SOT	MBL	DUP	00	TRG	TRG	TRG			 <b></b>					
Nuclide	U-235	`													
Lab Fraction	9	02	03	04	05	90	07								

Printed: 10/12/2015 8:59 AM Page 1 of 1

Count Room Report Client: Auxier Associates, Inc.

15-09136-UUISO-1 (pCi/l) in WA Tracer ID: U-10a

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SAF 1*																				
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Tracer ACT (dpm)	11.3429	11.3187	11.2627	11.2870	11.2012	11.1788	11.1732													
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Tracer Aliquot (g)	0.6082	0.6069	0.6039	0.6052	0.6006	0.5994	0.5991										:			
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Sample Desc	SOT	MBL	DUP	00	TRG	TRG	TRG		:											
Internal Fraction	10	02	03	0.4	ď5	90	20			-				+					-	
Inta Fra				)																

# Spike and Tracer Worksheet

Eberline Services Oak Ridge Laboratory

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-	10/5/2015
	Printed:

	Internal W	Internal Work Order		Run	Analysis Code	Code	Date	ite		Technicían	licían		Technician Initials	ın initials	Witnes	Witness Initials
	15-0	15-09136		7-	OSINO	SO	10/5/20	10/5/2015 7:34		JWOLFE	LFE		J.	4		
	SOT	LCS & Matrix Spikes	ilkes		SOT	MS	CSD	MSD	SOT	S.	MS	S	CSD	SD	M	MSD
Isotope	#JoS	Activity dpm/g	Solution Date	Approx Addition	Volume Used (g)	Volume Used (g)	Volume Used (g)	Volume Used (g)	Known pCi	Error Estimate	Added pCi	Error Estímate	Known pCi	Error Estimate	Added pCi	Error Estimate
U-234	U-8a	35.240	10/5/2015	0.500	0.5089				80.8	0.291	00.00	0.000	00.00	0.000	00:00	0.000
U-238	U-8a	34.350	10/5/2015	0.500	0.5089		1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		78.7	0.283	00:0	0.000	0.00	0.000	0.00	0.000
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			Tracers	100 mg / 100						Bala	ınce Prin	Balance Printer Tapes	S			
fraction	Isotope	# JoS	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition			Tracer					CCS		
10	U-232	U-10a	18.650	10/5/2015	0.6082	0.6500										
02	U-232	U-10a	18.650	10/5/2015	0.6069	0.6500						-				
63	U-232	U-10a	18.650	10/5/2015	0.6039	0.6500										
04	U-232	U-10a	18.650	10/5/2015	0.6052	0.6500								٠.		
90	U-232	U-10a	18.650	10/5/2015	0.6006	0.6500							*	) (	(	
90	U-232	U-10a	18.650	10/5/2015	0.5994	0.6500			2	ر س م				0.0000 0.0000 0.00000 0.00000000000000	ញា ភ្	
07	U-232	U-10a	18.650	10/5/2015	0.5991	0.6500			, G. 6869	n or (空)						
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Printed: 10/5/2015 7:34 AM Page 1 of 1

# **Aliquot Worksheet**

Eberline Analytical Oak Ridge Laboratory

	Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	ll eu			Tech	Technician		
	15-09136	~	OSINN	liters	10/16/2015	015			JWC	JWOLFE		
											0 0	-
4	Auxier & Associates, Inc.	Sample	Muffle Data	<u> </u>	Dilution Data		Aliquot Data	t Data	MS Allq	MS Allquot Data	H-3 Solids Only	s Only
Fraction	Client ID	Туре	Ratio Post/Pre	No.of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
6	TCS	SOT				The Application of States	1.0000E+00	1.0000E+00				
05	BLANK	MBL					1.0000E+00	1.0000E+00				
03	KC85-032-L	DUP					5.0000E-01	5.0000E-01				
2	KC85-032-L	റ്റ					5.0000E-01	5.0000E-01				
05	KC85-032-M	TRG					5.0000E-01	5.0000E-01	'		100000000000000000000000000000000000000	
90	KC94-199-U	TRG					5.0000E-01					
20	KC97-209-U	TRG		Total Control of the			5.0000E-01	5.0000E-01				
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	Comments											
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JM6122 Date: 10/5 1/5

Technician:





Sample Description:

SPIKE

Spectrum File:

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001308

Batch Identification: 1509136A-UU

Sample Identification: 01

Shelf 2 Sample Geometry: Procedure Description: U iso

Detector Name:

Alpha 057

Chamber Serial Number: 01017326A

Detector Serial Number: 57

Reagent Blank:

Env. Background: System Bkgd 131198 <not performed>

Sample Size:

1.000E+000 +/- 0.000E+000 liter

Sample Date/Time: 1.000E+000 +/- 0.000ESample Date/Time: 10/12/2015 1:42:25 PM
Acquisition Date/Time: 10/12/2015 1:43:57 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate:

U232 UU-10A

Tracer Quantity:

0.608 mL

Effective Efficiency:

0.1471 +/- 0.0094

Effective Efficiency: 0.14/1 +/- 0.0094

Counting Efficiency: 0.1577 +/- 0.0028 on 12/13/2014 2:27:38 PM

Chem. Recovery Factor: 0.9327 +/- 0.0619

Control Certificate Name: NatU\_U-8A

Chem. Recov. of Control: U-238

0.874468 +/- 0.075914

Peak Match Tolerance: 0.150 MeV

				·				
			PEA	K AREA RI	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
U-232 U-234	Т	5.282 4.733	281.66 387.00	11.69	0.34	0.00E+000 0.00E+000	26.0 8.2 3.0	
U-235 U-238		4.406 4.157	22.00 393.00	<b>42.73</b> 9.90	0.00 0.00	0.00E+000 0.00E+000	13.4	

T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS 

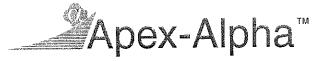
Nuclide	Id	Energy	Activity	MDA
	Conf.	(keV)	(pCi/liter )	(pCi/liter )
U-232	0.997	5302.50*	5.08E+000 +/- 6.37E-001	8.63E-002 +/- 1.08E-002
U-234	0.994	4761.50*	6.99E+000 +/- 1.12E+000	1.08E-001 +/- 1.36E-002
U-235	0.997	4385.50*	4.90E-001 +/- 2.18E-001	1.34E-001 +/- 1.67E-002
U-233	0.995	4184.40*	7.06E+000 +/- 1.13E+000	1.08E-001 +/- 1.35E-002

Sample Title: 01

Elapsed Live time: 10200 Elapsed Real Time: 10200

Channel								
1:	0	0	0	0 '	1 '	1	0 '	o'
9:	Ō	Ō	Ö	1	0	0	0	0
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25:	Ö	Ō	0	0	0	0	0	0
33:	Ō	1	0	0	0	0	0	1
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	1	1
89:	0	0	0	0	1	0	0	0
97:	0	0	0	0	0	0	0	0
105:	1	0	0	0	0	0	0	0
113:	0	1	0	1	0	0	0	0
121:	0	0	1	0	1	0	0	0
129:	0	0	0	0	0	1	0	0
137:	0	0	0	1	0	0	0	0
145:	0	0	0	2	1	0	1	0
153:	0	1.	1	0	0	2	0	1.
161:	0	1	1	3	0	0	1	1
169:	3	1	1	0	0	1	1	0 2
177:	0	1	0	1	0	0	2 2	0
185;	1	1	0	0	2	0	0	0
193:	2	0	2	2	1	2 0	1	2
201:	1	1	1	0	7	0	$\frac{1}{4}$	1
209:	1	0	2	3 2	2 0	2	3	1
217:	0	3	4	8	6	5	6	5
225:	4 2	6 7	1	9	14	8	8	5
233:		8	8	1.6	7	1.2	15	7
241:	10 22	6 14	15	17	9	16	17	12
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281: 289:	0	0	0	Õ	Ö	0	Ō	0
297:	0	0	Õ	1	Ö	1	0	0
305:	0	1	Ö	Ō	Ō	0	0	1
313:	1	0	1	Ö	2	0	1	0
321:	1	ĺ	1	1	1	0	0	1
329:	1	Ō	0	0	0	0	1	1 0
337:	0	Ö	0	1.	1	0	0	0
345:	0	Ö	ī	0	1	0	0	0
353:	Ö	0	1 1	0	1	1	0	1 1
361:	0	1	0	0	1	1	0	1
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Channel	Data Repor	t		10/12/2015	5:04:	04 PM		Page 3
801:	0	0	0	0	0	0	0	0
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Channel  809:		- 0	 0	 0	 0	0		0
817: 825:	0	0 0	0 0	0	0 0	0 0	0	0 0
833:	0	0	0	0	1	Ō	0	0
841: 849:	0 0	0 0	0	0	0 0	0	0 0	0 0
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865: 873:	0 0	0 0	0	0 0	0 0	0 0	0 0	0 0
881:	0	0	0	0	0	0	0 0	0 0
889: 897:	0	0 0	0	0 0	0 0	0	0	0
905:	0	0	0	0 0	0 0	0 0	0 0	0 0
913: 921:	0 0	0 0	0	0	0	0	Ō	Ö
929:	0	0	0	0 0	0 0	0 0	0 0	0 0
937: 945:	0 0	1. 0	0	0	0	0	Ö	0
953; 961:	0 0	0	0	0 0	0 1	0 0	0	0
969:	0	0	0	0	0	0	0	0
977: 985:	0 0	0	0	0 0	0	0 0	0 0	0 0
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Spectrum File:

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1509136A-UU

Batch Identification: Sample Identification:

Sample Geometry: Procedure Description: U iso

02 Shelf 2

Detector Name:

Chamber Serial Number: 10006121B

Detector Serial Number: 50

Env. Background: Reagent Blank:

Alpha 050

System Bkgd 131191 <not performed>

Sample Size:

1.000E+000 +/- 0.000E+000 liter

Sample Date/Time: 10/12/2015 9:23:36 AM Acquisition Date/Time: 10/12/2015 10:05:10 AM

Acquisition Live Time: Acquisition Real Time:

170.0 minutes 170.0 minutes

Tracer Certificate:

Tracer Quantity:

Counting Efficiency: 0.1657 +/- 0.0101 Chem. Recovery Factor: 0.1428 +/- 0.0026 on 12/13/2014 2:43:59 PM 1.1608 +/- 0.0737

 $0.60\overline{7}$  mL

U232 UU-10A

Peak Match Tolerance:

0.150 MeV

			PEAK	AREA RI	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
U-232 U-234 U-235 U-238	T	5.284 4.666 4.374 4.075	316.64 0.83 2.66 1.83	11.04 239.53 128.85 152.56	1.36 0.17 0.34 0.17	0.00E+000 0.00E+000 0.00E+000 0.00E+000	22.1 3.0 3.0 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*	5.07E+000 +/- 6.05E-001	1.10E-001 +/- 1.31E-002
U-234	0,937	4761.50*	1.33E-002 +/- 3.19E-002 5.26E-002 +/- 6.80E-002	6.69E-002 +/- 7.98E-003 9.45E-002 +/- 1.13E-002
U-235 H-238	0.999 0.918	4385.50* 4184.40*	2.92E-002 +/- 4.47E-002	6.66E-002 +/- 7.94E-003

: 00075

Sample Title: 02

Channel								
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17:	0	0	0	0	0	0	0	0
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33:	0	0	0	0	0	0	0	0
41:	1	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
<b>57:</b>	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	1	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	1
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	1	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	1	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 0	0	0	0
233:	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
265:	0	0	0	0	0	0	0	0
273:	0	0		0	0	0	0	0
281:	0	0 0	0 1	0	0	0	Ö	Ö
289:	0 0	0	0	0	0	0	0	Ö
297:	1	0	0	0	0	0	Ö	Ö
305:	0	0	0	0	0	Ö	Ö	0
313: 321:	0	0	0	0	0	Ö	Ō	Ö
321;	0	0	0	0	0	Ö	Ö	Ō
329: 337:	0	0	0	0	0	0	Ö	Ö
345:	0	0	1	0	0	ő	Ö	Ō
345: 353:	0	0	0	0	Ö	Ö	Ö	Ö
361:	0	0	0	0	0	Ö	Ö	Ö
207:	J	O	O	V	~	ŭ	-	•

Channel	Data Repor	ct	1	0/12/201	5 12:58:4	10 PM		Page 3
801:	0	0	0	0	0	0	0	0
	Sample Ti	Ltle:	02					
Channel 809:				0	0	 0		
817:	0	Ō	Ō	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	. 0 .	0	0	0	0	0	0	0 .
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	0	1	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	1	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	O	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



Spectrum File:

Batch Identification: 1509136A-UU Sample Identification: 03

Sample Geometry:

Shelf 2

Procedure Description: U iso

Detector Name:

Alpha 051

Chamber Serial Number: 10006123A

Detector Serial Number: 51

Reagent Blank:

Env. Background: System Bkgd 131192 <not performed>

5.000E-001 +/- 0.000E+000 liter

Sample Date/Time: 5.000E-001 +/- 0.000ESample Date/Time: 9/21/2015 9:23:36 AM
Acquisition Date/Time: 10/12/2015 10:05:16 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate:

U232 UU-10A

Tracer Quantity:

0.604 mL

Effective Efficiency: 0.1798 +/- 0.0106
Counting Efficiency: 0.1524 +/- 0.0027 on 12/13/2014 2:42:37 PM
Chem. Recovery Factor: 1.1795 +/- 0.0727

Peak Match Tolerance:

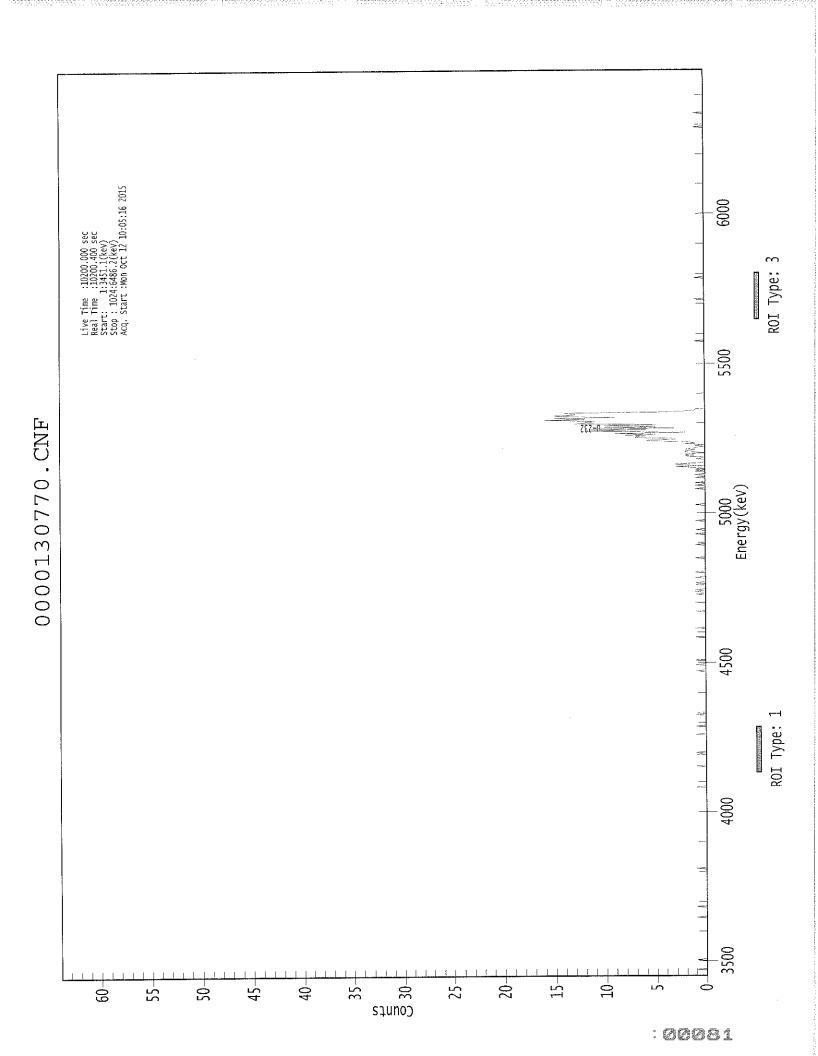
0.150 MeV

			<b></b>		<b>-</b>			
			PEAK					
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
U-232 U-234 U-235 U-238	T	5.288 4.730 4.406 4.178	341.79 6.43 3.32 4.49	10.64 99.27 119.77 98.45	2.21 3.57 0.68 0.51	0.00E+000 0.00E+000 0.00E+000 0.00E+000	39.2 3.0 3.0 3.0	

