MICHAEL PISANI & ASSOCIATES

0494255 Hero Lands

STANDARD LEVEL IV
REPORT OF ANALYSIS

WORK ORDER #19-02131-OR

April 25, 2019

EBERLINE ANALYTICAL/OAK RIDGE LABORATORY
OAK RIDGE, TN

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Eberline Services – Oak Ridge Laboratory

LABORATORY DATA SUPPORT CHECKLIST

MP-001-3

Eberline Services Work Order # 19 02131

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

Date for Partial	Initials	Date	Initials	Checklist Items
		2/25/19	[signature]	Sample Log-In
		3-15-19	[signature]	Data Compilation
		3/21/19	[signature]	First Technical Data Review
		3-22-19	[signature]	Second Technical Data Review
		4/10/19	[signature]	Data Entry/Electronic Deliverable
		4/10/19	[signature]	Case Narrative
		4/24/19	[signature]	Electronic Deliverable Proof
		4/24/19	[signature]	Samples Analyzed within Holding Time Yes? ☑ No? ☐
		4/24/19	[signature]	QA/QC Review
				Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

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

Date package approved by: [signature] [signature] 4/25/19

Laboratory Manager Date

Copy No. _____

Radiochemistry Services

SECTION I

CHAIN OF CUSTODY
& pH CHECK

Chain of Custody Record

№

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

EBERLINE SERVICES

Project Name: HERO LANDS	Project Number: 6494255
Send Report To: DAVE LETHEGROVE	Sampler (Print Name): ED GRANON
Address: MICHAEL PISANI + ASSOC	Sampler (Print Name):
3838 N. CAUSEWAY BLVD	Shipment Method: FED EX
METAIRIE LA 70002 STE 3000	Airbill Number:
Phone: 281-600-1000	Laboratory Receiving:
Fax:	

Analysis Requested: RA 226 / 228

REC'D FEB 21 2019

19 02131

Page 1 of 1

Purchase Order #:

	Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	RA 226 / 228	Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
4	BC 29A	2-14-19	0935	WATER	1			
5	BC 29B		1045					
6	BC 20		1225					
7	BC 18		1455					
8	BC 19		1540					
9	BC 17A	2-15-19	0755					
10	BC 17B		1100					

Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
[signature] 2-19-19	Randolph Spencer	2-21-19	0915
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:

Sample Custodian Remarks (Completed By Laboratory):

QA/QC Level	Turnaround	Sample Receipt	
Level I ☐	Routine ☐	Total # Containers Received?	
Level II ☐	24 Hour ☐	COC Seals Present?	
Level III ☐	1 Week ☐	COC Seals Intact?	
Other ☐	Other STANDARD	Received Containers Intact?	
		Temperature?	

EBERLINE SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #	19-02131
Lab Deadline	3/6/2019
Analysis	Ra226 - Level 4
Sample Matrix	Water

Comments

Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
04	42	SS1.5
05	29	SS1.5
06	37	SS1.5
07	32	SS1.5
08	32	SS1.5
09	37	SS1.5
10	43	SS1.5

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	(Prep)	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	DS	3/11/19 0830
Relinquished by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	DS	3/13/19 1110
Received by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	KB	3/13/19 1113
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	KB	3/13/19 1728
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #	19-02131
Lab Deadline	3/6/2019
Analysis	Ra228 - Level 4
Sample Matrix	Water

Comments

Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
04	42	SS1.5
05	29	SS1.5
06	37	SS1.5
07	32	SS1.5
08	32	SS1.5
09	37	SS1.5
10	43	SS1.5

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	(Prep)	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)		
Received by	(Sample Storage)	Rough Prep	Prep	(Separations)	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)		
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #	19-02131
Lab Deadline	2/22/2019
Analysis	TDS - Level 4
Sample Matrix	Water

Comments

Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
04	42	SS1.5
05	29	SS1.5
06	37	SS1.5
07	32	SS1.5
08	32	SS1.5
09	37	SS1.5
10	43	SS1.5

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room	JW Jachelle	2.22.19
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	Mu	25FEB19 0330
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room		
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room		

EBERLINE SERVICES

Sample Receiving Report
(Volumes, pH, & CPM)

Internal Work Order
19-02131
Received By
RSPENCER

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	SS1.5		
02	BLANK	0		WA	SS1.5		
03	DUP	0		WA	SS1.5		
04	BC 29A	1		WA	SS1.5	3.76	42
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	42
05	BC 29B	1		WA	SS1.5	3.76	29
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	29
06	BC 20	1		WA	SS1.5	3.76	37
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	37
07	BC 18	1		WA	SS1.5	3.76	32
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	32
08	BC 19	1		WA	SS1.5	2.50	32
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	2.5000	32
09	BC 17A	1		WA	SS1.5	3.76	37
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	37
10	BC 17B	1		WA	SS1.5	3.76	43
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	43

✓ ejt 2/21/19

Received by: Randolph Spencer Date: 2-21-19

SECTION II

SAMPLE ACKNOWLEDGEMENT

Client Name	Contract/PO	Project Type	Date Received	Required Turnaround Days	Eberline Services Work Order
Michael Pisani & Associates, Inc.	0494255	Environmental	02/21/2019	21	19-02131
Project Name	**Client WO**	**Sample Disp**	**Lab Deadline**	**Internal Deadline**	**Client Deadline**
HERO LANDS	HERO LANDS	W	03/06/2019	03/13/2019	03/14/2019

Internal ID	Client ID	Sample Date	Matrix	Storage	Ra226	Ra228	TDS																						Tl
01	LCS	02/21/19	WA	SS1.5	X	X	X																						3
02	BLANK	02/21/19	WA	SS1.5	X	X	X																						3
03	DUP	02/21/19	WA	SS1.5	X	X	X																						3
04	BC 29A	02/14/19 09:35	WA	SS1.5	X	X	X																						3
05	BC 29B	02/14/19 10:45	WA	SS1.5	X	X	X																						3
06	BC 20	02/14/19 12:25	WA	SS1.5	X	X	X																						3
07	BC 18	02/14/19 14:55	WA	SS1.5	X	X	X																						3
08	BC 19	02/14/19 15:40	WA	SS1.5	X	X	X																						3
09	BC 17A	02/15/19 07:55	WA	SS1.5	X	X	X																						3
10	BC 17B	02/15/19 11:00	WA	SS1.5	X	X	X																						3
																													0
																													0
																													0
																													0
																													0
																													0
																													0
																													0
																													0
																													0
Totals Per Analysis (non QA samples)					7	7	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

EBERLINE SERVICES

Sample Log In Report

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

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

Invoice	
	Accounts Payable
	Michael Pisani & Associates
	840 W Sam Houston Pkwy N Suite 600
	Houston, TX 77024
Voice	281-242-5700
Fax	281-520-4625
Contact	Dave Upthegrove
Voice	832-786-5006
Fax	

Report Data	
	Dave Upthegrove
	Michael Pisani & Associates
	840 W Sam Houston Pkwy N Suite 600
	Houston, TX 77478
Voice	832-786-5006
Fax	

Printed: 2/21/2019 3:49 PM

Eberline Services – Oak Ridge Laboratory

SAMPLE RECEIPT CHECKLIST
MP-001-2

WORK ORDER # 19-02131

SAMPLE MATRIX/MATRICES: (CIRCLE ONE OR BOTH)

(AQUEOUS) NON-AQUEOUS

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

WERE SAMPLES:

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

WERE CHAIN OF CUSTODY SEALS:

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

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

REMARKS: _____

SIGNATURE: Randolph Spencer DATE: 2-21-19

SECTION III

CASE NARRATIVE

EBERLINE ANALYTICAL

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

EBS-OR-45355

April 25, 2019

Dave Upthegrove
Michael Pisani & Associates
840 W Sam Houston Pkwy N #600
Houston, TX 77478

CASE NARRATIVE
Work Order # 19-02131-OR

SAMPLE RECEIPT

This work order contains seven water samples received 02/21/2019. Samples were analyzed for Radium-226/228 and Total Dissolved Solids.

CLIENT ID	LAB ID	CLIENT ID	LAB ID
BC 29A	19-02131-04	BC 19	19-02131-08
BC 29B	19-02131-05	BC 17A	19-02131-09
BC 20	19-02131-06	BC 17B	19-02131-10
BC 18	19-02131-07		

ANALYTICAL METHODS

Radium-226 was analyzed using EPA Method 903.0 Modified. Radium-228 was analyzed using EPA Method 904.0. Total Dissolved Solids were performed using Standard Methods 2540C.

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 1-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.

RADIUM-226

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

ANALYTICAL RESULTS CONTINUED

RADIUM-226 CONTINUED

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

RADIUM-228

Following alpha spectroscopy analysis of Radium-226, Barium/Radium Sulfate precipitates were redissolved and allowed for sufficient ingrowth of the Actinium-228 daughter. After ingrowth, Actinium-228 was selectively precipitated. Precipitates were filtered and beta emissions for Actinium-228 were then counted on a gas proportional counter. Chemical recovery was determined by the use of a Barium-133 tracer, the activity of which was determined by HPGe gamma spectroscopy and an elemental Yttrium carrier by gravimetric measurements. The product of these two recoveries was used to calculate chemical yield.

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

TOTAL DISSOLVED SOLIDS (TDS)

A volumetric aliquot of each sample was filtered through a tared 0.45µm filter media into a tared 250ml beaker. Samples were dried on a hot plate and were allowed to cool. The TDS content was determined by reweighing tared beakers.

Samples demonstrated a Total Dissolved Solids content that ranged from 994.0 to 15,255.0 mg/L.

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: 4/25/2019

Eberline Analytical wants and encourages your feedback regarding our performance providing radioanalytical services. Please visit http://eberlineanalytical.com/ to provide us with feedback on our services.

SECTION IV

ANALYTICAL RESULTS SUMMARY

Eberline Analytical
Final Report of Analysis

Report To:
Dave Upthegrove
Michael Pisani & Associates
840 W Sam Houston Pkwy N Suite 600
Houston, TX 77478

Work Order Details:
SDG: 19-02131
Project: 0494255 Hero Lands
Analysis Category: ENVIRONMENTAL
Sample Matrix: WA