T = Tracer Peak used for Effective Efficiency

---- NUCLIDE ANALYSIS RESULTS

Nuclide	Id	Energy	Activity	MDA
	Conf.	(keV)	(pCi/liter)	(pCi/liter)
U-232	0.998	5302.50*	1.01E+001 +/- 1.17E+000	2.36E-001 +/- 2.73E-002
U-234	0.993	4761.50*	1.90E-001 +/- 1.90E-001	2.79E-001 +/- 3.22E-002
U-235	0.997	4385.50*	1.21E-001 +/- 1.46E-001	2.06E-001 +/- 2.38E-002
U-238	1.000	4184.40*	1.32E-001 +/- 1.31E-001	1.54E-001 +/- 1.78E-002



Sample Title: 03

			1	1	1	I	1	1
Channel  -					0	0	0	1
1:	0 0	0	0 0	0	0	0	0	Ō
9:	0	0	1	0	0	0	0	Ö
17:	0	0	0	0	Ö	0	0	0
25: 33:	0	0	0	0	Ö	0	Ö	. 0
33: 41:	0	0	0	0	Ö	Ö	Ö	Õ
41:	0	0	0	0	ŏ	ŏ	Ö	Ō
57 <b>:</b>	0	0	Ö	0	Ö	Ö	0	0
65:	0	0	1	Ö	Ö	Ō	0	0
73:	Ö	0	Ō	0	Ō	Ō	1	0
81:	Ö	0	Ö	0	0	0	0	0
89:	Ö	0	Ö	Ö	Ö	0	0	0
97:	Ö	Ö	Ö	0	0	0	0	0
105:	Ö	Ö	Ö	0	0	0	0	0
113:	0	Ö	Ö	0	Ō	0	0	0
121:	Ö	1	Ö	0	0	0	0	0 -
129:	Ō	0	Ö	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	- O	0	0	0
169:	0	0	. 0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	1	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	1	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	1	0	1	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	1	0	0	0	0	0	0
281:	0	0	1	0	0	Ü	0	0
289;	0	0	0	0	0	0	0	1
297:	0	1	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	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:	1	0	0	0	0	0	0 0	1 0
353:	0	0	0	0 0	1	0	0	0
361:	0	0	0	U	U	U	U	U

Channel	Data R	eport			10/12/2015	12:58:47	PM		Page	2
369:	0		0	0	0	0	0	0	0	
	Sampl	e Title	9: 03							
Classon o l	ī	1 .	_ 1	_			_			
Channel 377:	0		0	0	0	0 '	0 '	1	0 '	
385:	0		0	0	Ö	Ō	0	0	0	
393:	1		0	Ö	0	Ö	0	0	0	
401:	0		0	0	0	Ö	0	0	0	
401:	0		0	0	1	0	0	0	0	
417:	0		Ö	0	0	0	1	0	0	
425:	0		0	Ō	0	0	0	1	0	
433:	0		1	0	1	0	0	0	0	
441:	0		1	0	1	0	0	0	0	
449:	0		1	0	0	0	0	0	1	
457:	0		0	0	0	0	0	0	0	
465:	0		0	0	0	0	0	0	1	
473:	0		0	0	0	0	0	0	0	
481:	0		0	0	0	0	0	1	0	
489:	0		0	0	0	0	0	0	0 1	
497:	0		0	1	0	0	0	0	0	
505:	0		0	0	0	0	0	0	0	
513:	0		1	0	0	0	0	0	0	
521:	0		0	0	1	0	0	0	0	
529: 537:	0		0	0	0	0	0	Ö	Ö	
545:	0		0	0	Ö	Ö	1	0	0	
553:	0		1	Ō	Ō	1.	0	0	0	
561:	Ō		0	1	0	0	1	0	0	
569:	C		1	0	1	0	1	3	0	
577 <b>:</b>	3		3	1	0	0	0	0	1	
585:	C	1	0	2	1	2	1	0	2	
593:	2		1	2	1	1	0	1 3	0 7	
601:	2		1	2	5 5	6 9	3 2	3 11	12	
609:	7		6	8	~	9 5	10	5	13	
617:	6		12	3 11	10 16	12	15	9	14	
625:	11 15		12 13	13	14	4	2	1	1	
633: 641:	13		0	0	0	Ō	0	0	0	
649:	C		0	0	Ō	Ö	0	0	0	
657:	C		Ö	0	Ō	0	0	0	0	
665:	Č		0	0	0	0	0	0	0	
673:	C		0	0	0	0	0	0	0	
681:	C	)	0	0	0	0	0	0	0	
689;	(		0	0	0	0	0	0	0	
697:	(		0	0	0	0	0 0	0 0	0	
705:	(		0	0	0	0 1	0	0	0	
713:	(		0	0 0	0	0	0	0	0	
721:	(		0	0	0	0	0	Ö	Ö	
729: 737:	(		0	0	0	0	Ö	Ŏ	Ö	
737: 745:	(		0	0	ő	Ö	Ō	0	0	
753:	(		0	0	Ō	0	0	0	0	
761:		)	0	0	1	0	0	0	0	
769:		· )	0	0	0	0	0	0	0	
777:	(	)	0	0	0	0	0	0	0	
785:		)	0	0	1	0	0	0	0	
793:	(	)	0	0	0	0	0 .	0	0	

Channel Da	ata Repor	t	1	.0/12/2015	12:58:	47 PM		Page 3
801:	0	0	0	0	0	0	0	0
č	Sample Ti	tle:	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	Ö	0
849:	0	0	0	0	0	0	Ó	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	О	1	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	l	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



KC85-032-L

Spectrum File:

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001307

Batch Identification: Sample Identification:

1509136A-UU 04

Sample Geometry:

Shelf 2

Procedure Description: U iso

Detector Name:

Alpha 052

Chamber Serial Number: 10006123B Detector Serial Number: 52

Env. Background:

System Bkgd 131193

Reagent Blank:

<not performed>

5.000E-001 +/- 0.000E+000 liter

Dample Date/Time: 9/21/2015 9:23:36 AM
Acquisition Date/Time: 10/12/2015 10:05:11 AM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate:

U232 UU-10A

Tracer Quantity:

0.605 mL

Counting Efficiency: 0.1607 +/- 0.0100 Chem. Recovery Factor: 0.1607 +/- 0.0029 on 12/13/2014 2:40:57 PM 1.0082 +/- 0.0645

Peak Match Tolerance:

0.150 MeV

		- <b></b>	PEAK	AREA RE	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	<b></b>
U-232 U-234 U-235 U-238	T	5.280 4.741 4.314 4.136	308.66 12.13 0.32 7.83	11.16 61.14 646.93 70.93	0.34 1.87 0.68 0.17	0.00E+000 0.00E+000 0.00E+000 0.00E+000	20.6 2.9 2.9 2.9	

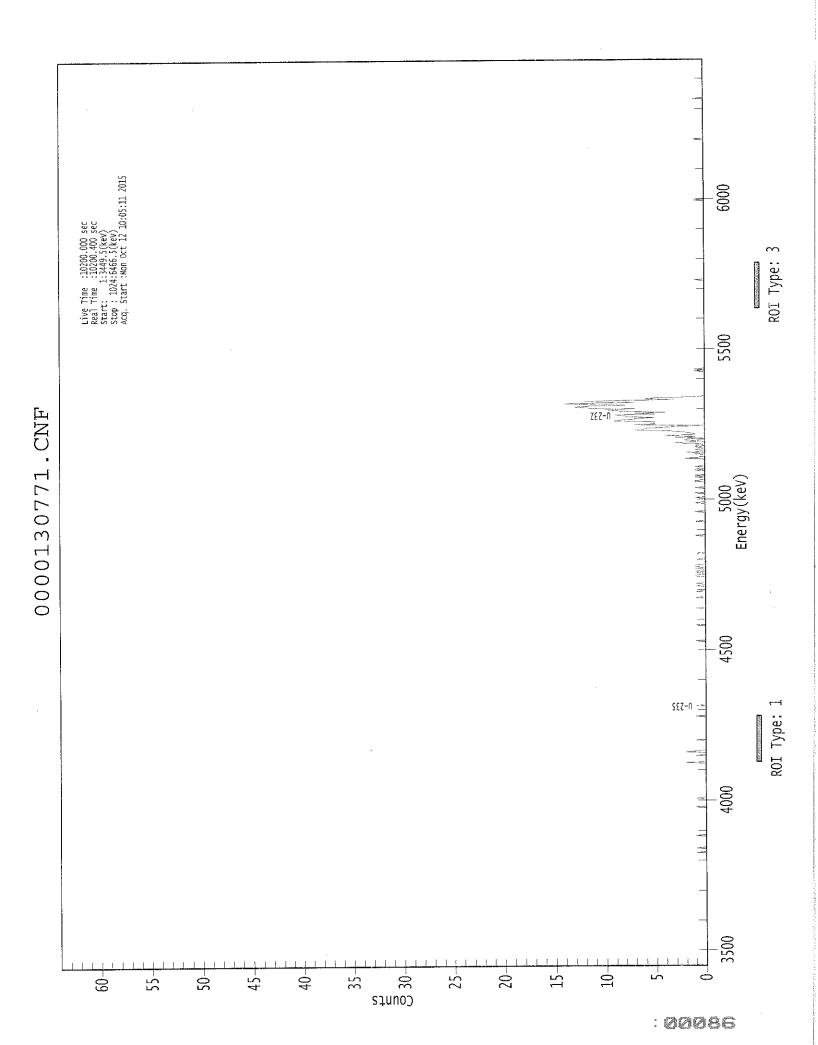
T = Tracer Peak used for Effective Efficiency

 NUCLIDE	ANALYSIS	RESULTS	<b></b>

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter )
U-232	0.996	5302.50*	1.01E+001 +/- 1.22E+000	1.57E-001 +/- 1.89E-002
U-234	0.997	4761.50*	3.98E-001 +/- 2.48E-001	2.48E-001 +/- 2.99E-002
U-235	0.964	4385.50*	1.29E-002 +/- 8.37E-002	2.28E-001 +/- 2.75E-002
U-238	0.983	4184.40*	2.56E-001 +/- 1.84E-001	1.36E-001 +/- 1.64E-002

:00085

low



Sample Title: 04

- 1	_	1	1		1	1		
Channel  -	0	 0	 0	0	0	0	0	0
1: 9:	0	0	0	Ö	Ö	Ō	0	0
17:	0	0	Ö	Ö	Ō	0	0	0
25:	0	ő	Ö	0	Ö	0	0	0
33:	0	Ö	Ö	Ö	0	0	0	0
41:	0	Ö	Ö	. 0	0	0	0	0
49:	Ö	ő	Ô	0	0	0	0	0
57;	Ö	Ö	Ō	0	0	0	0	0
65:	Ö	Ō	0	0	0	0	0	0
73:	Ö	Ō	0	0	0	0	0	0
81:	Ö	0	0	0	0	0	0	0
89:	Ō	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	1	0	0	0	0	1	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	1	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	1	0	0	0	0
185:	0	О	0	0	0	1	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	2	0	0
233:	0	0	0	0	0	1 0	0	0
241:	0	2	1	0	0	0	1	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	Ö
273:	0	0	0	0	0	0	0	0
281:	0		0 0	0	0	1	Ô	0
289:	0	0 0	0	0	0	Ō	Ö	Ö
297:	0	0	0	0	0	Ö	Ö	Ö
305:	0 0	0	0	0	Ö	Ö	Ö	0
313:	0	0	0	0	ő	Ö	Ō	0
321:	0.	0	0	0	Ő	Ö	Ō	0
329:	0	0	0	0	Ö	Õ	Ō	0
337:	0	0	0	Ō	ő	Ö	Ō	0
345:	0	0	0	Õ	Õ	Ō	0	0
353: 361:	0	0	0	Ö	Ö	Ö	1	0
361:	U	V	O	Ŭ	•	-		

Channel I	Data Re	port		10/12/2	015 12:5	8:55 PM		Page
369:	0	0	0	0	0	0	0	0
	Sample	Title:	04			•		
Channel								
377:	0	0 '	0 '	0 '	o '	o '	0 '	ο ˙
385:	1	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	. 0	1	0	0	0	0
409:	0	0	0	0	0	0	0	1
417:	0	0	0	0	0	0	1	0
425:	0	0	0	0	1	0	0	1
433:	0	0	0	0	0	0	0	1 0
441:	1	0	0	1 1	0 1	1 0	0	0
449:	1	0	1	0	0	0	0	Ö
457: 465:	0	1	0	0	0	0	Ö	. 0
473:	0	0	0	0	0	Ö	0	0
481:	0	0	Ö	Ö	0	1	0	0
489:	0	Ō	0	0	0	0	0	0
497:	0	0	0	0	0	1	0	0
505:	0	0	0	. 0	O	0	0	0
513:	1	0	0	0	0	0	0	0
521:	0	0	1	0	0	. 0	0	0
529:	1	0	0	0	0	1	0	0
537:	0	0	0	1	0	0	0	0 1
545:	0	0	1	1 0	0	0	0	1
553: 561:	0 1	1	0	1	0	0	0	Ō
569:	0	0	0	0	2	1	0	Ö
577:	0	1	Ö	2	0	0	1	0
585:	0	1	Ō	1	0	2	3	0
593:	1	2	2	0	3	1	4	1
601:	1	2	2	4	7	6	6	4
609:	. 3	0	7	5	5	5	9	9
617:	7	7	5	8	.8	9	5	
625:	4	8	9	10	7 12	12 10	13 3	12 6
633:	8 5	12 1	14 0	7 0	0	0	0	0
641: 649:	0	0	0	0	0	0	Ö	Ö
657:	0	0	0	Ő	0	Ō	Ō	0
665:	0	Ō	0	0	0	0	1	0
673:	1	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 0
713:	0	0	0	0	0	0	0	0
721: 729:	0	0	0	0 0	0	0	. 0	Ö
729: 737:	0	0	0	0	0	0	Ő	Ö
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	1	0	0
~ 777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0 0
793:	0	0	0	0	0	Ü	U	U

Channe1	Data Repor	t	1	0/12/2015	12:58:5	55 PM		Page 3
801:	0	0	0	0	0	0	0	0
	Sample Ti	tle:	04					
Channel   809: 817: 825: 833: 841: 849: 857:	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0	 0 0 0 0 0	 0 0 0 0 0 0	0 0 0 0 0 0	 0 0 0 0 0	 0 0 0 0 0 0	 0 0 0 0 0 0
857: 865: 873: 881: 889: 897: 905: 913: 929: 937: 945: 953: 969: 977:			0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0		0 0 0 0 0 0 0 0 0 0 0 0 0 0	1 0 0 0 0 0 0 0 0
985: 993: 1001: 1009: 1017:	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0	0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0



(0M

Sample Description:

Spectrum File:

KC85-032-M \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001307

1509136A-UU

Batch Identification: Sample Identification:

Sample Geometry:

05 Shelf 2

Procedure Description: U iso

Detector Name:

Chamber Serial Number: 10006122A Detector Serial Number: 53

Alpha 053

Env. Background: Reagent Blank:

System Bkgd 131194 <not performed>

Sample Size:

5.000E-001 +/- 0.000E+000 liter

Sample Date/Time:

9/21/2015 9:23:36 AM 10/12/2015 10:05:13 AM

Acquisition Date/Time:
Acquisition Live Time:
Acquisition Real Time

170.0 minutes 170.0 minutes

Tracer Certificate:

U232 UU-10A 0.601 mL

Tracer Quantity:

0.1709 +/- 0.0103

Effective Efficiency: Counting Efficiency:

0.1455 +/- 0.0026 on 12/13/2014 2:39:33 PM

Chem. Recovery Factor:

1.1744 +/- 0.0739

Peak Match Tolerance:

0.150 MeV

		PEAK AREA REPORT							
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	<b></b>	
U-232 U-234 U-235 U-238	Т	5.287 4.741 4.417 4.144	323.15 25.66 4.83 10.15	10.92 38.99 91.00 64.46	0.85 0.34 0.17 0.85	0.00E+000 0.00E+000 0.00E+000 0.00E+000	16.8 4.5 5.9 4.5		

T = Tracer Peak used for Effective Efficiency

<del></del> -	NUCLIDE	ANALYSIS	RESULTS	

Nuclide	Id	Energy	Activity	MDA
	Conf.	(keV)	(pCi/liter )	(pCi/liter )
U-232	0.998	5302.50*	1.00E+001 +/- 1.19E+000	1.86E-001 +/- 2.20E-002
U-234	0.997	4761.50*	7.97E-001 +/- 3.25E-001	1.49E-001 +/- 1.76E-002
U-235	0.993	4385.50*	1.85E-001 +/- 1.70E-001	1.60E-001 +/- 1.89E-002
11-238	0.989	4184.40*	3.14E-001 +/- 2.06E-001	1.85E-001 +/- 2.19E-002

Sample Title: 05

	Trapsed W	Cal IIII		223				
Channel								
1:	0	0	0	0	0	.0	0	0
9:	0	1	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	1	0	0	0	. 0
49:	Ö	Õ	Ō	0	0	0	0	0
57:	0	Ö	Ö	Ō	0	0	0	0
65:	0	0	Ö	Ö	Ō	0	0	0
	0	0	0	0	Ö	0	0	0
73:		0	0	0	Ö	Ö	0	0
81:	0		0	0	Ö	Ö	Ö	0
89:	0	0		0	0	0	0	Ő
97:	0	0	0		0	0	0	0
105:	0	0	0	0		0	0	0
113:	0	0	0	0	0	_	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	0	0	_	
137:	0	0	0	0	0	0	0	0
145:	0	1	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	1	0	0
193:	0	0	0	0	0	0	0	1
201:	0	0	0	1	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	Ō	0	0	0	0	0	1	0
233:	Ō	0	0	0	0	0	0	1
241:	ő	Ö	Ō	0	0	0	0	2
249:	1	Ö	Ō	1	1	0	0	0
257:	0	Ő	1	0	0	0	0	0
265:	0	0	0	Ö	0	0	. 0	0
205: 273:	0	0	0	ő	ŏ	0	Ö	0
		0	0	Ö	Ö	0	. 0	0
281:	0	0	0	0	Ö	Ö	0	0
289:	0		0	0	0	Ö	Ö	0
297:	0	0	0	0	1	1	Ö	Ő
305:	0	0			0	0	ő	Ö
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	1		0	0	0
337:	0	1 0	1	0	0		0	0
345:	0		0	0	0	0		0
353:	0	0	0	0	0	0	0	0
361:	0	1	0	0	0	0	0	U

Channel Data Report 10/12/2015 12:59:02 PM Page 369: 1 1 0 0 0 | Sample Title: 05 | Sample Title: 06 | Sample Title: 07 | Sample Titl Sample Title: 05 0 0 0 0 0 0 0 785: 793:

Channel	Data Reg	port		10/12/20	15 12:59	:02 PM		Page 3
801:	0	0	0	0	0	0	0	0
	Sample	Title:	05					
Channel 809: 817: 825: 833: 841:	0 0 0 0		 0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0	0 0 0 0 0	0 0 0 0
849: 857: 865: 873: 881: 889:	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0 0
897: 905: 913: 921:	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0 0	0 0 0	0 0 0 0	0 0
929: 937: 945: 953: 961: 969: 977:	0 1 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0	0 0 0 0 0	0 0 0 0	0 0 0 0 0	0 0 0 0 0
985: 993: 1001: 1009: 1017:	0 0 0	0 0 0 0	0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0	0 0 0 0	0 0 0 0



low

Sample Description: Spectrum File:

KC94-199-U \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001307

Batch Identification:

06

Sample Identification: Sample Geometry:

Shelf 2

1509136A-UÜ

Procedure Description: U iso

Detector Name:

Alpha 054

Chamber Serial Number: 10006122B Detector Serial Number: 54

Env. Background:

Reagent Blank:

System Bkgd 131195 <not performed>

Sample Size:

5.000E-001 +/- 0.000E+000 liter

Sample Date/Time: 9/18/2015 9:23:36 AM
Acquisition Date/Time: 10/12/2015 10:05:15 AM
Acquisition Live Time:

Acquisition Live Time: Acquisition Real Time:

170.0 minutes 170.0 minutes

Tracer Certificate:

U232 UU-10A

Tracer Quantity:

0.599 mL

Effective Efficiency:

0.1572 +/- 0.0098

Counting Efficiency:

0.1452 +/- 0.0026 on 12/13/2014 2:38:19 PM

Chem. Recovery Factor:

1.0826 +/- 0.0704

Peak Match Tolerance:

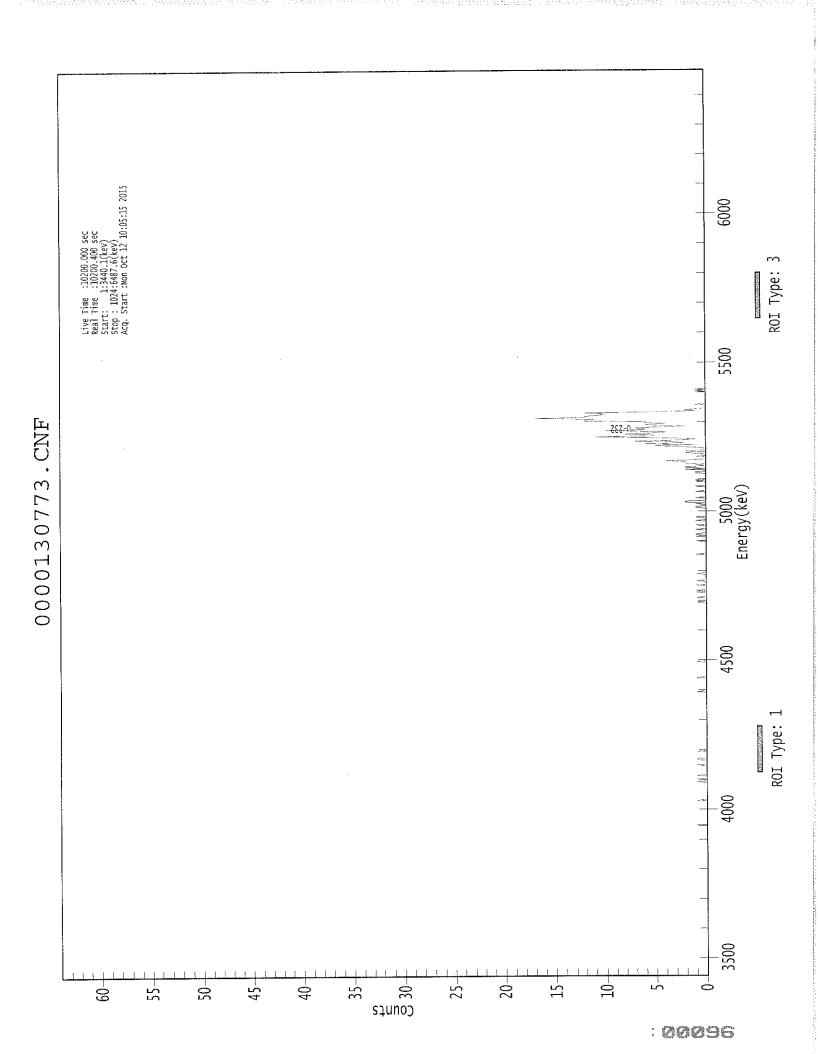
0.150 MeV

			PEAK	AREA RI	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
U-232 U-234 U-235 U-238	T	5.281 4.739 4.443 4.127	296.66 6.83 3.00 7.66	11.39 76.08 130.67 72.63	0.34 0.17 0.00 0.34	0.00E+000 0.00E+000 0.00E+000 0.00E+000	29.9 3.0 3.0 3.0	

T = Tracer Peak used for Effective Efficiency

 NUCLIDE	ANALYSIS	RESULTS	

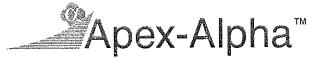
Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter )
U-232	0.997	5302.50*	1.00E+001 +/- 1.23E+000	1.62E-001 +/- 1.98E-002
U-234	0.996	4761.50*	2.31E-001 +/- 1.78E-001	1.41E-001 +/- 1.73E-002
U-235	0.977	4385.50*	1.25E-001 +/- 1.64E-001	2.50E-001 +/- 3.06E-002
U-238	0.977	4184.40*	2.58E-001 +/- 1.90E-001	1.61E-001 +/- 1.97E-002



Sample Title: 06

Channel								
1:	o'	o '	o'	o '	oʻ	oʻ	ο `	ο '
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	. 0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	. , 0	0	0	0	0	0	0	0
65:	0	0	0	0	0	. 0	0	0
73:	0	0	0	0	0	О	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	1	0	0	0	0 0	0
177:	0	0	0	0	0	0	-	0
185:	0	0	0	0	0	0 0	0 1	0
1.93:	0	0	0	0	0 -	0	0	0
201:	0	0	0 0	0 0	0	0	0	0
209:	0	0 0	0	1	0	0	1	0
217:	0	0	1	0	0	0	0	0
225: 233:	0 0	0	0	0	0	0	1	0
233: 241:	0	0	0	0	1	1	0	Ő
241: 249:	0	0	0	0	0	1	Ö	Ŏ
257:	0	0	0	Ö	Ö	Õ	Ö	Ö
265:	0	Ō	0	Ö	Ö	0	Ö	0
273:	Ö	Ö	Ö	Ö	Õ	Ō	0	0
281:	n o	Ö	Ő	0	Ō	0	0	0
289:	Ö	Ö	Ō	Ō	0	0	0	0
297:	Ö	Ö	Ö	0	0	0	0	0
305:	Ō	Ō	0	0	0	0	0	0
313:	Ō	Ō	0	0	0	0	0	0
321:	1	Ō	Ō	Ō	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	1	0	0	0	0	0	0	0
345:	O	0	0	0	0	О	0	0
353:	0	0	1	0	0	O	0	0
361:	0	0	0	0	0	0	0	0

Channel	Data Repor	t	10	/12/201	5 12:59:0	)9 PM		Page 3
801:	0	0	0	0	0	0	0	0
	Sample Ti	tle: (	)6					
Channel   809:			0	0	0	 O	 0	0
817: 825:	0	0	0	0 0	0 0	0 0	0 0	0 0
833:	Ō	Ö	Ö	0	Ō	0	0	0
841: 849:	0 0	0 0	0	0	0 0	0 0	0 0	0 0
857: 865:	0	0	0	0	0	0	0 0	0 0
873:	0	Ō	0	Ō	0	0	0	0
881: 889:	0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
897: 905:	0	0 0	0 0	0	0 0	0	0 0	0
913:	0	0	0	0	0	. 0	0 0	0 0
921: 929:	0 0	0 0	0 0	0	0	0	0	0
937: 945:	0 0	0 0	0	0	0 0	0	0 0	0 0
953:	0	0	0	0	0 0	0	0 0	0 0
961: 969:	0	0 0	0	0	0	0	0	Ö
977: 985:	0 0	0 0	0 0	0 0	0 0	0 0	0 0	0 0
993:	0	0	0	0	0	0	0 0	0 0
1001: 1009: 1017:	0 0 0	0	0	0	0	0	0	0



KC97-209-U

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001307

1509136A-UU Batch Identification:

Sample Identification: 07

Sample Geometry:

Shelf 2 Procedure Description: U iso

Detector Name:

Spectrum File:

Alpha 055

Chamber Serial Number: 10006124A Detector Serial Number: 55

Reagent Blank:

Env. Background: System Bkgd 131196 <not performed>

Sample Size:

5.000E-001 +/- 0.000E+000 liter

Sample Date/Time: 9/19/2015 9:23:36 AM
Acquisition Date/Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate:

U232 UU-10A

Tracer Quantity:

0.599 mL

Effective Efficiency: 0.1523 +/- 0.0097 Counting Efficiency: 0.1564 +/- 0.0028 on 12/13/2014 2:35:48 PM Chem. Recovery Factor: 0.9739 +/- 0.0641

Peak Match Tolerance:

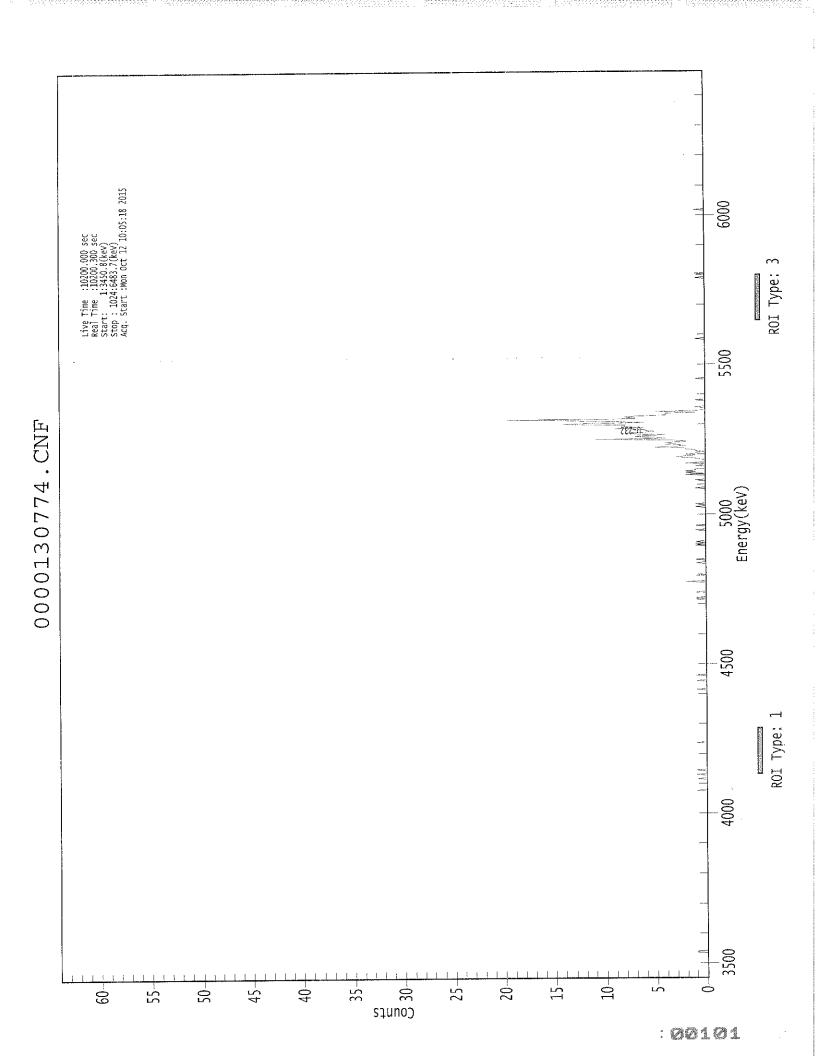
0.150 MeV

			PEAK	AREA RE	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	-
U-232 U-234 U-235 U-238	T	5.283 4.767 4.440 4.140	287.32 5.98 3.00 4.66	11.58 87.78 130.67 94.59	0.68 1.02 0.00 0.34	0.00E+000 0.00E+000 0.00E+000	8.2 3.0 3.0 3.0	

T = Tracer Peak used for Effective Efficiency

NUCLIDE ANALYSIS RESULTS

Nuclide	Id	Energy	Activity	MDA
	Conf.	(keV)	(pCi/liter )	(pCi/liter )
U-232	0.997	5302.50*	1.00E+001 +/- 1.25E+000	1.97E-001 +/- 2.45E-002
U-234	1.000	4761.50*	2.08E-001 +/- 1.85E-001	2.20E-001 +/- 2.73E-002
U-235	0.979	4385.50*	1.29E-001 +/- 1.69E-001	2.58E-001 +/- 3.20E-002
U-238	0.986	4184.40*	1.62E-001 +/- 1.54E-001	1.66E-001 +/- 2.06E-002

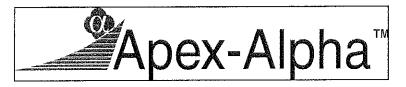


Sample Title: 07

Channel -								
1:	0 1	0	0 '	o'	o ˈ	o ˈ	0	0 '
9:	Ö	Ö	0	0	0	0	0	0
17:	Ō	0	0	0	0	0	0	0
25:	Ö	0	0	0	0	1	1	0
33:	0	0	0	0	0	. 0	0	. 0
41:	Ō	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	O	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0 .	0	0	0	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0 .	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	1	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	1	0	0	0	0	1	0	0
233:	0	0	1	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	1	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	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
305:	0	0	0	0	0	0	0 0	0
313:	0	0	0	0	0 0	0 1	0	0
321:	0	0	0	0		0	0	1
329:	0	0	0	0	0 0	1	0	0
337:	0	0	0	0 0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	U	U	U	V	V