Lab ID	Sample Type	Client ID	Sample Date	Receipt Date	Analysis Date	Batch ID	Analyte	Method	Result	CU	CSU	MDA	Report Units
19-02131-01	LCS	KNOWN	02/21/19 00:00	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	1.00E+01	4.60E-01			pCi/l
19-02131-01	LCS	SPIKE	02/21/19 00:00	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	9.49E+00	1.39E+00	2.44E+00	2.80E-01	pCi/l
19-02131-02	MBL	BLANK	02/21/19 00:00	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	1.86E-01	2.12E-01	2.15E-01	2.80E-01	pCi/l
19-02131-03	DUP	BC 29A	02/14/19 09:35	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	6.91E-03	2.30E-01	2.30E-01	5.50E-01	pCi/l
19-02131-04	DO	BC 29A	02/14/19 09:35	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	7.79E-03	1.09E-01	1.09E-01	3.11E-01	pCi/l
19-02131-05	TRG	BC 29B	02/14/19 10:45	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	1.49E+00	5.24E-01	6.12E-01	2.25E-01	pCi/l
19-02131-06	TRG	BC 20	02/14/19 12:25	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	1.54E-01	1.86E-01	1.89E-01	2.27E-01	pCi/l
19-02131-07	TRG	BC 18	02/14/19 14:55	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	3.13E-01	3.06E-01	3.13E-01	3.96E-01	pCi/l
19-02131-08	TRG	BC 19	02/14/19 15:40	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	-7.95E-02	1.90E-01	1.91E-01	5.16E-01	pCi/l
19-02131-09	TRG	BC 17A	02/15/19 07:55	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	1.18E-01	1.94E-01	1.95E-01	3.41E-01	pCi/l
19-02131-10	TRG	BC 17B	02/15/19 11:00	2/21/2019	3/13/2019	19-02131	Radium-226	EPA 903.0 Modified	4.75E-01	3.17E-01	3.33E-01	3.39E-01	pCi/l
19-02131-01	LCS	KNOWN	02/21/19 00:00	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	9.07E+00	4.62E-01			pCi/l
19-02131-01	LCS	SPIKE	02/21/19 00:00	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	8.36E+00	7.21E-01	2.03E+00	8.67E-01	pCi/l
19-02131-02	MBL	BLANK	02/21/19 00:00	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	1.15E-01	3.88E-01	3.89E-01	8.18E-01	pCi/l
19-02131-03	DUP	BC 29A	02/14/19 09:35	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	3.17E-01	4.41E-01	4.47E-01	9.08E-01	pCi/l
19-02131-04	DO	BC 29A	02/14/19 09:35	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	4.38E-01	4.89E-01	4.98E-01	9.96E-01	pCi/l
19-02131-05	TRG	BC 29B	02/14/19 10:45	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	1.88E+00	4.28E-01	6.05E-01	7.05E-01	pCi/l
19-02131-06	TRG	BC 20	02/14/19 12:25	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	4.20E-01	4.14E-01	4.25E-01	8.39E-01	pCi/l
19-02131-07	TRG	BC 18	02/14/19 14:55	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	1.81E+00	5.47E-01	6.83E-01	9.47E-01	pCi/l
19-02131-08	TRG	BC 19	02/14/19 15:40	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	1.24E+00	4.47E-01	5.27E-01	8.14E-01	pCi/l
19-02131-09	TRG	BC 17A	02/15/19 07:55	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	4.83E-01	4.02E-01	4.17E-01	8.07E-01	pCi/l
19-02131-10	TRG	BC 17B	02/15/19 11:00	2/21/2019	3/14/2019	19-02131	Radium-228	EPA 904.0	6.32E-01	3.73E-01	4.00E-01	7.25E-01	pCi/l
19-02131-04	TRG	BC 29A	02/14/19 09:35	2/21/2019	2/25/2019	19-02131	TDS	SM2540C	1.81E+03				mg/l
19-02131-05	TRG	BC 29B	02/14/19 10:45	2/21/2019	2/25/2019	19-02131	TDS	SM2540C	1.53E+04				mg/l
19-02131-06	TRG	BC 20	02/14/19 12:25	2/21/2019	2/25/2019	19-02131	TDS	SM2540C	9.94E+02				mg/l
19-02131-07	TRG	BC 18	02/14/19 14:55	2/21/2019	2/25/2019	19-02131	TDS	SM2540C	3.63E+03				mg/l
19-02131-08	TRG	BC 19	02/14/19 15:40	2/21/2019	2/25/2019	19-02131	TDS	SM2540C	1.35E+03				mg/l
19-02131-09	TRG	BC 17A	02/15/19 07:55	2/21/2019	2/25/2019	19-02131	TDS	SM2540C	1.84E+03				mg/l
19-02131-10	TRG	BC 17B	02/15/19 11:00	2/21/2019	2/25/2019	19-02131	TDS	SM2540C	5.30E+03				mg/l

CU=Counting Uncertainty;CSU=Combined Standard Uncertainty (1-sigma);MDA=Minimal Detected Activity;LCS=Laboratory Control Sample; MBL=Blank; DUP=Duplicate; TRG=Normal Sample; DO=Duplicate Original

0017

EBERLINE ANALYTICAL

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

SECTION V

ANALYTICAL STANDARD

13a-6
(f 6a)

National Institute of Standards & Technology

Certificate

ORIGINAL

Standard Reference Material 4251C
Barium-133 Radioactivity Standard

ORIGINAL

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

Radiological Hazard

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

Chemical Hazard

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

Storage and Handling

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

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

Preparation

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

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

Gaithersburg, Maryland 20899
October 1994

Thomas E. Gills, Chief
Standard Reference Materials Program

*Notes and references are on pages 5 and 6.

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

QCP-009

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

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

		CURRENT DATE	5/5/2018 0:00
SOLUTION REFERENCE #	NIST SRM4251C	**SOLUTION #**	Ba-6

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

Radionuclide	^{133}Barium	**Reference Date**	9/1/1993 0:00
Certified Activity		µCi	
Certified Concentration	1.318E+01	µCi per gram	

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

Chemical Composition of Standard Solution

$^{133}BaCl_2$ in 1M HCl

Dilution Instructions: **Dilution Solvent Used** 1M HCl

Dilute to a volume of 1000.00 **milliliters**

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

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

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

Expiration Date: April 26, 2019

Verified & Approved By _____ Date: 5/5/18

QC Approval _____ Date: 5/8/18

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

QCP-009

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

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

	QCP-009-1-A	Date	5/5/18
Solution Reference #	NIST SRM4251C	Solution #	Ba-6a

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

Radionuclide of Interest	^{133}Ba	Reference Date	9/1/1993 0:00
Parent Solution Conc.	1.48E+05 dpm/ml		

Chemical Composition of Standard Solution
$^{133}BaCl_2$ in 1M HCl

Dilution Instructions: **Dilution Solvent Used** 1M HCl

SECONDARY VOLUMETRIC DILUTION

Vol. Parent Solution:	25.0000 ml	Final Activity Concentration:	3.6950E+03 dpm/ml
Total Activity:	3.6950E+06 dpm		
Final Volume:	1000.00 ml		

NOTES:

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

Expiration Date: April 26, 2019

Verified & Approved By _____ Date: 5/5/18

QC Approval _____ Date: 5/8/18

Ra-5

QA/QC REVIEWED
Date 2/8/94 Initials WT

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

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

Description of Solution

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

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

c. Carrier content: None added

d. Density: 1.0318 g/ml @ 20°C.

Radioimpurities: None detected(other than daughters)

Radioactive Daughters

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

Radionuclide Concentration

(Ra-226) 0.1929 μCi/g.