Channel	Data	Repo	rt			10/12/2015	12:59:1	7 PM		Page	2
369:		0	0		0	0	0	0	0	. 0	
	Samp	le T	itle:	07							
Channel		-									
377:		0	0		0	0	0	0	0	0	
385:		0	0		0	0	0	0	0	0	
393:		0	0		0	0 0	0	0	0	0	
401: 409:		0	0		0	0	0	0	Ö	Ö	
417:		0	Ő		Õ	0	Ō	0	0	0	
425:		0	0		0	1	0	1	0	0	
433:		0	0		0	1	0	0	0	0	
441:		0	0		0	0	0	0	0	2 0	
449:		0	0		0	0	0 0	0	1 0	0	
457: 465:		0	0		0	0	1	. 0	Ö	0	
473:		1	0		Ö	Ö	0	Ō	0	0	
481:		0	Ö		0	0	0	0	0	. 0	
489:		1	0		1	0	1	0	0	0	
497:		0	. 0		0	0	0	0	0	0	
505:		0	1		0	0	0	0	1 0	0	
513: 521:		0	0		0	0	0	0	0	0	
521:		0	0		0	1	Ö	Ö	1	0	
537:		0	Ő		Ŏ	0	0	0	0	0	
545:		0	0		0	0	0	0	0	0	
553:		1	0		0	0	0	0	0	0	
561:		0	1		0	0	0	0 1	0 0	2 0	
569: 577:		0	2 1		1	2 0	1 2	0	0	0	
5//: 585:		0	1.		1	3	2	1	2	1	
593:		1	Ō		1	1	2	2	5	3	
601:		2	4		3	4	2	2	4	11	
609:		4	5		7	6	4	7	8	6	
617:	-	5	6		6	9	6 12	8 20	8 7	8 7	
625: 633:	Т	. <b>4</b> 8	12 7		6 4	10 4	4	1	5	1	
633: 641:		0	ó		0	1	0	Ō	Ō	Ō	
649:		0	0		0	1	0	0	0	0	
657:		0	0		0	0	0	0	0	0	
665:		0	0		0	0	0	0	0 0	0	
673:		0	0		0	1 0	0	0	0	0	
681: 689:		0	0		0	0	0	0	Ö	0	
697:		0	Ő		Ö	Ō	0	0	0	0	
705:		0	0		0	0	0	0	0	0	
713:		0	0		0	0	0	0	0	0	
721:		1	0		0	0	0	0 0	0 0	0	
729:		0	0		0	0	0 0	0	0	0	
737: 745:		0 0	0		0	0	0	0	0	0	
753:		0	0		0	Ö	0	0	Ö	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 1	0	0	
785: 793:		0	0		0 1	0	0	0	0	0	
793:		U	J			V	•	Ü	V	3	

Channel	Data Repor	t	1	0/12/2015	12:59:3	L7 PM		Page 3	3
801:	0	0	0	0	0	0	0	0	
	Sample Ti	tle:	07						
Channel									
809:	0	0	0	0	0	0	0	0	
817:	0	0	0	0	0	0	0	0	
825:	0	0	0	0	0	0	0	0	
833:	0	0	0	0	0	0	0	0	
841:	0	0	0	0	0	0	0	0	
849:	0	0	0	0	0	0	0	0	
857:	0	0	0	0	0	0	0	0	
865:	0	0	1	0	0	0	0	0	
873:	0	0	0	0	0	0	0	0	
881:	0	0	0	0	0	0	0	0	
889:	0	0	0	0	0	0	0	0	
897:	0	0	0	0	0	. 0	0	· O	•
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	



## QA SUMMARY REPORT Review Of QA Results - Pulser Check

Date : 10/12/2015 Time : 5:49:04 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Passed	10/12/2015 5:27:32 AM
Alpha 004	21f	ALL	Passed	10/12/2015 5:27:33 AM
Alpha 005	21f	ALL	Not Done	
Alpha 006	21f	ALL	Not Done	
Alpha 007	21f	ALL	Not Done	
Alpha 008	21f	ALL	Not Done	
Alpha 009	21f	ALL	Not Done	
Alpha 010	21f	ALL	Passed	10/12/2015 5:27:33 AM
Alpha 011	21f	ALL	Passed	10/12/2015 5:27:34 AM
Alpha 012	21f	ALL	Passed	10/12/2015 5:27:35 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Passed	10/12/2015 5:27:36 AM
Alpha 015	21f	ALL	Passed	10/12/2015 5:27:37 AM
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:38 AM
Alpha 034	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:39 AM
Alpha 035	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:41 AM
Alpha 036	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:42 AM
Alpha 037	Alpha Analyst100DC	ALL pic	Passed	10/12/2015 5:27:44 AM
Alpha -038	Alpha Analyst100DC	Peak Energy	Action	10/12/2015 5:27:46 AM
Alpha 039	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:47 AM
Alpha 040	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:49 AM
Alpha 041	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:51 AM
Alpha 042	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:53 AM
Alpha 043	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:54 AM
Alpha 044	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:55 AM
Alpha 045	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:57 AM
Alpha 046	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:27:59 AM
Alpha 047	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:00 AM
Alpha 048	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:02 AM
Alpha 049	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:03 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:05 AM
Alpha 051	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:07 AM
Alpha_052	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:09 AM
Alpha 053	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:11 AM
Alpha 054	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:12 AM
Alpha 055	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:15 AM
Alpha 056	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:16 AM
Alpha 057	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:18 AM
Alpha_058	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:20 AM

Page 2 of 2

Review of QA Results - Pulser Check

10/12/2015 5:49:04 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_059	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:22 AM
Alpha_060	Alpha Analyst100DC	ALL	Passed	10/12/2015 5:28:24 AM

APPROVED BY:	
APPROVAL DATE:	10112

Nuclide Library Title: Uranium

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

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

<sup>\* =</sup> key line

TOTALS:

<sup>4</sup> Nuclides

<sup>4</sup> Energy Lines

## SECTION IX ANALYTICAL DATA (ISOTOPIC THORIUM)

Eberline Services Oak Ridge Laboratory Analysis Sheet

**15-09136** ThISO Run 1

Printed: 10/7/2015 3:08 PM Page 1 of 3

Analysis code         ThISO         or         LCS         LCS         O925/15 00:00         1,0000E+00           Date Received         9J25/2015         03         DUP         KCB6-032-L         35         09/21/15 1442         5,0000E-01           Date Received         9J25/2015         03         DUP         KCB6-032-L         35         09/21/15 1442         5,0000E-01           Lab Deadline         10/16/2015         04         DO         KCB6-032-L         35         09/21/15 1442         5,0000E-01           Report Level         PPoject         PPA-KAN         06         TRG         KCB4-199-U         37         09/18/15 13-15         5,0000E-01           Report Level         PPA-KAN         06         TRG         KCB4-199-U         37         09/18/15 13-15         5,0000E-01           Activity Units         PpCi         T </th <th>Work Order</th> <th>15-09136</th> <th>Internal Fraction</th> <th>Sample Desc</th> <th>Client ID</th> <th>Login CPM</th> <th>Sample Date</th> <th>Sample Aliquot</th>	Work Order	15-09136	Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
1         02         MBL         BLANK         09/25/15 00:00           9/25/2015         03         DUP         KC85-032-L         35         09/21/15 14:42           10/16/2015         04         DO         KC85-032-L         35         09/21/15 14:42           Auxiler & Associates, Inc.         05         TRG         KC85-032-M         31         09/21/15 14:42           PAP-KAN         06         TRG         KC85-032-M         37         09/21/15 14:25           POCI         TRG         KC97-209-U         35         09/19/15 11:15           POCI         TRG         KC97-209-U         36         09/19/15 11:15           Alpha Spectroscopy         Th-229         Th-229         Th-229         Th-229         Th-229           Th-18a         Th-18a         Th-229         Th-229         Th-229         Th-229         Th-229         Th-229         Th-229           Th-18a         Th-18a         Th-18a         Th-229         Th-229 </th <th>Analysis Code</th> <th>Thiso</th> <th>01</th> <th>FCS</th> <th>CCS</th> <th></th> <th>09/25/15 00:00</th> <th>1.0000E+00</th>	Analysis Code	Thiso	01	FCS	CCS		09/25/15 00:00	1.0000E+00
9/25/2015         03         DuP         KC85-032-L         35         09/21/15 14.42           4 L0/16/2015         04         DO         KC85-032-L         35         09/21/15 14.42           Auxier & Associates, Inc.         05         TRG         KC95-032-M         31         09/21/15 14.42           PAP-KAN         06         TRG         KC94-199-U         37         09/11/15 13.25           PDCI         TRG         KC94-199-U         35         09/11/15 13.25           PDCI         TRG         KC97-209-U         35         09/11/15 13.25           Alpha Spectroscopy         TR         KC97-209-U         35         09/19/15 11.15           Alpha Spectroscopy         Th-229         TR         TR         TR           Th-18a         Th-18a         TR         TR         TR           Th-18a         TR         TR         TR         TR           Th-18a	Run	-	02	MBL	BLANK		09/25/15 00:00	1.0000E+00
Auxier & Associates, Inc.         Do         KC85-032-L         35         09/21/15 14:42           Auxier & Associates, Inc.         Do         TRG         KC84-199-L         37         09/12/15 13:25           4         07         TRG         KC94-199-L         37         09/18/15 03:25           PDCI         N         N         N         N         N         N           EMI Th-01 Modified         N         N         N         N         N         N         N           Alpha Spectroscopy         Th-229         N         N         N         N         N         N         N         N           Alpha Spectroscopy         Th-18a         N	Date Received	9/25/2015	03	DUP	KC85-032-L	35	09/21/15 14:42	5.0000E-01
Auxier & Associates, Inc.         06         TRG         KC85-032-M         31         09/21/15 13-25           PAP-KAIN         06         TRG         KC94-199-U         37         09/18/15 09:56           4         07         TRG         KC97-209-U         35         09/18/15 11:15           POLI         NA         CONTRACTOR         35         09/18/15 11:15           Alpha Spectroscopy         Th-229         CONTRACTOR         CONTRACTOR         CONTRACTOR           Th-18a         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR           Th-18a         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR           Alpha Spectroscopy         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR           Alpha Spectroscopy         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR           Alpha Spectroscopy         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR           Th-229         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR         CONTRACTOR           Alpha Spectroscopy         CONTRACTOR         CONTRACTOR <th>Lab Deadline</th> <th>10/16/2015</th> <th>04</th> <th>DO</th> <th>KC85-032-L</th> <th>35</th> <th>09/21/15 14:42</th> <th>5.0000E-01</th>	Lab Deadline	10/16/2015	04	DO	KC85-032-L	35	09/21/15 14:42	5.0000E-01
PAP-KAN         06         TRG         KC94-199-U         37         09/18/15 09:56           4         07         TRG         KC97-209-U         35         09/19/15 11:15           pCi         n         n         n         n         n         n           WA         mAA         n         n         n         n         n         n           EML Th-01 Modified         n         n         n         n         n         n         n         n           Alpha Spectroscopy         n         n         n         n         n         n         n         n         n         n           Th-18a         n<	Client	Auxier & Associates, Inc.	90	TRG	KC85-032-M	31	09/21/15 13:25	5.0000E-01
4         07         TRG         KC97-209-U         35         09/19/15 11:15           pCi         NA         Control Modified         Control Modified	Project	PAP-KAN	8	TRG	KC94-199-U	37	09/18/15 09:56	5.0000E-01
	Report Level	4	20	TRG	KC97-209-U	35	09/19/15 11:15	5.0000E-01
	Activity Units	pCi						
	Aliquot Units							
	Matrix	WA						
	Method	EML Th-01 Modified						
	Instrument Type	Alpha Spectroscopy		00 00 00 00 00 00 00 00 00 00 00 00 00				
	Radiometric Tracer	Th-229						
	Radiometric Sol#	Th-18a					-	
Carrier Conc (mg/ml)         Carrier Conc (mg/ml)	Tracer Act (dpm/g)	22.46						
Carrier Conc (mg/ml)	Carrier							
	Carrier Conc (mg/ml)							

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

15-09136 ThiSO Run 1

Eberline Services Oak Ridge Laboratory Analysis Sheet

Printed: 10/7/2015 3:08 PM Page 2 of 3

Grav Mean SAF SAF % Rec % Rec 1* 2*																			
_		_																	
% Rec Added (ml) 0.00	00.00	0.00		0.00	0.00	0.00	0.00	0.00 0.00 0.00	00.00 00.00 00.00	0.00	0.00 0.00 0.00	0.00 0.00 0.00	00.0 00.0 00.0	00.0 00.0 00.0	00.00 00.00 00.00	00.00 00.00 00.00	00.00 00.00 00.00	00.0 00.0 00.0	00.0 00.0 00.0
Tracer (pCi)																			
ACT (dpm)	5.3	5.3		5.2	5.2	5.2 5.2 5.2	5.2 5.2 5.2 5.2 5.2		5.2 5.2 5.2 5.2										
Tracer Aliquot (g) 0.4694	0.2341	0.2341		0.2312	0.2312	0.2312 0.2321 0.2314	0.2312 0.2321 0.2314 0.2317			:									
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\* SAF1 is used for Gross Alpha and all other radionuclides. SAF2 is used for Gross Beta only. Andicates estimated SAF value. \*\* Actual mass exceeded the calibration curve range. Results should be qualified as appropriate.

Eberline Services Oak Ridge Laboratory Analysis Sheet

15-09136 ThISO Run 1

Printed: 10/7/2015 3:08 PM Page 3 of 3

Sep # By Sep t1 Date/Time JDEMELAS **JDEMELAS JDEMELAS JDEMELAS JDEMELAS JDEMELAS JDEMELAS** Sep t0 By 10/07/15 15:08 10/07/15 15:08 10/07/15 15:08 10/07/15 15:08 10/07/15 15:08 10/07/15 15:08 10/07/15 15:08 Sep t0 Date/Time JWOLFE JWOLFE JWOLFE JWOLFE **JWOLFE** JWOLFE JWOLFE Prep By 10/05/15 07:33 10/05/15 07:33 10/05/15 07:33 10/05/15 07:33 10/05/15 07:33 10/05/15 07:33 10/05/15 07:33 Prep Date Rough Prep By Rough Prep Date Sample Desc CS DUP TRG TRG TRG MBL 8 Internal Fraction 9 05 90 02 03 07 9

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

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Preliminary Data Report & Analytical Calculations

Work Order: 15-09136-ThISO-1

Page 1 of 3

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Auxier & Associates, Inc.

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Printed: 10/8/2015 9:14 AM Page 2 of 3

Preliminary Data Report & Analytical Calculations	Work Order: 15-09136-ThISO-1

Eberline Services Oak Ridge Laboratory

00E-01         95.75         0.00         0.07/2015 15:08           00E-04         110.62         0.00         0.00         107/2015 15:08           00E-04         97.58         0.00         0.00         107/2015 15:08           00E-04         113.12         0.00         0.00         107/2015 15:08           00E-04         113.12         0.00         0.00         107/2015 15:08           00E-05         113.12         0.00         0.00         107/2015 15:08           00E-07         113.12         0.00         0.00         107/2015 15:08           00E-07         113.12         0.00         0.00         107/2015 15:08           00E-08         0.00         0.00         107/2015 15:08	<i>u</i> ,	Sample Desc		Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
110.62 0.00 0.00 106.79 0.00 0.00 97.58 0.00 0.00 113.12 0.00 0.00 50.19 0.00 0.00	TH-228 LCS 09/26/15 00:00		09/25/15 00:00		1.00E+00	95.75	0.00	0.00		10/7/2015 15:08	
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97.58       0.00       0.00         113.12       0.00       0.00         112.04       0.00       0.00         50.19       0.00       0.00         60.19       0.00       0.00	TH-228 DUP 09/21/15 14:42 5	09/21/15 14:42		ιĊ	5.00E-01	106.79	00.0	00:0		10/7/2015 15:08	
50.19 0.00 0.00	TH-228 DO 09/21/16 14:42 6	09/21/15 14:42		ιΩ	5.00E-01	97.58	0.00	0.00		10/7/2015 15:08	
50.19 0.00 0.00	TH-228 TRG 09/21/15 13:25	09/21/15 13:25			5.00E-01	113.12	00.00	00.0		10/7/2015 15:08	
90.00 0.00	TH-228 TRG 09/18/15 09:56	09/18/15 09:56	56		5.00E-01	112.04	00'0.	0.00		10/7/2015 15:08	
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Auxier & Associates, Inc.

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Bkg CPM	2.50 E-02	4.00 E-03	7.00 E-03	2.00 E-03	7.00 E-03	2.00 E-03	1.30 E-02				•			
Counts	170 3.95 E+02	170 2.32 E+00	170 3.81 E+00	170 2.66 E+00	170 -1.90 E-01	170 7.66 E+00	5.79 E+00							
Count Time	170	170	170	170	170	170	170							
Сапіег	Alpha_039	Alpha_040	Alpha_041	Alpha_042	Alpha_043	Alpha_044	Alpha_045							
Detect	A_Spec													
Halflife (days)														
Counting Date/Time	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15							
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Lab Fraction	0.1	02	03	04	05	90	07							

# Preliminary Data Report & Analytical Calculations Work Order: 15-09136-ThISO-1

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Auxier & Associates, Inc.

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# Preliminary Data Report & Analytical Calculations Work Order: 15-09136-ThISO-1

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Nuclide Sample Sample Desc Date	TH-230 LCS 09/25/15 00:00	TH-230 MBL 09/25/15 00:00	TH-230 DUP 09/21/15 14:42	TH-230 DO 09/21/15 14:42	TH-230 TRG 09/21/15 13:25	TH-230 TRG 09/18/15 09:56	TH-230 TRG 09/19/15										
e Sample Aliquot	00:00 1.00E+00	00:00 1.00E+00	14:42 5.00E-01	14:42 5.00E-01	13:25 5.00E-01	09:56 5.00E-01	9/15 11:15 5.00E-01				The state of the s				-		
Radiometric % Rec	95.75	110.62	106.79	97.58	113.12	112.04	50.19										
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#### Eberline Services Oak Ridge Labora

Work Order: 15-09136-ThISO-1	Counting Halfilfe Detect Carrier Count Counts Bkg	10/07/15 18:15 A_Spec Alpha_039 170 4.59 E+02 1.20 E-02	10/07/15 18:15 A_Spec Alpha_040 170 7.00 E+00 0.00 E+00	10/07/15 18:15 A_Spec Alpha_041 170 5.96 E+00 1.20 E-02	10/07/15 18:15 A_Spec Alpha_042 170 7.49 E+00 3.00 E-03	10/07/15 18:15 A_Spec Alpha_043 170 3.15 E+00 5.00 E-03	10/07/15 18:15 A_Spec Alpha_044 170 7.00 E+00 0.00 E+00	10/07/15 18:15 A_Spec Alpha_045 170 8.66 E+00 2.00 E-03									
Work O	Counting Date/Time	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15									
uge Laboratory	Nuciide Sample Desc	TH-230 LCS	TH-230 MBL	TH-230 DUP	TH-230 DO	TH-230 TRG	TH-230 TRG	TH-230 TRG	7.000	T WIN TO THE COLOR		The state of the s	77 117 77 78 20 70 70				
<b>)</b>	Lab Fraction	01	02	03	04	05	90	07					THE PARTY OF THE P			Towns Control	

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Error Estimate	9.16E-01	4.40E-02	6.18E-02	1.26E-01	4.93E-02	5.20E-02	1.77E-01									TO VALLEY OF THE PARTY OF THE P		
Results	5.80E+00	2.58E-02	-3.66E-02	9.32E-02	-1.99E-02	1.70E-02	2.82E-02		T T T T T T T T T T T T T T T T T T T								in the second se	
Activity Units	pCI/I	pCi/I	pCi/I	pCi/I	pci/I	pCi/l	pCi/I		30000				Time to the control of the control o					
Client Identification	rcs	BLANK	KC85-032-L	KC85-032-L	KC85-032-M	KC94-199-U	KC97-209-U			TOTAL PARTY OF THE	TOTAL MARKET			·				
Sample Desc	rcs	MBL	DUP	OO	TRG	TRG	TRG											
Nucilde	TH-232	TH-232	TH-232	TH-232	TH-232	TH-232	TH-232						TO ALLE				, , ,	
Lab Fraction	2	02	03	04	05	90	20											

**OSI4T** 

Analysis Code

98160-91

Eberline Services Work Order

Auxier & Associates, Inc.

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OSIYL

Analysis Code

alculations
ThISO-1

Page 2 of 3

Printed: 10/8/2015 9:14 AM

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Work Order:

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Sep t1 Date/Time							T. W. C.			THE POPULATION AND ADDRESS OF THE PO	T. Carlo					The state of the				
Sep 10 Date/Time	10/7/2015 15:08	10/7/2015 15:08	10/7/2015 15:08	10/7/2015 15:08	10/7/2015 15:08	10/7/2015 15:08	10/7/2015 15:08					Transfer of the second	The state of the s	3					To the state of th	
SAF																				
Mean % Rec	0.00	00.00	0.00	0.00	0.00	0.00	0.00											THE PROPERTY OF THE PROPERTY O		
Grav % Rec	00.00	0.00	0.00	0.00	0.00	00.00	0.00				and the same of th								7.7.7.2	
Radiometric % Rec	95.75	110.62	106.79	97.58	113.12	112.04	50.19													
Sample Aliquot	1.00E+00	1.00E+00	5.00E-01	5.00E-01	5.00E-01	5.00E-01	5.00E-01				1									
Sample Date	09/25/15 00:00	09/25/15 00:00	09/21/15 14:42	09/21/15 14:42	09/21/15 13:25	09/18/15 09:56	09/19/15 11:15						444							
Sample Desc	SOT	MBL	DUP	ОС	TRG	TRG	TRG													
Nuclide	TH-232	T T T A A A A A A A A A A A A A A A A A						1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Postal		T T LAU	PLOTA	PROF.							
Lab Fraction	5	07	03	04	02	90	20													

12-06138

Eberline Services Work Order

Auxier & Associates, Inc.

Client

Work Order: 15-09136-ThISO-1

H	19.3	18.6	18.7	17.4	20	18.4	17.6	1		7			-					
Bkg	2.10 E-02	0.00 E+00	1.40 E-02	6.00 E-03	5.00 E-03	2.00 E-03	9.00 E-03		1000									
Counts	170 4.05 E+02	170 2.00 E+00	170 -1.38 E+00	2.98 E+00	170 -8.50 E-01	170 6.60 E-01	170 4.70 E-01		- main			-				170,00		
Count	170	170	170	170	170	170	170											
Carrier	Alpha_039	Alpha_040	Alpha_041	Alpha_042	Alpha_043	Alpha_044	Alpha_045											
Defect	A_Spec									7,00,00		1000						
Halfilfe (days)					775/1.	300			TO THE PARTY OF TH	000		777	1 17.4	7-99 (4)				
Counting Date/Time	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15	10/07/15 18:15											
Sample Desc	SOT	MBL	DUP	00	TRG	TRG	TRG		***						r			
Nuclide	TH-232	777.A.		7744					774	17772.								
Lab Fraction	2	02	03	04	05	90	07				3.7	77411					To dept a train	

98160-91

Eberline Services Work Order

**OSI4T** 

Analysis Code

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Auxier & Associates, Inc.

: AA1

Printed: 10/7/2015 3:08 PM Page 1 of 1

Count Room Report Client: Auxier Associates, Inc.

15-09136-ThISO-1 (pCi/l) in WA Tracer ID: Th-18a

									T		T				;			1	
SAF 2*									nn er gerne bly sakter men-					2					
SAF 1*																			
Radiometric % Rec	0.00	00.00	00.00	0.00	0.00	00.00	0.00	F 80 1700 to 500 to					, , , , , , , , , , , , , , , , , , ,					TA PANAN.	
Radiometric Tracer (pCi)					o for manual from a		Total Andrews												
Tracer ACT (dpm)	10.5427	5.2579	5.2579	5.1928	5.2130	5.1972	5.2040			:							100 mm m m m m m m m m m m m m m m m m m		eth sedad i mom
Tracer Aliquot (g)	0.4694	0.2341	0.2341	0.2312	0.2321	0.2314	0.2317			To an interest of the second									
Sample Aliquot	1.0000	1.0000	0.5000	0.5000	0.5000	0.5000	0.5000	and the second s								**************************************		A DATE OF THE PARTY OF THE PART	
Sample Date	09/25/15 00:00	09/25/15 00:00	09/21/15 14:42	09/21/15 14:42	09/21/15 13:25	09/18/15 09:56	09/19/15 11:15												
Client ID	SOT	BLANK	KC85-032-L	KC85-032-L	KC85-032-M	KC94-199-U	KC97-209-U		:		4		7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7						
Sample Desc	SOT	MBL	DUP	00	TRG	TRG	TRG		 										
Internal Fraction	10	02	03	2	05	90	20												



### Spike and Tracer Worksheet

Eberline Services Oak Ridge Laboratory

Page 1 of 1 Printed: 10/5/2015 7:33 AM

Initials	***************************************	Q	Error Estimate	0.000	0.000	0.000																				•	
Witness Initials		MSD	Added pCi	00.0	00.00	00.00							6, 1996. 9		, , , , , , , , , , , , , , , , , , ,			Φ									
ın Initials		SD	Error Estimate	0.000	0.000	0.000		SOT						0.1841				Matrix Spike									
Technician Initials	4	CSD	Known pCi	00.00	0.00	0.00	S						•.					2									į
		S	Error Estimate	0.000	0.000	0.000	Balance Printer Tapes											i vi									
ician	LFE	SM	Added	0.00	00.00	00.00	nce Prin										•	•	.4.64		•						
Technician	JWOLFE	S	Error Estimate	0.175	0.145	0.175	Bala							i		յո ը Ժ											
		1CS	Known pCi	4.86	5.37	4.86		Tracer						i	(	4,000 4,000	. 40° 00° 00° 00° 00° 00° 00° 00° 00° 00°		-0,232		7	i					
g)	15 7:28	MSD	Volume Used (g)											:	•	* <b>*</b> 2	#.				:						
Date	10/5/2015 7:28	CSD	Volume Used (g)															•		•							
Code	õ	MS	Volume Used (g)					Approx Addition	0.2200	0.2200	0.2200	0.2200	0.2200	0.2200	0.2200												
Analysis Code	ThISO	SOT	Volume Used (g)	0.1041	0.5067	0.1041	and the second s	Volume Used (g)	0.4694	0.2341	0.2341	0.2312	0.2321	0.2314	0.2317		7. 69		A CONTRACTOR OF THE PROPERTY O	A service of the serv					A CONTRACTOR OF THE CONTRACTOR	A CONTRACTOR OF THE CONTRACTOR	
Run	~		Approx Addition	0.100	0.500	0.100		Solution Date	10/5/2015	10/5/2015	10/5/2015	10/5/2015	10/5/2015	10/5/2015	10/5/2015			2 - 100 2 = 1 2 - 100 2 = 1					 111111111111111111111111111111111111111	The mate			-911 25
		sex	Solution Date	10/5/2015	10/5/2015	10/5/2015	Tracers	Activity dpm/g	22.460	22.460	22.460	22.460	22.460	22.460	22.460												
rk Order	136	LCS & Matrix Spikes	Activity dpm/g	103.560	23.520	103.560		# JoS	Th-18a	Th-18a	Th-18a	Th-18a	Th-18a	Th-18a	Th-18a							2, 12, 100					
Internal Work Order	15-09136	TCS 8	# JoS	Th-8b	Th-1b	Th-8b		Isotope	Th-229	Th-229	Th-229	Th-229	Th-229	Th-229	Th-229		The state of the s			0.7100							
			Isotope	Th-228	Th-230	Th-232		fraction	10	02	03	40	05	90	07												

Printed: 10/5/2015 7:33 AM Page 1 of 1

**Aliquot Worksheet** 

Eberline Analytical Oak Ridge Laboratory

	Work Order	Run	Analysis Code	Ratunts	Lab Deadline	dine			36	Technician		
	15-09136	<b>\_</b>	Thiso	liters	10/16/2015	2015			WC	JWOLFE		
								:				
40	Auxier & Associates, Inc. Sample	Sample	Muffle Data		Dilution Data		Aliquot Data	t Data	MS Aliq	MS Aliquot Data	H-3 Solids Only	ls Only
Fraction		Type	Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
0	S)T	SOT					9	1.0000E+00				
05	BLANK	MBL					1.0000E+00	1.0000E+00	-			
63	ž	DUP					5.0000E-01	5.0000E-01				
04		2					5.0000E-01	5.0000E-01				
90	KC85-032-M	TRG				750 750 750 750 750 750 750 750 750 750	5.0000E-01	5.0000E-01				
90	KC94-199-U	TRG	議ではできません				5.0000E-01	5.0000E-01				
07	KC97-209-U	TRG					5.0000E-01	5.0000E-01				
						123 123 123 124 124 124 124 125 125 125 125 125 125 125 125 125 125						
				AND THE RESERVE OF THE PARTY OF	The second section of the second seco							
										THE RESERVE THE PERSON NAMED IN COLUMN TWO IS NOT THE PERSON NAMED IN COLUMN TWO IS NAMED IN		
						10   10   10   10   10   10   10   10			A COLUMN TO THE PARTY OF THE PA			
	<del></del>											
	Comments											

MOID Date: 10/S 15

Technician:

:00122



SPIKE

Spectrum File:

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001303

Batch Identification: 1509136A-TH

Sample Identification: 01

Sample Geometry:

Shelf 2

Procedure Description: Th iso

Detector Name:

Chamber Serial Number: 06027396A Detector Serial Number: 83109

Alpha 039

Reagent Blank:

Env. Background: System Bkgd 130607 <not performed>

Sample Size:

1.000E+000 +/- 0.000E+000 liter

Sample Size: 1.000E+000 +/- 0.000E+
Sample Date/Time: 10/7/2015 4:10:44 PM
Acquisition Date/Time: 10/7/2015 6:15:05 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Tracer Certificate:

Th229 S TH-18A

Tracer Quantity:

0.469 mL

Effective Efficiency: 0.1852 +/- 0.0117 Counting Efficiency: 0.1934 +/- 0.0034 on 10/25/2014 2:53:34 PM Chem. Recovery Factor: 0.9575 +/- 0.0628

Control Certificate Name: NatTh Th-8

Chem. Recov. of Control: TH-232

1.194491 +/- 0.102740

Peak Match Tolerance: 0.175 MeV

			<b> </b>		<del>-</del>	<del></del>		
			PEAK	AREA RE	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	<b></b> -
TH-227 TH-228 TH-229 TH-230 TH-232	T	5.795 5.350 4.860 4.609 3.937	19.79 394.75 331.94 458.96 405.43	46.85 9.93 10.82 9.17 9.78	2.21 4.25 3.06 2.04 3.57	0.00E+000 0.00E+000 0.00E+000 0.00E+000 0.00E+000	3.0 6.9 3.9 7.4 8.3	

T = Tracer Peak used for Effective Efficiency

---- NUCLIDE ANALYSIS RESULTS

Id Energy Nuclide Conf. (keV) MDA Activity (pCi/liter ) (pCi/liter ) \_\_\_\_\_\_ TH-227 0.984 5850.00\* 2.90E-001 +/- 1.41E-001 1.17E-001 +/- 1.46E-002 TH-228 0.987 5400.00\* 5.65E+000 +/- 8.98E-001 1.44E-001 +/- 1.78E-002 TH-229 0.999 4872.00\* 4.77E+000 +/- 5.92E-001 1.28E-001 +/- 1.59E-002 TH-230 0.980 4672.00\* 6.58E+000 +/- 1.01E+000 1.12E-001 +/- 1.38E-002 TH-232 0.981 3997.00\* 5.80E+000 +/- 9.16E-001 1.35E-001 +/- 1.67E-002