Method of Calibration

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

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	±3.4%
b. Random uncertainty in assay:	±3.1%
c. Random uncertainty in weighing(s):	±0.2%
d. Total uncertainty at the 99% confidence level:	±4.6%

NIST Traceability

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

Leak Test(s)

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

Notes

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

Ana U. Nuñez
QUALITY CONTROL

Feb. 3, 1994
Date Signed

ISOTOPE PRODUCTS LABORATORIES
1800 North Keystone Street
Burbank, California 91504
(818) 843 - 7000

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP 009

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

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

		CURRENT DATE	9/17/2018 0:00
SOLUTION REFERENCE #	IPL 453-26	**SOLUTION #**	Ra-5

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

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

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

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

Dilution Instructions: **Dilution Solvent Used** 1M HNO_3

Dilute to a volume of 1000.00 **milliliters**

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

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

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

Expiration Date: September 10, 2019

Verified & Approved By _____ Date: 9/17/2018

QC Approval _____ Date: 9/18/18

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP 009

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

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

	MP 009	Date	9/17/2018 0:00
Solution Reference #	IPL-453-26	Solution #	Ra-5b

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

Radionuclide of Interest	^{226}Radium	Reference Date	2/1/1994 0:00
Parent Solution Conc.	2.22E+03 dpm/ml		

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

Dilution Instructions: **Dilution Solvent Used** 1M HNO_3

SECONDARY VOLUMETRIC DILUTION

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

Final Activity Concentration: 4.4440E+01 dpm/ml

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

NOTES:

Expiration Date: 10-Sep-19

Verified & Approved By _____ Date: 9/17/2018 0:00

QC Approval _____ Date: 9/18/18

ANALYTICS #411 Rec'd 2/15/06 R Trenton

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

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

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

Ra^{228}

72325-207

Ra-228 5 mL Liquid in Flame Sealed Vial

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

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

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

ISOTOPE:	Ra-228
ACTIVITY (dps):	4.022 E3
HALF-LIFE:	5.75 years
CALIBRATION DATE:	February 10, 2006 12:00 EST
RELATIIVE EXPANDED UNCERTAINTY (k=2):	4.0%

Impurities: γ-impurities <0.1%

5.10721 grams 0.1M HCl solution with 50 µg/g Ba carrier.

P O NUMBER 00003181, Item 1

SOURCE PREPARED BY: M Taskaeva
M. Taskaeva, Radiochemist

Q A APPROVED: 2-13-06

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

MP-009

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

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

CURRENT DATE	2/5/2019 0:00
SOLUTION REFERENCE #	Analytics 7235-207
SOLUTION #	Ra-12

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

Radionuclide	^{228}Ra	
Certified Activity	1.087E-01	µCi
Certified Concentration		µCi per gram

Reference Date: 2/10/2006 0:00

Ampoule /Solution Gross	9.0741	Weight, Grams
Empty Ampoule	3.9858	Weight, Grams
Solution Net	5.0883	Weight, Grams
Total Activity in Ampoule	0.1087	µCi

Chemical Composition of Standard Solution

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

Dilution Instructions:

Dilution Solvent Used: 0.5 M HCl

Dilute to a volume of: 991.00 Kg

Certified Total Activity of: 0.1087 µCi Which Equals: 2.413E+05 dpm at the date listed above

And after dilution the activity of this solution is: **2.435E+02** dpm/ml

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

Expiration Date: January 31, 2020

Recertified By _____ Date: 2/5/19

QC Approval _____ Date: 2/5/19

SECTION VI

QUALITY CONTROL SAMPLE RESULTS SUMMARY

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
19-02131	Ra226	1	pCi	l	Michael Pisani & Associates, Inc.

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-226		94.81%	25.70%	100.00%	4.60%	1.00E+01	4.60E-01	9.49E+00	2.44E+00	Ra-5b	4.40E+01	4.60E+00	5.05E-01

Matrix Spike

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

Duplicate Results

Analyte	*Normalized Difference*	*RPD*	*Original Result*	*Original CSU*	*Duplicate Result*	*Duplicate CSU*
RA-226	0.01	11.95	7.79E-03	1.09E-01	6.91E-03	2.30E-01

QC Summary

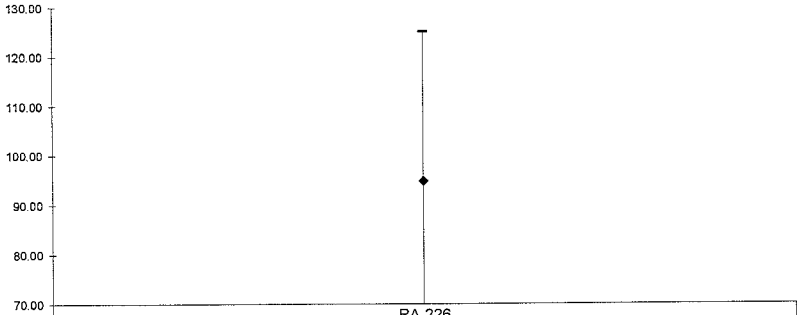
LCS Relative Bias	*LCS % R*		*MS % R*	*MS ND*	*Rep RPD*	*Rep ND*
0.95	OK				NA	OK

0028

Version

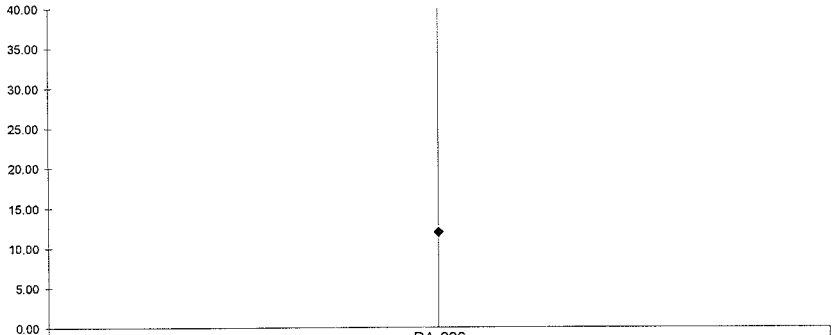
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
19-02131	Ra226	1	pCi	l	Michael Pisani & Associates, Inc.

LCS % Recovery



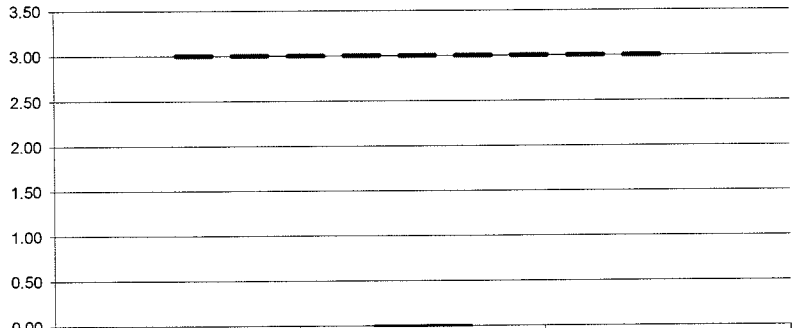
	RA-226
Lower Error	64.51
Upper Error	125.11
%R	94.81
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



	RA-226
Lower Error	149.74
Upper Error	-125.84
RPD	11.95
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-226	0.00	0.01	0.00
UCL	3	3	3

No Matrix Spike

0029

Version

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
19-02131	Ra228	1	pCi	l	Michael Pisani & Associates, Inc.