> AG 10/8/15

Sample Title: 01

Elapsed Live time: 10200 Elapsed Real Time: 10200

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Channel	0	0	1	0	0	0	0	1
9:	0	0	1	0	Ö	Ö	Ö	0
17:	0	ő	0	Ö	Ö	Õ	1	0
25:	Ö	Ö	1	Ō	0	0	0	0
33:	Ö	Ö	0	Ō	0	1	0	0
41:	0	Ō	0	0	1	0	1	0
49:	0	1.	0	1	0	0	0	0
57 <b>:</b>	1	1	0	2	0	1	1	0
65:	0	1	1	0	0	1	0	0
73:	1	0	0	1.	1	1	1	0
81:	1	2	0	0	0	0	0	0
89:	2	1	0	1	0	2	1	1
97:	2	0	1	0	0	0	2	1
105:	3	2	1	2	4	5	4	2
113:	0	0	2	3	1	3	1	2
121:	3	1	2	2	2	6	7	4
129:	2	3	7	3	5	5	4	6
137:	4	4	3	6	6	5	2	0
145:	. 3	8	2	7	8	5	3	9
153:	3	8	4	5	8	7	15 10	15
161:	6	8	13	6	7	6	12	8
169:	7	5	8	10	3 3	7 7	6 3	15 5
177:	11	7	2	4	3 0 ·	1	0	1
185:	4	2	1	0 0	1	0	0	0
193:	0	0 0	1 0	0	0	0	0	0
201: 209:	0	1	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	1
225:	0	0	1	0	Ö	0	0	1
233:	1	1	0	. 1	Ö	Ő	Ö	Ō
241:	0	0	1	0	Ö	Ö	Ō	1
249:	Ö	ő	Ō	Ö	Ö	Ö	1	0
257:	Ö	Õ	Ō	Ō	Ō	Ō	0	0
265:	Ö	Ō	0	0	1	0	0	1
273:	Ō	0	0	1	0	0	0	2
281:	1	0	0	1	2	1	0	0
289:	0	0	2	0	0	0	1	0
297:	0	0	1 2	1	1	0	0	0 3 0
305:	1	2	2	0	1	2	0	0
313:	3	0	1	1	0	1	2	1
321:	1	3 5 0	1	1	O	1	0	1
329:	0	5	1	1 3 2 5	1 3 2	0	1	1 5 3 4
337:	2	0	0	3	3	3	1	5
345:	1.	2	1	2	2	3	3	3
353:	3	3	5	5	2	2	5	
361:	3	4	4	7	7	3	11	7

Channel	Data Repor	rt		10/8/2015	5:16:	24 AM		Page	2
369:	8	б	5	5	10	8	10	5	
	Sample Ti	Ltle:	01						
369:  Channel 377: 385: 393: 4097: 4253: 4497: 4267: 4273: 4497: 4273: 4497: 4573: 4673: 4897: 55297: 55697: 55697: 55697: 55697: 55697: 55697: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5677: 5777:	8	6		5 	10 		16 4 8 3 3 2 0 3 5 8 5 2 4 3 2 1 1 1 0 0 1 0 1 1 5 2 3 2 6 8 0 9 4 1 0 1 1 1 1	14 15 75 23 37 466 24 31 01 13 20 00 01 14 32 37 28 73 01 00 10	
705: 713: 721: 729: 737: 745: 753: 761: 769: 777: 785: 793:	0 0 1 2 1 0 0 0	1 0 2 0 1 0 0 1 0	1 0 0 1 1 0 0 0	1 2 1 1 1 0 0 0	0 2 4 1 3 0 0 0 0	2 2 2 2 2 0 0 0 0 0	0 2 1 1 2 1 0 0 0 0	0 3 2 2 0 0 0 0 0	

Channel	Data Repor	`t		10/8/2015	5:16:	24 AM		Page 3
801:	0	0	0	0	0	0	1	0
-	Sample Ti	tle:	01					
Channel								
809:	0	1	0	0	0	0	0	0
817:	0	0	1	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	1	0	0	0	0	1
849:	0	0	0	0 .	0	0	0	0
857:	0	0	1	0	0	0	0	1
865:	0	1	0	0	1	0	0	. 0
873:	0	0 .	1	0	0	0	0	0
881:	0	0	0	. 0	0	0	1	0
889:	0	0	0	1	0	0	0	0
897:	2	0	0	0	0	0	0	0
905:	1	0	1	2	0	0	2	0
913:	0	0	3	0	0	0	1	2
921:	0	2	0	1	2	2	0	3
929:	1	3	1	3	1	2	0	1
937:	2	4	3	2	2	1	1.	0
945:	1	1	0	0	0	1	0	0
953:	0	0	. 1	1	0	0	0	0
961:	0	0	. 0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	1	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0



BLANK

Spectrum File:

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001304

Batch Identification: 1509136A-TH

Sample Identification: 02 Sample Geometry:

Shelf 2

Procedure Description: Th iso

Detector Name:

Alpha 040

Chamber Serial Number: 06027396B

Detector Serial Number: 91135

Env. Background: System Bkgd 130608

Reagent Blank:

<not performed>

Sample Size:

1.000E+000 +/- 0.000E+000 liter

Sample Date/Time:

10/7/2015 4:10:44 PM

Acquisition Date/Time: 10/7/2015 4:10:44 PM 10/7/2015 6:15:07 PM 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: 0.2053 +/- 0.0165
Counting Efficiency: 0.1856 +/- 0.0032 on 10/25/2014 2:57:14 PM
Chem. Recovery Factor: 1.1062 +/- 0.0908

Peak Match Tolerance:

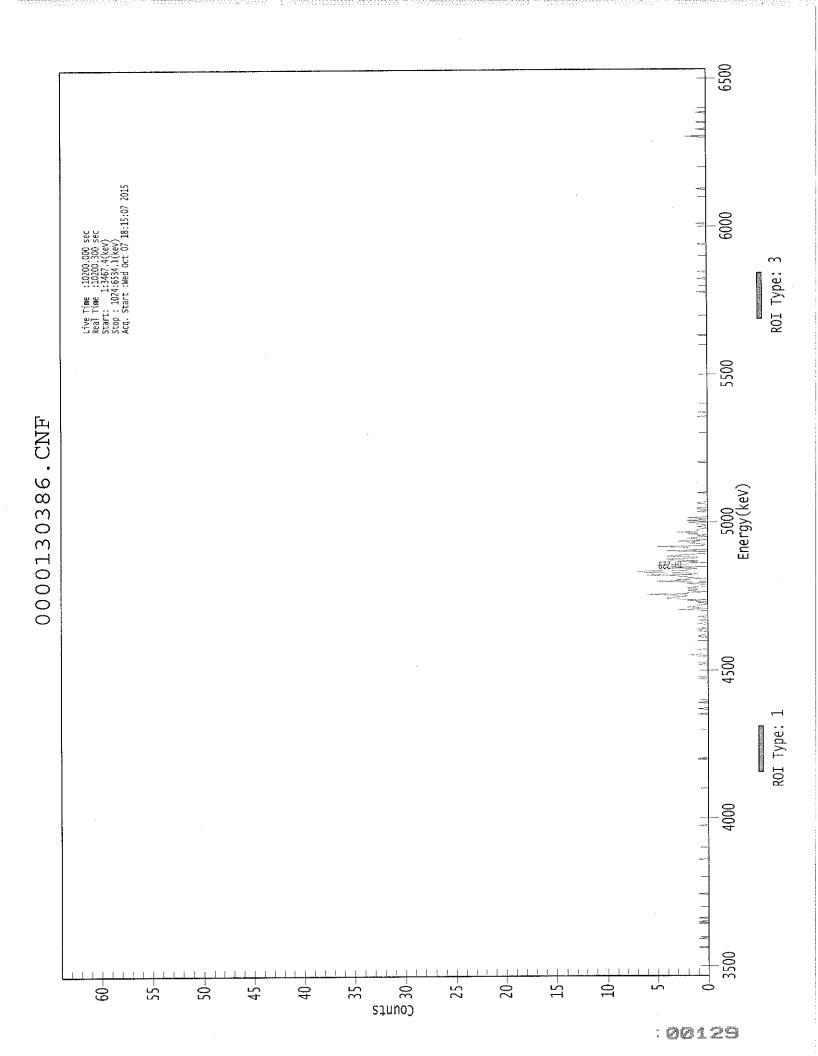
0.175 MeV

		PEAK	AREA RE	PORT	<b></b>	
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
TH-227 TH-228 TH-229 TH-230 TH-232	5.880 5.310 4.852 4.579 3.917	4.49 2.32 183.49 7.00 2.00	98.45 149.12 14.49 79.20	0.51 0.68 0.51 0.00	0.00E+000 0.00E+000 0.00E+000 0.00E+000	3.0 3.0 7.0 3.0 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	0.995	5850.00*	5.94E-002 +/~ 5.93E-002	6.95E-002 +/- 1.09E-002
TH-228	0.959	5400.00*	3.00E-002 +/- 4.49E-002	7.29E-002 +/- 1.14E-002
TH-229	0.998	4872.00*	2.38E+000 +/- 3.74E-001	6.81E-002 +/- 1.07E-002
TH-230	0.956	4672.00*	9.05E-002 +/- 7.31E-002	7.75E-002 +/- 1.22E-002
TH-232	0.967	3997.00*	2.58E-002 +/- 4.40E-002	7.74E-002 +/- 1.22E-002



Sample Title: 02

Elapsed Live time: 10200 Elapsed Real Time: 10200

Channel	   <b> </b>		1					
1:	0	0	0	0 '	0	0	· 0	0 '
9:	Ö	Ö	Ō	0	0	0	. 0	0
17:	Ŏ	Ō	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	1	0	0	0	0	0	0	0
41:	0	0	1	0	0	0	0	. 0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	1	. 0	1	0	0
65:	0	1	0	0	0	0	0	0
73:	. 0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	1	0	0	0
97:	0	0	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	1	0	0	0	0
137:	0	0	0	0	0	0	. 0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	1	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	. 0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	C	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
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	1	1	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257: 265:	0	0	0	0	0	0	0	Ő
265: 273:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	Ō	1
203. 297:	0	0	0	0	0	1		0
305:	0	0	0	Õ	1	0	Ō	Ō
313:	0	0	0		0	Ō	Ō	Ō
321:	0	0	0		Ö	Ō	. 0	Ō
329:	0	0	0		Ō	0	Ō	1
337:	0	1	0	Ō	0	0	0	0
345:	0	0	0	0	Ō	0	0	1
353:	Ō		0		0	0	0	0
361:	1	, 1	2		0		0	. 0
	_		_					

Channel	Data	Rep	ort		10/8/2015	5:16:	:32 AM		Page	2
369:		1	0	0	0	0	0	0	0	
	Samp	ole '	Title: 02							
Channall										
Channel   377:		0	0	1	0	0	0 '	1	0 '	
385:		1	Ö	ō	0	0	1	1	0	
393:		1	Ö	ō	0	0	1	0	0	
401:		0	1.	0	0	. 0	1	0	0	
409:		0	0	0	0	0	3	0	1	
417:		2	1	1	0	0	1	0	2	
425:		0	4	4	3	2	2	6	2	
433:		2	0	2	1	2	1	2	0	
441:		0	0	2	0	2	5	2	3	
449:		0	2	2	3	6	1	2	6	
457:		7	2	2	1	5	0	4	5	
465:		2 .	2	0	3	1	4	4	1	
473:		1	4	3	2	0	0	0 0	4 1	
481:		0	2	2	2 0	5 1	0 2	1	0	
489:		2	1. O	3 2	1	3	1	1	1	
497:		1 0	0	1	0	0	1	1	2	
505: 513:		0	2	0	0	2	0	0	0	
521:		0	0	0	1	0	Ö	1	1	
529:		0	0	Ö	0	1	1	0	0	
537:		0	0	Ō	0	0	0	0	0	
545:		1	Ö	Ö	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 <b>:</b>		0	0	0	1	0	0	0	0	
585:		0	0	0	0	0	0	0	0	
593:		0	0	0	0	0	0	0	0	
601:		0	0	0	0	0	0	0	0	
609:		0	0	0	0	0	0	0	0	
617:		0	0	0	0	0	0 0	0 1	0 0	
625:		0	0	0	0	0	0	0	0	
633:		0	0	0	1 0	0	0	0	0	
641: 649:		0 0	0 0	0	0	0	Ö	0	0	
657:		0	Ö	0	Ö	Ö	Ö	0	. 0	
665:		0	Ö	Ö	0	Ō	0	0	0	
673:		0	Ö	0	0	0	0	0	0	
681:		0	0	0	0	0	0	0	0	
689:		0	0	0	0	0	0	0	0	
697:		0	0	0	0	0	0	0	0	
705:		0	0	0	0	0	0	0	0	
713:		0	0	0	0	0	0	0	0	
721:		0	0	1	0	0	0	0	0	
729:		0	0	0	0	0	0	0 0	0	
737:		0	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	
761:		0 0	0 0	0	1	0	0	0	0	
769: 777:		0	0	0	0	0	0	0	0	
777: 785:		0	0	1	Ö	Ő	Ö	Ö	Ō	
765: 793:		0	0	1	Ö	ŏ	Ö	Ō	0	
100.		J	•		=					

Channel	Data R	eport		10/8	/2015	5:16:32	AM		Page 3
801:	0	(	) (	)	0	0	0	0	0
	Sampl	e Title	: 02						
Channel			_	-					
809:	0	· (	0 (	)	0	0	0	0	0
817:	0	(	0 (	)	0	0	0	0	0
825:	0	1	1 (	)	0	0	0	0	0
833:	0	) (	0 (	)	0	0	0	0	0
841:	0	) (	0 (	C	0	0	0	0	0
849:	1	. (	0 (	C	0	0	0	0	0
857:	0	) (	0 (	)	0	0	0	0	0
865:	0	) (	0 (	)	0	0	0	0	0
873:	0	) (	0 (	)	0	0	0	0	0
881:	0	) (	0 (	0	0	0	0	0	1
889:	0	) (	0 (	0	0	0	0	0	0
897:	0	) (	0 (	)	0	0	. 0	0	0
905:	C	) (	0 (	0	0	0	0	0	0
913:	Ö	) (	0 (	0	0	0	0	0	0
921:	C	)	0 (	0	0	0	0	0	0
929:	C	,	0 (	0	0	0	0	0	0
937:	C	)	0 (	0	0	0	0	0	0
945:	C	)	0 :	2	0	0	0	0 -	0
953:	· C	)	0 :	1	0	0	0	0	0
961:	C		0 :	1	0	0	0	0	0
969:	C		0	0	0	0	1	0	0
977:	C	)	0	0	0	0	0	0	0
985:	C	)	0	0	0	0	0	0	0
993:	C	)	0	0	0	0	0	0	0
1001:	C	)	0	0	0	0	0	0	0
1009:	C	)	0	0	0	0	0	0	O
1017:	C		0	0	0	0	0	0	0



Spectrum File:

Batch Identification:

Sample Identification: 03

Sample Geometry:

Procedure Description: Th iso

Detector Name:

Chamber Serial Number: 05026930A Detector Serial Number: 91087

Sample Date/Time:

Sample Date/Time:

Acquisition Date/Time:

Acquisition Live Time:

Acquisition Real Time:

Tracer C

Tracer Certificate:

Tracer Quantity:

Peak Match Tolerance:

KC85-032-L DUP

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001303

1509136A-TH

Shelf 2

Alpha 041

Env. Background: System Bkgd 130609

Th229 S\_TH-18A

 $0.234~\mathrm{mL}$ 

Effective Efficiency: 0.2000 +/- 0.0162 Counting Efficiency: 0.1873 +/- 0.0033 on 10/25/2014 3:00:28 PM Chem. Recovery Factor: 1.0679 +/- 0.0887

0.175 MeV

			PEAR	C AREA RE	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
TH-227 TH-228 TH-229 TH-230 TH-232	T	5.767 5.323 4.890 4.609 4.067	1.98 3.81 178.81 5.96 -1.38	176.34 117.34 14.71 95.01 168.33	1.02 1.19 1.19 2.04 2.38	0.00E+000 0.00E+000 0.00E+000 0.00E+000	3.0 3.0 7.0 3.0 3.0	

T = Tracer Peak used for Effective Efficiency

 NUCLIDE	ANALYSIS	RESULTS	<b>-</b>

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter )
TH-227	0.965	5850.00*	5.39E-002 +/- 9.54E-002	1.71E-001 +/- 2.73E-002
TH-228	0.970	5400.00*	1.03E-001 +/- 1.22E-001	1.77E-001 +/- 2.82E-002
TH-229	0.998	4872.00*	4.76E+000 +/- 7.58E-001	1.75E-001 +/- 2.79E-002
TH-230	0.980	4672.00*	1.58E-001 +/- 1.52E-001	2.07E-001 +/- 3.29E-002
TH-232	0.975	3997.00*	-3.66E-002 +/- 6.18E-002	2.17E-001 +/- 3.46E-002

Sample Title: 03

Elapsed Live time: 10200 Elapsed Real Time: 10200

Channel	- 1							
1:	0	0	0	0 1	0	o'	o ˈ	0 '
9:	Ö	Ö	Õ	Ō	0	0	0	0
17:	Ö	Ö	Ö	0	0	0	0	0
25:	0	Ö	Ö	0	0	0	0	0
33:	Ö	Ō	Ō	0	0	. 0	0	0
41:	Õ	0	0	0	0	0	0	0
49:	Ö	0	0	0	0	0	0	0
57 <b>:</b>	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	O	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0 -	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	1
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	. 0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	1	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	. 0	0
337:	0	0	0	0	0	0	0 0	0 0
345:	0	1	0	0	0	0 0	0	0
353:	0	0	0	0	1 0	0	0	0
361:	1	0	0	0	U	U	U	U

Channel I	Data Rep	ort	1.	0/8/2015	5:16:	38 AM		Page	2
369:	0	0	0	0	0	0	1	0	
	Sample	Title: (	03						
Channel									
377:	0	0	0	0	0 1	0 0	0 1	0 0	
385: 393:	0 0	0 0	0	0	0	0	0	0	
401:	Ő	Ö	Ö	0	0	0	0	0	
409:	0	0	1	0	0	0	0	1	
417:	0	0	0	0	0	0	0 1	0	
425: 433:	1 0	0 2	0 1	1 1	0	2	1	1	
441:	0	1	0	3	3	2	1	2	
449:	5	3	5	1	2	4	3	6	
457:	4	1	5	3	3	4	3	2	
465:	. 4	. 2 2	2 2	· 2	2 3	0 2	4 2	0	•
473: 481:	5 2	2	2	2	2	1	3	2	
489:	2	3	1	2	1	ō	2	0	
497:	0	2	4	1	1	0	4	2	
505:	3	1	0	0	0	0	0 1	2 0	
513: 521:	2 1	1 1	1 0	0 1	3 1	1 2	0	2	
521: 529:	2	1	0	0	0	Õ	Ö	Ō	
537:	0	Ō	0	0	0	0	0	0	
545:	0	0	0	0	1	1	0	0	
553:	0	0	0	0 0	1 0	0	. 0	1	
561: 569:	0 0	0	0	0	0	Ö	0	0	
577:	0	0	Ö	Ö	Ö	Ō	0	0	
585:	0	0	0	0	0	0	0	0	
593:	C	0	0	0	0	0	0	0	
601: 609:	0	0	0	0 0	0	0 1	0	0	
617:	0	0	0	1	0	Ö	Ö	Ö	
625:	0	0	0	0	0	0	0	0	
633:	0	0	0	0	0	0	0	0	
641:	0 0	0	0 0	0 0	1 0	0 1	0 0	0 0	
649: 657:	0	0	0	0	0	Ō	1	Ö	
665:	Ö	Ö	0	1	0	1	0	0	
673:	0	0	0	1	0	0	0	0	
681:	0	0 0	0 0	0 0	0	0 0	0 0	0	
689: 697:	0 0	0	0	0	0	0	0	0	
705:	0	Ö	Ö	Ö	Ō	0	0	0	
713:	0	0	0	0	0	0	0	0.	
721:	0	0	0	0	0	0 0	0 0	0 0	
729: 737:	0 0	0	0 0	0	0	0	0	0	
737: 745:	1	0	0	Ö	Ö	Ö	Ö	Ö	
753:	0	0	0	0	0	0	0	0	
761:	0	0	0	0	0	0	Ò	1	
769: 777:	0 0	0	0 0	0	0 0	0 0	0 0	0	
777: 785:	0	0	0	1	0	0	0	Ö	
793:	0	0	0	0	0	0	0	0	

Channel	Data Repor	t		10/8/2015	5:16:	38 AM		Page 3	3
801:	0	0	0	0	0	0	0	0	
	Sample Ti	tle:	03						
Channel									
809:	0	0	0	0	0	0	0	0	
817:	0	0	0	0	0	0	0	0	
825:	0	0	0	0	0	0	0	0	
833:	0	0	0	0	0	0.	0	0	
841:	0	0	0	0	0	0	0	0	
849:	0	0	0	0	0	0	0	0	
857:	0	0	0	0	0	0	0	. 0	
865:	0	0	0	0	0	0	0	1	
873:	1	0	0	0	0	0	0	0	
881:	0	0	0	0	0	0	1	0	
889:	0	0	0	0	0	0	0	0	
897:	0	0	0	0	0	. 0	0	0	
905:	. 0	0	0	0	0	0	0	0	
913:	0	0	0	0	0	0	0	0	
921:	0	0	0	0	0	0	0	0	
929:	0	0	0	0	0	0	0	0	
937:	0	0	0	0	0	0	0	0	
945:	0	0	0	0	0	0	0	0	
953:	0	0	0	0	0	1	1	0	
961:	0	0	0	0	0	0	0	0	
969:	0	0	0	0	0	0	0	0	
977:	0	0	0	0	0	0	0	0	
985:	0	0	0	0	0	0	0	0	
993:	0	0	0	0	0	0	0	0	
1001:	0	0	0	0	0	0	0	O	
1009:	0	0	0	0	0	0	0	0	
1017:	0	0	0	0	0	0	0	0	



KC85-032-L

Spectrum File:

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001303

Batch Identification:

1509136A-TH 04

Sample Identification: Sample Geometry:

Shelf 2

Procedure Description: Th iso

Detector Name:

Alpha 042

Chamber Serial Number: 05026930B Detector Serial Number: 84185

Env. Background:

System Bkgd 130610

Reagent Blank:

<not performed>

Sample Size:

5.000E-001 +/- 0.000E+000 liter

 Sample Date/Time:
 9/21/2015
 4:10:44 PM

 Acquisition Date/Time:
 10/7/2015
 6:15:12 PM

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:

0.1695 +/- 0.0148

Counting Efficiency:

0.1737 +/- 0.0030 on 10/25/2014 3:04:21 PM

Chem. Recovery Factor:

0.9758 +/- 0.0871

Peak Match Tolerance:

0.175 MeV

			PEAK	AREA RI	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
TH-227 TH-228 TH-229 TH-230 TH-232	Т	5.791 5.287 4.879 4.657 3.968	6.83 2.66 149.66 7.49 2.98	76.08 128.85 16.04 74.41 134.36	0.17 0.34 0.34 0.51 1.02	0.00E+000 0.00E+000 0.00E+000 0.00E+000	6.0 3.0 12.8 3.0 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 TH-228 TH-229 TH-230	0.982 0.936 1.000	5850.00* 5400.00* 4872.00* 4672.00*	2.19E-001 +/- 1.71E-001 8.45E-002 +/- 1.10E-001 4.70E+000 +/- 8.06E-001 2.35E-001 +/- 1.79E-001	1.34E-001 +/- 2.30E-002 1.52E-001 +/- 2.61E-002 1.50E-001 +/- 2.58E-002 1.64E-001 +/- 2.82E-002
TH-232	0.996	3997.00*	9.32E-002 +/- 1.26E-001	1.97E-001 +/- 3.38E-002

Sample Title: 04

Elapsed Live time: 10200 Elapsed Real Time: 10200

Channel								
1:	o '	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	1	0	0	0	1
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
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	1	0	0	0	0
137:	0	0	0	0	0	1	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	1	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	1	0
209:	0	0	0	0	0	0	0	0
217:	0	1	0	0	0	0	0	0
225:	0	0	0.	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	. 0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	ū	· · ·	0	0	0
289:	0	0	0	0	0	0	0	1
297:	0	0	0	0	0	0	0	0
305:	0	0	0		0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	1 0	0		0	0	0	0
361:	1	U	Ü	U	U	U	U	J

Channel	Data Re	port		10/8/20	15 5:1	6:44 AM	•	Page 2
369:	0	0	0	0	0	0	0	0
	Sample	Title:	04					
Channel		[						
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	1	0	0	0	0	1
401:	0	0	0	0	1	0	0	0
409:	0	1	0	0	0	0	0	1
417:	1	0	2	0	0	0	0	0
425:	0	1	0	1	0	1	1	1
433:	0	3	0	0	1	2	0	1
441:	2	0	1	3	1	3	3	2
449:	1	1	3	5	4	7	5	2
457:	3	5	4	4	3	3	3	2
465:	1	4	0	2	1	1	1	2
473:	1	3	1	1	1	3	3	0
481:	2	2	0	2	0	2	1	1
489:	0	0	0	0	0	2	0	2
497:	1	2	3	0	0	1	1	0
505:	0	0	1	0	1	1	0	0
513:	0	2	0	0	0	3	1	0
521:	0	0	0	1	1	2	1	1
529:	2	0	0	0	0	0	0	0
537:	0	0	1	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	. 0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	2	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	1	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	Ö
657 <b>:</b>	0	0	0	0	0	0	0	Ö
665:	0	0	0	0	0	0	0	ő
673: 681:	0	0	0	0	0	0	0	Ö
689:	0	0	0	0	0	Ő	0	Ö
697:	0	0	0	Ö	0	Ō	Ō	Ō
705:	0	0	0	Ö	Ő	Ō	Ō	Ō
713:	0	0	Ö	Ö	Ō	. 0	0	0
721:	0	0	Ö	0	0	0	0	0
729:	0	0	0	. 0	Ō	0	0	
737:	0	0	0	0	Ō	0	0	
745:	0	0	Ö	0	0	0	0	
753:	1	0	1	0	0	0	0	
761:	0	Ő	0	Ō	0	0	0	
769:	Ő	Ō	Ō	0	. 0	0	0	0
777:	Ő	ō	Ō	1	0	0	1	
785:	0	1	0	0	0	1	0	
793:	0	0	0	0	. 0	0	0	0

Data Repor	rt.		10/8/2015	5:16:	44 AM		Page	3
0	0	0	0	0	0	0	0	
Sample Ti	tle:	04						
0	0	0	0.	0	0	0	0	
0	0	O	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0 -	· . 0	0	0	1.7
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	.0	O	0	1	0 .	0	0	
0	0	O	0	1	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
0	0	. 0	0	0	0	0	0	
	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	
	O Sample Ti	Sample Title:	Sample Title: 04       0	Sample Title: 04          0	Sample Title: 04	Sample Title: 04	Sample Title: 04	Sample Title: 04



Spectrum File: Batch Identification: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001303

1509136A-TH

KC85-032-M

Sample Identification:

05

Sample Geometry: Procedure Description:

Shelf 2 Th iso

Detector Name:

Chamber Serial Number: 04026481A Detector Serial Number: 91088

Alpha 043

Env. Background: Reagent Blank:

System Bkqd 130611 <not performed>

Sample Size:

5.000E-001 +/- 0.000E+000 liter

Sample Date/Time: Acquisition Date/Time: 10/7/2015 4:10:44 IM

10/7/2015 6:15:14 PM

9/21/2015 4:10:44 PM

Acquisition Live Time: Acquisition Real Time:

170.0 minutes 170.0 minutes

Tracer Certificate:

Th229\_S\_TH-18A

Tracer Quantity:

0.232 mL

Effective Efficiency:

0.2260 +/- 0.0175

Counting Efficiency:

0.1998 +/- 0.0035 on 10/25/2014 3:08:45 PM

Chem. Recovery Factor:

1.1312 +/- 0.0896

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 TH-228 TH-229 TH-230 TH-232	Т	5.794 5.442 4.896 4.624 3.948	0.49 -0.19 200.32 3.15 -0.85	416.98 1131.1 13.88 126.67 246.69	0.51 1.19 0.68 0.85 0.85	0.00E+000 0.00E+000 0.00E+000 0.00E+000 0.00E+000	3.0 3.0 5.0 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	0.984	5850.00*	1.18E-002 +/- 4.92E-002	1.26E-001 +/- 1.91E-002
In-22/	0.504		•	•
TH-228	0.991	5400.00*	-4.53E-003 +/- 5.12E-002	1.57E-001 +/- 2.38E-002
TH-229	0.997	4872.00*	4.72E+000 +/- 7.15E-001	1.33E-001 +/- 2.01E-002
TH-230	0.988	4672.00*	7.40E-002 +/- 9.44E-002	1.41E-001 +/- 2.13E-002
TH-232	0.988	3997.00*	-1.99E-002 +/- 4.93E-002	1.40E-001 +/- 2.13E-002

Sample Title: 05

Elapsed Live time: 10200 Elapsed Real Time: 10200

Clana an a 1	1	1	l	[				
Channel 1:	0	0	0	0	0 '	0 '	0	0
9:	0	0	0	Ö	Ö	Ō	0	0
17:	0	0	0	Ō	Ō	0	0	0
25:	0	1	0	Ö	0	0	0	0
33:	0.		0	. 0	1 0	Ō	0	. 0
33: 41:	0	. 0	0	0	0	Ö	1	0
	0	0	0	0	0	Ō	0	0
49:		0	0	0	Ö	Ö	0 -	0
57:	0	0	0	0	0	Ő	Ö	Ō
65:	0	0	0	. 0	0	0	Ō	Ō
73:	0	0	0	0	0	0	0	Ö
81:	0		0	0	0	0	Ő	ĺ
89:	0	0	0	0	0	0	0	Ō
97:	1	0	0	0	0	1	0	Ö
105:	0	0		0	0	0	0	ő
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	Ö
137:	0	0	0	0	0	0	0	Ō
145:	0	0		0	0	0	0	0
153:	0	0	0	0	0	0	0	Ö
161:	0	0	0	0	0	0	0	ŏ
169:	0	0	0		0	0	0	ő
177:	0	0	0		0	0	0	ő
185:	0	0	0		0	0	0	Ö
193:	0	0	0		0	0	0	Ö
201:	0	0	0		0	0	0	ő
209;	0		0		0	0	0	Ö
217:	0	0	0		0	0	0	Ö
225:	0	0	0		0	0	0	Ö
233:	0 2	0	. 0		0	0	0	Ö
241: 249:	0	0	0		0	0	Ö	Ö
		0	0		0	0	0	Ö
257:	0	0	0		0	0	0	ő
265:	0	0	0		0	0	0	Ö
273:	0	0	0		0	0	0	Ö
281:	J	0	_	J	0	0	0	Ő
289:	0	0	0		0	0	0	Ő
297:	0	0	0		0	0	0	Ő
305:	0	0	0		0	0	0	0
313:	0	0	0		0	0	0	0
321:	0	0	0		0	0	0	
329:	0				0	0	0	0
337:	0				0	0	0	
345:	0				0	0	0	
353:	0				0	0	0	
361:	0	0	U	U	U	U	V	J

Channel	Data Rep	port		10/8/20	15 5:1	6:51 AM		Page 2
369;	0	0	0	Ö	0	1	0	0
	Sample	Title:	05					
Channel		[						
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	1.	1	Ó	0	0	0	0	0
417:	0	0	0	0	0	1	0	0
425:	0	0	1	2	0	0	0	0
433:	1	1	0	0	1.	0	0	1
441:	0	0	0	1	1	0	0	0
449:	1	3	5	2	3	2	3	4
457:	3	5	2	8	4	5	5	6
465:	7	3	4	7	2	6	3	2
473:	5	1	2	2	3	6	2	4
481:	3	1	1	4	3	2	1	1
400.	, 1	0	0	3	3	2	2	2
497:	Ò	3	3	3	0	3	0	0
505:	2	1	1	0	0	2	2	0
513:	1	0	. 1	0	1	1	1	0
521:	0	0	1	0	1	0	1	2
529:	0	0	1	4	0	1	2	1
537:	1	2	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	. 0	0	0	0	0
625:	0	0	0	0	. 0	0	0	0 0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0 0	0 1	0	0	0	0	0
657:	0 0	0	0	0	0	0	0	Ö
665: 673:	0	0	0	0	0	0	0	Ö
673: 681:	0	0	0	0	0	0	0	Ö
689:	0	0	0	Ö	Ö	Ō	0	0
697:	0	0	0	Ö	Ö	0	Ō	Ō
705:	0	Ö	0	Ō	Ō	0	0	0
713:	Ö	Ö	Ō	0	Ō	0	1	0
721:	Õ	Ö	Ō	0	0	- 0	0	0
729:	Ő	ĺ	Ő	0	0	0	0	0
737:	0	Ō	Ō	0	0	0	0	0
745:	Ō	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	
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