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-228		92.18%	24.23%	100.00%	5.10%	9.07E+00	4.62E-01	8.36E+00	2.03E+00	Ra-12	5.03E+01	5.10E+00	4.00E-01

Matrix Spike

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

Duplicate Results

Analyte	*Normalized Difference*	*RPD*	*Original Result*	*Original CSU*	*Duplicate Result*	*Duplicate CSU*
RA-228	0.36	32.17	4.38E-01	4.98E-01	3.17E-01	4.47E-01

QC Summary

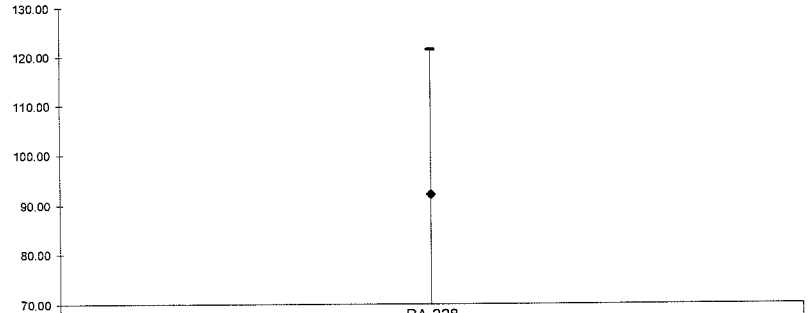
LCS Relative Bias	*LCS % R*		*MS % R*	*MS ND*	*Rep RPD*	*Rep ND*
0.92	OK				NA	OK

0030

Version

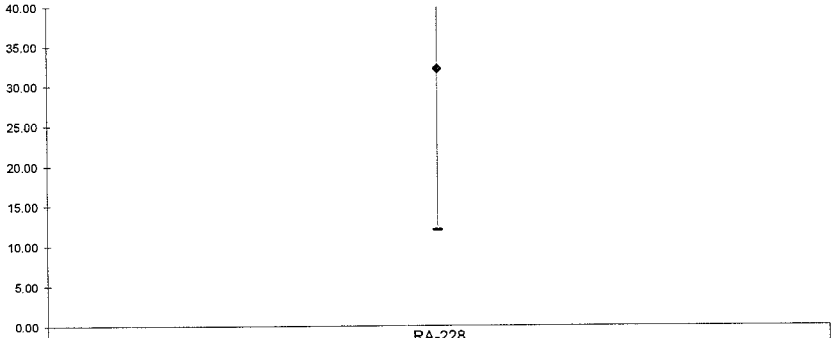
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
19-02131	Ra228	1	pCi	l	Michael Pisani & Associates, Inc.

LCS % Recovery



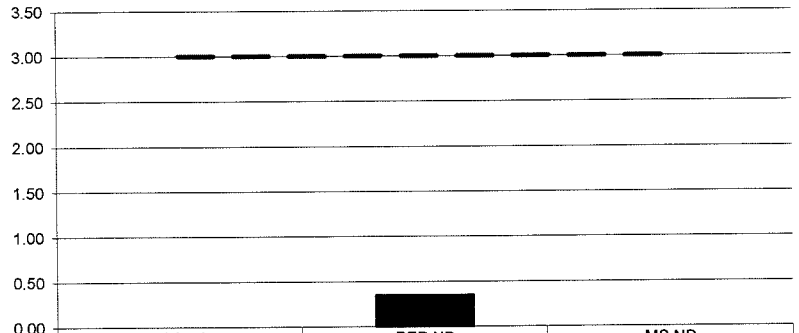
	RA-228
Lower Error	62.85
Upper Error	121.51
%R	92.18
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



	RA-228
Lower Error	52.31
Upper Error	12.02
RPD	32.17
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-228	0.00	0.36	0.00
UCL	3	3	3

No Matrix Spike

0031

Version

SECTION VII

LABORATORY TECHNICIAN'S NOTES

RA-226 NOTES

EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	19-02131
Analysis Code	Ra226
Run Number	1

#	Date	Dept	User	Notes
1	03/08/19 09:09	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

JHarvey
3/8/19

EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	19-02131
Analysis Code	Ra226
Run Number	1

#	Date	Dept	User	Notes
1	03/08/19 09:09	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	03/13/19 11:08	CHEM	JBAILEY	ADDED EDTA TO SAMPLES AND LET SIT. ADDED AMMONIUM SULFATE AND ACETIC ACID TO SAMPLES. FILTERED ONTO TARED FILTER PAPERS, LET DRY UNDER HEAT LAMP, REWEIGHED, AND SUBMITTED TO COUNT.

3/13/19

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
19-02131	
Analysis Code	Run
Ra226	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
020284P	Ammonium Hydroxide	Reagent Grade	JHARVEY	3/8/2019
020921D02	Barium Carrier	1 mg/ml	JHARVEY	3/8/2019
019767D02	Lead Carrier	166 mg/ml	JHARVEY	3/8/2019
020659P	Nitric Acid	Reagent Grade	JHARVEY	3/8/2019
020759D02	Ammonium Sulfate	200 mg/ml	JHARVEY	3/8/2019
020175P	Acetic Acid	Reagent Grade	JBAILEY	3/13/2019
020416D01	Ammonium Sulfate	200 mg/ml	JBAILEY	3/13/2019
020809S	EDTA	0.25M	JBAILEY	3/13/2019