Channel	Data Repor	rt		10/8/2015	5:16:	51 AM		Page 3
801:	0	0	0	0	0	0	0	0
	Sample Ti	tle: (	05					
Channel   809: 817: 825: 833: 841: 849: 857: 865: 873: 881: 889: 905: 913: 921: 929: 937: 945: 953: 961: 969: 977:								
985: 993: 1001: 1009: 1017:	0 0 0 0	1 0 0 0						



Sample Description:

KC94-199-U

Spectrum File:

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001303

Batch Identification: Sample Identification: 1509136A-TH

Sample Geometry:

Shelf 2

Procedure Description: Th iso

Detector Name:

Alpha 044

Chamber Serial Number: 04026481B

Detector Serial Number: 84168

Env. Background:

System Bkgd 130612

Reagent Blank:

<not performed>

Sample Size:

5.000E-001 +/- 0.000E+000 liter

Sample Date/Time: 9/18/2015 4:10:44 PM Acquisition Date/Time: 10/7/2015 6:15:17 PM

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:

0.2058 +/- 0.0165

Counting Efficiency:

0.1837 +/- 0.0032 on 10/25/2014 3:13:11 PM

Chem. Recovery Factor:

1.1204 +/- 0.0922

Peak Match Tolerance:

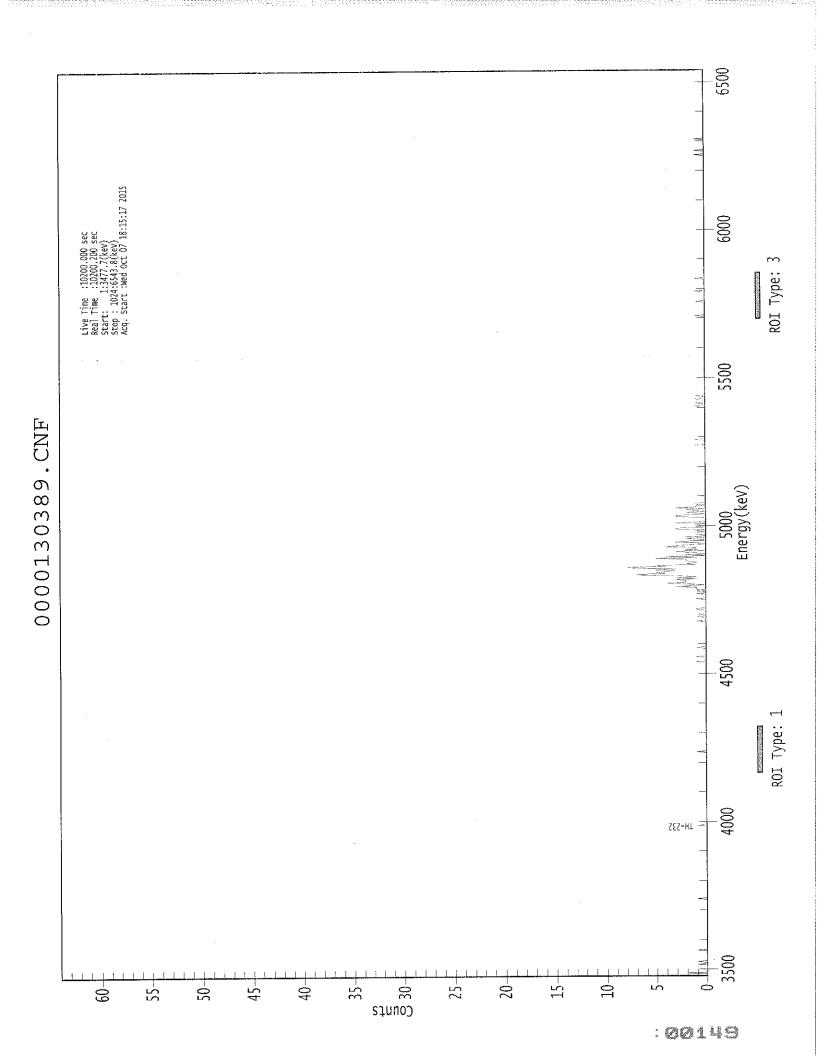
0.175 MeV

			PEAR	AREA RE	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
TH-227 TH-228 TH-229 TH-230 TH-232	T	5.772 5.385 4.895 4.641 3.987	3.32 7.66 181.83 7.00 0.66	119.77 72.63 14.54 79.20 305.43	0.68 0.34 0.17 0.00 0.34	0.00E+000 0.00E+000 0.00E+000 0.00E+000	3.0 3.0 8.2 3.0 3.0	

T = Tracer Peak used for Effective Efficiency

		- <b></b>		
<b></b>	NUCLIDE	ANALYSIS	RESULTS	

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter )	MDA (pCi/liter )
TH-227 TH-228	0.969	5850.00* 5400.00*	8.78E-002 +/- 1.06E-001 2.01E-001 +/- 1.50E-001	1.49E-001 +/- 2.35E-002 1.26E-001 +/- 1.98E-002 1.08E-001 +/- 1.70E-002
TH-229 TH-230 TH-232	0.997 0.995 0.999	4872.00* 4672.00* 3997.00*	4.70E+000 +/- 7.42E-001 1.81E-001 +/- 1.46E-001 1.70E-002 +/- 5.20E-002	1.55E-001 +/- 2.44E-002 1.23E-001 +/- 1.94E-002



Sample Title: 06

Elapsed Live time: 10200 Elapsed Real Time: 10200

Channel   -								
1:	o'	o ʻ	0	2	0	0	0	0
9:	0	0	0	0	0	1	0	0
17:	1	0	0	0	0	0	0	0
25:	0	0	0	0	0	1	0	0
33:	. 0	0	0	0	0	0	0	V 1 10
41:	0	0	0	0	0	0	0	0
49:	0	Ō	Ō	0	0	0	0	0
57 <b>:</b>	Ö	. 0	0	0 .	0	0	0	0
65:	Ö	0	: 0	0	0	0	0 1	0
73:	Ő	0	. 0	Ō	0	0	0	0
81:	Ö	Ö	Ö	0	0	0	0	1
89:	0	Ö	Ö	Õ	Ō	0	0	0
97:	0	0	Ő	Ö	Ö	Ō	0	0
105:	0	0	Ö	ő	Ö	Ō	0	0
113:	0	0	0	Ö	Ö	Õ	Ö	0
121:	0	0	0	0	0	Ö	Ö	Ō
	0	0	0	0	0	Ö	Ö	Ö
129:		0	0	0	0	Ö	Ö	Ŏ
137:	0		0	0	0	0	Ö	0
145:	0	0	0	. 0	0	0	0	0
153:	0	0		0	0	0	0	0
161:	0	0	. 0		0	0	0	0
169:	0	0	1	0		0	0	0
177:	0	0	0	0	0		0	
185:	0	0	0	0	0	0	=	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	1	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	. 0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	1	0	0	0	0	0
361:	1	0	0	0	0	0	0	0

Channel I	Data Rep	port		10/8/201	5 5:16	:57 AM		Page 2
369:	0	0	1	0	0	0	0	0
	Sample	Title:	06					
369:  Channel 377: 385: 393: 409: 425: 433: 449: 457: 4653: 4897: 5131: 529: 5375: 5697: 583: 5649: 649: 657:	0	O Title:  O O O O O O O O O O O O O O O O O O O	06 	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0 0 0 0 1 0 0 1 0 0 1 2 7 8 2 1 3 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0		0000013355530203300000001000000000000000
649: 657: 665: 673: 681: 689:						0 0 0 0	0 0 0 0	0 0 0 0
697: 705: 713: 721: 729: 737: 745: 753:	0 0 0 0 0 0 0	0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0 0 0 0
761: 769: 777: 785: 793:	1 0 0 0	0 0 0 0	0 0 0 1 0		0 1 0 0	0 0 0 0	0 0 0 0	0 0 0 0

Channel	Data Repo	rt		10/8/2015	5:16:	57 AM		Page 3
801:	0	0	0	0	0	0	0	0
	Sample T	itle:	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	О	0	0	0	0	0
913:	0	0	О	0	0	0	0	0
921:	0	0	0	0	0	0	1	0
929:	0	0	0	1	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	1	0	0	0	0	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	О	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



Sample Description:

KC97-209-U

Spectrum File:

\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00001303

Batch Identification:

1509136A-TH

Sample Identification: Sample Geometry:

07 Shelf 2

Procedure Description:

Th iso

Detector Name:

Alpha\_045

Chamber Serial Number: 04026482A

Detector Serial Number: 91131

Env. Background:

System Bkgd 130613

Reagent Blank:

<not performed>

Sample Size:

5.000E-001 +/- 0.000E+000 liter

Sample Date/Time:

9/19/2015 4:10:44 PM

Acquisition Date/Time: 10/7/2015 6:15:20 PM 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:

0.0883 +/- 0.0104

Counting Efficiency:

0.1760 +/- 0.0031 on 10/25/2014 3:16:42 PM

Chem. Recovery Factor:

0.5019 +/- 0.0599

Peak Match Tolerance:

0.175 MeV

			PEAK	AREA RE	EPORT			
Nuclide		Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)	
TH-227 TH-228 TH-229 TH-230 TH-232	T	5.871 5.385 4.864 4.627 3.850	3.30 5.79 78.15 8.66 0.47	136.59 97.97 22.31 68.12 626.93	1.70 2.21 0.85 0.34 1.53	0.00E+000 0.00E+000 0.00E+000 0.00E+000	3.0 3.0 15.0 3.0 3.0	

T = Tracer Peak used for Effective Efficiency

 NUCLIDE	ANALYSIS	RESULTS	

Nuclide	Id	Energy	Activity	MDA
	Conf.	(keV)	(pCi/liter)	(pCi/liter )
TH-227	0.998	5850.00*	2.03E-001 +/- 2.82E-001	4.53E-001 +/- 1.05E-001
TH-228	0.999	5400.00*	3.54E-001 +/- 3.56E-001	4.89E-001 +/- 1.13E-001
TH-229	1.000	4872.00*	4.71E+000 +/- 1.09E+000	3.61E-001 +/- 8.35E-002
TH-230	0.989	4672.00*	5.20E-001 +/- 3.74E-001	2.87E-001 +/- 6.64E-002
TH-232	0.894	3997.00*	2.82E-002 +/- 1.77E-001	4.26E-001 +/- 9.86E-002

\*\*\*\*\*\*\*\*\*\*\*\*\*\* SPECTRAL DATA REPORT \*\*\*\*\* \*\*\*\*\*\*\*\*\*\*\*\*\*\*

Sample Title: 07

Elapsed Live time: 10200 Elapsed Real Time: 10200

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

Channel	Data	Repor	t		10/8/201	15 5:1	7:04 AM		Page	2
369:		0	0	0	1	0	0	. 0	0	
	Samp	ole Ti	tle: 0	7						
Channel		!								
377:		o '	1	0	0	0	0	0	1	
385:		0	0	0	0	1	0	0	0	
393:		0	0	0	0	0	0	0	0	
401:		0	0	0	. 0	0	1	1	0	
409:		0	1	1	0	0	2	0	0	
417:		1	1	0	0	0	0	0	0	
425:		0	0	1	0	0	0 2	0 1	0	
433:		1	0	2	2 3	1 3	3	2	1	
441:		1	2 2	4 1	2	2	. 2	1	0	
449: 457:		1 2	0	2	0	0	2	1	1	
465:		0 1 1	1	0	Ő	. 0	. 0	1	. 1	
473:		2	3	Ŏ	Õ	1	1	2	0	
481:		0	0	Ō	0	0	0	0	0	
489:		0	1	0	0	0	0	0	0	
497:		0	1	0	1	0	0	0	1	
505:		0	1	2	0	0	0	0	0	
513:		0	1	0 /	0	. 0	1	1	0	
521:		0	0	0	0	0	0	0	0	
529:		0	0	0	0	0	0	0	0	
537:		0	0	0	0	0 0 -	0	0	0	
545:		0	0	0 0	0	0	0	0	0	
553: 561:		0	0	0	0	0	0	0	ő	
569:		0	0	0	0	ő	Õ	Ō	0	
577:		0	Ö	Ő	Ō	0	0	0	0	
585:		Ō	Ō	0	0	1	0	0	0	
593:		0	0	0	0	0	0	0	0	
601:		0	0	0	0	0	0	0	0	
609:		1	0	0	0	0	0	0	0	
617:		0	0	0	0	0	0	0	0	
625:		0	0	. 0	1 0	0	0	0 1	1 0	
633:		0	0 0	0	0	0	0	0	1	
641: 649:		1 0	1	0	0	0	0	0	0	
657:		0	0	Ö	0	Ö	Ō	0	0	
665:		0	Ō	0	0	0	0	0	0	
673:		0	0	0	0	0	O	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	0	0	
721: 729:		0 0	0	0	0	0	0	0	0	
729: 737:		0	0	Ö	0	0	Ő	0	0	
737: 745:		1	0	0	Ö	Ö	0	0	Õ	
753:		0	0 .	Ō	0	0	0	0	0	
761:		0	0	0	0	1	0	0	0	
769:		0	0	0	0	0	0	0	0	
777:		0	0	0	1	0	0	0	0	
785:		0	0	0	0	0	0	0	0	
793:		0	0	0	0	0	0	0	0	

Channel	Data Report		,	10/8/2015	5:17:0	)4 AM		Page	3
801:	0	0	0	0	0	0	0	0	
	Sample Tit	le:	07						
Channel 809: 817: 825: 833: 841: 849: 857: 865: 873: 881: 889: 905: 913: 921: 929: 937: 945: 953: 969:	Sample Tit	le: - 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	07				000000000000000000000000000000000000000	000000000000000000000000000000000000000	
977: 985: 993: 1001: 1009: 1017:	0 0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0 0	0 0 0 0	0 0 0	



## QA SUMMARY REPORT Review Of QA Results - Pulser Check

Date : 10/7/2015 Time : 5:53:15 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha 001	21f	ALL	Not Done	
Alpha 002	21f	ALL	Not Done	
Alpha 003	21f	ALL	Passed	10/7/2015 5:32:25 AM
Alpha 004	21f	ALL	Passed	10/7/2015 5:32:26 AM
Alpha 005	21f	ALL	Not Done	
Alpha 006	21f	ALL	Not Done	
Alpha 007	21f	ALL	Not Done	
Alpha 008	21f	ALL	Not Done	
Alpha 009	21f	ALL	Not Done	
Alpha 010	21f	ALL	Passed	10/7/2015 5:32:27 AM
Alpha 011	21f	ALL	Passed	10/7/2015 5:32:28 AM
Alpha 012	21f	ALL	Passed	10/7/2015 5:32:28 AM
Alpha 013	21f	ALL	Not Done	
Alpha 014	21f	ALL	Passed	10/7/2015 5:32:29 AM
Alpha 015	21f	ALL	Passed	10/7/2015 5:32:30 AM
Alpha 016	21f	ALL	Not Done	
Alpha 033	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:31 AM
Alpha 034	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:33 AM
Alpha 035	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:34 AM
Alpha 036	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:36 AM
Alpha 037	Alpha Analyst100DC	ALL V	Passed	10/7/2015 5:32:37 AM
Alpha 038	Alpha Analyst100DC	Peak Energy O 1/2	Action	10/7/2015 5:32:38 AM
Alpha 039	Alpha Analyst100DC	Peak Energy O	Passed	10/7/2015 5:32:40 AM
Alpha 040	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:42 AM
Alpha 041	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:43 AM
Alpha 042	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:45 AM
Alpha 043	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:47 AM
Alpha 044	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:49 AM
Alpha 045	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:52 AM
Alpha 046	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:54 AM
Alpha 047	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:55 AM
Alpha 048	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:57 AM
Alpha_049	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:32:59 AM
Alpha 050	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:01 AM
Alpha 051	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:02 AM
Alpha 052	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:04 AM
Alpha 053	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:06 AM
Alpha_054	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:09 AM
Alpha 055	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:11 AM
Alpha 056	Alpha Analyst 100DC	ALL	Passed	10/7/2015 5:33:14 AM
Alpha 057	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:17 AM
Alpha_058	Alpha Analyst100DC	ALL	Passed	10/7/2015 5:33:20 AM

Nuclide Library Title: Thorium

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

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

<sup>\* =</sup> key line

TOTALS:

<sup>5</sup> Nuclides

<sup>5</sup> Energy Lines