Alpha 3

Date	Sample #	Client	Loadtime	Counttime	Analysis	Tech
3/12/19	1903027A(1-4)	UCOR	0912	2hr50min	Np	ICP
3/12/19	1903027A(1-4)	UCOR	0933	2hr50min	Th	ICP
3/12/19	1902106A(1-4)	UCOR	0934	2hr50min	Th	ICP
3/12/19	1902106A(3-4)	UCOR	1209	2hr50min	Th^{229}	ICB
3/12/19	1902091A(1-13)	Univ. of GA	1210	2hr50min	Np	ICB
3/12/19	1902097A(1-3)	AECom	1211	2hr50=	uu	ICB
3/12/19	1902097A(4-11)	AECom	1228	2hr50=	uu	ICB
3/12/19	1902103A(1-11)	UCOR	1700	2hr50mins	Rad	ICB
3/13/19	Daily Pulser	Lab	0507	10min	Na	ICP
3/13/19	1902095A(7-11)	UCOR	0825	2hr50min	Am^{243}	ICP
3/13/19	1902095A(1-11)	UCOR	0826	2hr50min	Pu^{242}	ICP
3/13/19	1902095A(1-10)	UCOR	0840	2hr50min	Np	ICP
3/13/19	1902103A(7-11)	UCOR	1125	2hr50=	uu	ICB
3/13/19	1902103A(4-11)	UCOR	1126	2hr50=	uu NT	ICB
3/13/19	1903014A(1-3)	UCOR	1127	2hr50=	uu.	ICB
3/13/19	1903014A(4)	UCOR	1135	2hr50mins	uu	ICB
3/13/19	1903036A(1-4)	Weston	1136	2hr50=	Rad	ICB
3/13/19	1902131A(1-10)	MPA	1423	2hr50=	Rad	ICB

RA-228 NOTES

EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	19-02131
Analysis Code	Ra228
Run Number	1

#	Date	Dept	User	Notes
1	03/08/19 09:10	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

JHarvey
3/8/19

EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	19-02131
Analysis Code	Ra228
Run Number	1

#	Date	Dept	User	Notes
1	03/08/19 09:10	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	03/14/19 13:31	CHEM	JBAILEY	ADDED FILTER PAPERS FROM COUNT ROOM TO LABELED C-TUBES, FILLED WITH EDTA SOLUTION AND LET SIT OVERNIGHT. REMOVED FILTER FROM EDTA-ADDED 2MLS YTTRIUM 9MG/ML CARRIER ADDED 18N NAOH TO SAMPLES AND RECORDED T1. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 6N HNO3, DI WATER, AND 10N NAOH. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 1N HNO3, DI WATER, AND AMMONIUM OXALATE. FILTERED ONTO TARED FILTER PAPERS. LET DRY UNDER HEAT LAMP, REWEIGHED AND SUBMITTED TO COUNT.

3/14/19

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
19-02131	
Analysis Code	Run
Ra228	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
020284P	Ammonium Hydroxide	Reagent Grade	JHARVEY	3/8/2019
020921D02	Barium Carrier	1 mg/ml	JHARVEY	3/8/2019
019767D02	Lead Carrier	166 mg/ml	JHARVEY	3/8/2019
020659P	Nitric Acid	Reagent Grade	JHARVEY	3/8/2019
020759D02	Ammonium Sulfate	200 mg/ml	JHARVEY	3/8/2019
019875D01	Ammonium Oxalate	5%	JBAILEY	3/14/2019
019773D13	Nitric Acid	1N	JBAILEY	3/14/2019
019673D02	Nitric Acid	6N	JBAILEY	3/14/2019
019680D02	Sodium Hydroxide	10M	JBAILEY	3/14/2019
019680D01	Sodium Hydroxide	18M	JBAILEY	3/14/2019
020524S	Yttrium Carrier	9 mg/ml	JBAILEY	3/14/2019

Aqua LB41110

Date	Sample #	Client	Loadtime	Counttime	Analysis	Tech
3/13/19	1903044AB(1)	UCOR	0904	30 min	αβ	KP
3/13/19	1902065Sr(6-13)	Zion	0917	2 hrs	Tot Sr	KP
3/13/19	1902065Sr(14)	Zion	0945	2 hrs	Tot Sr	KP
3/13/19	1903003AB(2-4)	United	1121	2 hr	αβ	KB
3/13/19	1903044AB(2-5)	UCOR	1122	2 hr	αβ	KB
3/13/19	1902065Sr(19)	Zion	1147	2 hrs	Tot Sr	KP
3/13/19	1902103RA(5-11)	UCOR	1353	2 hr	Ra-228	KB
3/13/19	1902106SY(1-5)	UCOR	1557	2 hr	Sr^{90} Y	KB
3/14/19	Daily Bkgd/QC	Lab	0525/0629	1hr/30min	αβ	KP
3/14/19	Cross Talk	Lab	0706	5 min	αβ	KP
3/14/19	Cross Talk	Lab	0715	5 min	αβ	ICP
3/14/19	1902156SY(1-4,6)	UCOR	0733	2 hrs	Sr 90	KP
3/14/19	1903040(1-4,6,8)	UCOR	0731	2 hrs	Tot Sr	KP
3/14/19	1902066Sr(1)	Zion	0935	30 min	Tot Sr	KP
3/14/19	1902066Sr(2-10)	Zion	0940	2 hrs	Tot Sr	KP
3/14/19	1902066Sr(15,16)	Zion	1006	2 hrs	Tot Sr	KP
3/14/19	1902101AB(5-13)	Hudson	1144	2 hr	αβ	KB
3/14/19	1902131RA(1-10)	MPA	1348	2 hrs	Ra-228	KB

TDS NOTES

EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	19-02131
Analysis Code	TDS
Run Number	1

#	Date	Dept	User	Notes
1	02/23/19 09:18	PREP	JPACHELLA	Samples were filtered, aliquoted into tared beakers, dried, and reweighed.

2-23-19 JPachella

SECTION VIII

ANALYTICAL DATA (RADIUM-226)

19-02131
Ra226
Run 1

Work Order	19-02131
Analysis Code	Ra226
Run	1
Date Received	2/21/2019
Lab Deadline	3/6/2019
Client	Michael Pisani & Associates, Inc.
Project	HERO LANDS
Report Level	4
Activity Units	pCi
Aliquot Units	l
Matrix	WA
Method	EPA 903.0 Modified
Instrument Type	Alpha Spectroscopy
Radiometric Tracer	Ba-133
Radiometric Sol#	Ba-6a
Tracer Act (dpm/g)	459.81
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		02/21/19 00:00	1.0000E+00
02	MBL	BLANK		02/21/19 00:00	1.0000E+00
03	DUP	BC 29A	42	02/14/19 09:35	1.0000E+00
04	DO	BC 29A	42	02/14/19 09:35	1.0000E+00
05	TRG	BC 29B	29	02/14/19 10:45	1.0000E+00
06	TRG	BC 20	37	02/14/19 12:25	1.0000E+00
07	TRG	BC 18	32	02/14/19 14:55	1.0000E+00
08	TRG	BC 19	32	02/14/19 15:40	1.0000E+00
09	TRG	BC 17A	37	02/15/19 07:55	1.0000E+00
10	TRG	BC 17B	43	02/15/19 11:00	1.0000E+00

0046

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

19-02131
Ra226
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	2.1894	1006.7	793.0	174.87		0.0199	0.0305	0.0106		110.00	3.00^	1.00
02	MBL	2.1898	1006.9	515.0	113.55		0.0199	0.0307	0.0108		110.00	3.00^	1.00
03	DUP	2.1902	1007.1	485.0	106.91		0.0196	0.0287	0.0091		106.91	3.00^	1.00
04	DO	2.1922	1008.0	412.0	90.74		0.0197	0.0289	0.0092		90.74	3.00^	1.00
05	TRG	2.1904	1007.2	525.0	115.72		0.0197	0.0276	0.0079		110.00	2.74	1.00
06	TRG	2.1886	1006.3	503.0	110.96		0.0198	0.0290	0.0092		110.00	3.00^	1.00
07	TRG	2.1853	1004.8	352.0	77.77		0.0202	0.0282	0.0080		77.77	2.77	1.00
08	TRG	2.1840	1004.2	448.0	99.04		0.0201	0.0293	0.0092		99.04	3.00^	1.00
09	TRG	2.1787	1001.8	688.0	152.46		0.0199	0.0291	0.0092		110.00	3.00^	1.00
10	TRG	2.1799	1002.3	699.0	154.82		0.0204	0.0286	0.0082		110.00	2.82	1.00

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

19-02131
Ra226
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
02	MBL			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
03	DUP			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
04	DO			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
05	TRG			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
06	TRG			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
07	TRG			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
08	TRG			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
09	TRG			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		
10	TRG			03/08/19 08:35	JHARVEY	03/13/19 10:21	JBAILEY		

0048

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

Preliminary Data Report & Analytical Calculations

Work Order: 19-02131-Ra226-1

Client	Eberline Analytical Work Order	Analysis Code	Run
Michael Pisani & Associates, Inc.	19-02131	Ra226	1

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-226	LCS	LCS	pCi/l	9.49E+00	1.39E+00	2.80E-01	1.00E+01	94.81	OK		OK	
02	RA-226	MBL	BLANK	pCi/l	1.86E-01	2.12E-01	2.80E-01					OK	OK
03	RA-226	DUP	BC 29A	pCi/l	6.91E-03	2.30E-01	5.50E-01				NA	OK	
04	RA-226	DO	BC 29A	pCi/l	7.79E-03	1.09E-01	3.11E-01					OK	
05	RA-226	TRG	BC 29B	pCi/l	1.49E+00	5.24E-01	2.25E-01					OK	
06	RA-226	TRG	BC 20	pCi/l	1.54E-01	1.86E-01	2.27E-01					OK	
07	RA-226	TRG	BC 18	pCi/l	3.13E-01	3.06E-01	3.96E-01					OK	
08	RA-226	TRG	BC 19	pCi/l	-7.95E-02	1.90E-01	5.16E-01					OK	
09	RA-226	TRG	BC 17A	pCi/l	1.18E-01	1.94E-01	3.41E-01					OK	
10	RA-226	TRG	BC 17B	pCi/l	4.75E-01	3.17E-01	3.39E-01					OK	

Client: Michael Pisani & Associates, Inc.
Eberline Analytical Work Order: 19-02131
Analysis Code: Ra226
Run: 1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	RA-226	LCS	02/21/19 00:00	1.00E+00	100.00	0.00	110.00		3/13/2019 10:21	
02	RA-226	MBL	02/21/19 00:00	1.00E+00	100.00	0.00	110.00		3/13/2019 10:21	
03	RA-226	DUP	02/14/19 09:35	1.00E+00	100.00	0.00	106.91		3/13/2019 10:21	
04	RA-226	DO	02/14/19 09:35	1.00E+00	90.74	0.00	90.74		3/13/2019 10:21	
05	RA-226	TRG	02/14/19 10:45	1.00E+00	100.00	0.00	110.00		3/13/2019 10:21	
06	RA-226	TRG	02/14/19 12:25	1.00E+00	100.00	0.00	110.00		3/13/2019 10:21	
07	RA-226	TRG	02/14/19 14:55	1.00E+00	77.77	0.00	77.77		3/13/2019 10:21	
08	RA-226	TRG	02/14/19 15:40	1.00E+00	99.04	0.00	99.04		3/13/2019 10:21	
09	RA-226	TRG	02/15/19 07:55	1.00E+00	100.00	0.00	110.00		3/13/2019 10:21	
10	RA-226	TRG	02/15/19 11:00	1.00E+00	100.00	0.00	110.00		3/13/2019 10:21	

Client: Michael Pisani & Associates, Inc.
Eberline Analytical Work Order: 19-02131
Analysis Code: Ra226
Run: 1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-226	LCS	03/13/19 14:23		A_Spec	Alpha_033	170	1.91 E+02	4.00 E-03	16
02	RA-226	MBL	03/13/19 14:23		A_Spec	Alpha_034	170	3.49 E+00	3.00 E-03	14.9
03	RA-226	DUP	03/13/19 14:23		A_Spec	Alpha_035	170	1.10 E-01	1.70 E-02	12.7
04	RA-226	DO	03/13/19 14:23		A_Spec	Alpha_036	170	1.50 E-01	5.00 E-03	16.9
05	RA-226	TRG	03/13/19 14:23		A_Spec	Alpha_037	170	3.17 E+01	2.00 E-03	15.4
06	RA-226	TRG	03/13/19 14:23		A_Spec	Alpha_038	170	2.83 E+00	1.00 E-03	14.6
07	RA-226	TRG	03/13/19 14:23		A_Spec	Alpha_039	170	4.98 E+00	6.00 E-03	15
08	RA-226	TRG	03/13/19 14:23		A_Spec	Alpha_040	170	-1.59 E+00	2.70 E-02	16.1
09	RA-226	TRG	03/13/19 14:23		A_Spec	Alpha_041	170	2.47 E+00	9.00 E-03	16.6
10	RA-226	TRG	03/13/19 14:23		A_Spec	Alpha_042	170	1.03 E+01	1.00 E-02	16.2

Count Room Report
Client: Michael Pisani Associat

19-02131-Ra226-1 (pCi/l) in WA
Tracer ID: Ba-6a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	02/21/19 00:00	1.0000	2.1894	1006.7080	793.0000	174.87	3.00^	1.00
02	MBL	BLANK	02/21/19 00:00	1.0000	2.1898	1006.8919	515.0000	113.55	3.00^	1.00
03	DUP	BC 29A	02/14/19 09:35	1.0000	2.1902	1007.0759	485.0000	106.91	3.00^	1.00
04	DO	BC 29A	02/14/19 09:35	1.0000	2.1922	1007.9955	412.0000	90.74	3.00^	1.00
05	TRG	BC 29B	02/14/19 10:45	1.0000	2.1904	1007.1678	525.0000	115.72	2.74	1.00
06	TRG	BC 20	02/14/19 12:25	1.0000	2.1886	1006.3402	503.0000	110.96	3.00^	1.00
07	TRG	BC 18	02/14/19 14:55	1.0000	2.1853	1004.8228	352.0000	77.77	2.77	1.00
08	TRG	BC 19	02/14/19 15:40	1.0000	2.1840	1004.2250	448.0000	99.04	3.00^	1.00
09	TRG	BC 17A	02/15/19 07:55	1.0000	2.1787	1001.7880	688.0000	152.46	3.00^	1.00
10	TRG	BC 17B	02/15/19 11:00	1.0000	2.1799	1002.3398	699.0000	154.82	2.82	1.00

33-42

Spike and Tracer Worksheet

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
19-02131	1	Ra226	3/8/2019 8:27	JHARVEY		

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	*Sol #*	*Activity dpm/g*	*Solution Date*	*Approx Addition*	*Volume Used (g)*	*Volume Used (g)*	*Volume Used (g)*	*Volume Used (g)*	*Known pCi*	*Error Estimate*	*Added pCi*	*Error Estimate*	*Known pCi*	*Error Estimate*	*Added pCi*	*Error Estimate*
Ra-226	Ra-5b	43.960	3/8/2019	0.500	0.5053				10.01	0.460	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	*Isotope*	*Sol #*	*Activity dpm/g*	*Solution Date*	*Volume Used (g)*	*Approx Addition*
01	Ba-133	Ba-6a	459.810	3/8/2019	2.1894	2.2000
02	Ba-133	Ba-6a	459.810	3/8/2019	2.1898	2.2000
03	Ba-133	Ba-6a	459.810	3/8/2019	2.1902	2.2000
04	Ba-133	Ba-6a	459.810	3/8/2019	2.1922	2.2000
05	Ba-133	Ba-6a	459.810	3/8/2019	2.1904	2.2000
06	Ba-133	Ba-6a	459.810	3/8/2019	2.1886	2.2000
07	Ba-133	Ba-6a	459.810	3/8/2019	2.1853	2.2000
08	Ba-133	Ba-6a	459.810	3/8/2019	2.1840	2.2000
09	Ba-133	Ba-6a	459.810	3/8/2019	2.1787	2.2000
10	Ba-133	Ba-6a	459.810	3/8/2019	2.1799	2.2000

Balance Printer Tapes

Tracer

LCS

Matrix Spike

0053

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 3/8/2019 9:01 AM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
19-02131	1	Ra226	liters	3/6/2019	JHARVEY

Lab Fraction	Michael Pisani & Associates, Inc. Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	BC 29A	DUP					1.0000E+00	1.0000E+00				
04	BC 29A	DO					1.0000E+00	1.0000E+00				
05	BC 29B	TRG					1.0000E+00	1.0000E+00				
06	BC 20	TRG					1.0000E+00	1.0000E+00				
07	BC 18	TRG					1.0000E+00	1.0000E+00				
08	BC 19	TRG					1.0000E+00	1.0000E+00				
09	BC 17A	TRG					1.0000E+00	1.0000E+00				
10	BC 17B	TRG					1.0000E+00	1.0000E+00				

Comments	

0054

Technician: JHarvey Date: 3/8/19

Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
19-02131	**1**	**Ra226**			**JBAILEY**

TRetec	Michael Pisani & Associates, Inc.	Sample	Carrier Data	Filter Data			Gravimetric
Fraction	Client ID	Type	Carrier Added (ml)	Filter Tare (g)	Filter Final (g)	Filter Net (g)	% Recovery
01	LCS	LCS		0.0199	0.0305	**0.0106**	
02	BLANK	MBL		0.0199	0.0307	**0.0108**	
03	DUP	DUP		0.0196	0.0287	**0.0091**	
04	BC 29A	DO		0.0197	0.0289	**0.0092**	
05	BC 29B	TRG		0.0197	0.0276	**0.0079**	
06	BC 20	TRG		0.0198	0.0290	**0.0092**	
07	BC 18	TRG		0.0202	0.0282	**0.0080**	
08	BC 19	TRG		0.0201	0.0293	**0.0092**	
09	BC 17A	TRG		0.0199	0.0291	**0.0092**	
10	BC 17B	TRG		0.0204	0.0286	**0.0082**	

0055

Technician: JB Date: 3/13/19

KD 3/13/19

Apex-Alpha™

Sample Description: SPIKE
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 01
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_033
Chamber Serial Number: 04026479A
Detector Serial Number: 91132
Env. Background: System Bkgd 238450
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 3/13/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:12 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1603 +/- 0.0028 on 2/22/2019 8:51:55 AM
Effective Efficiency: 0.1603 +/- 0.0028

Control Certificate Name: Ra226_Ra-5b
Chem. Recov. of Control: RA-226 0.316026 +/- 0.025392
Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

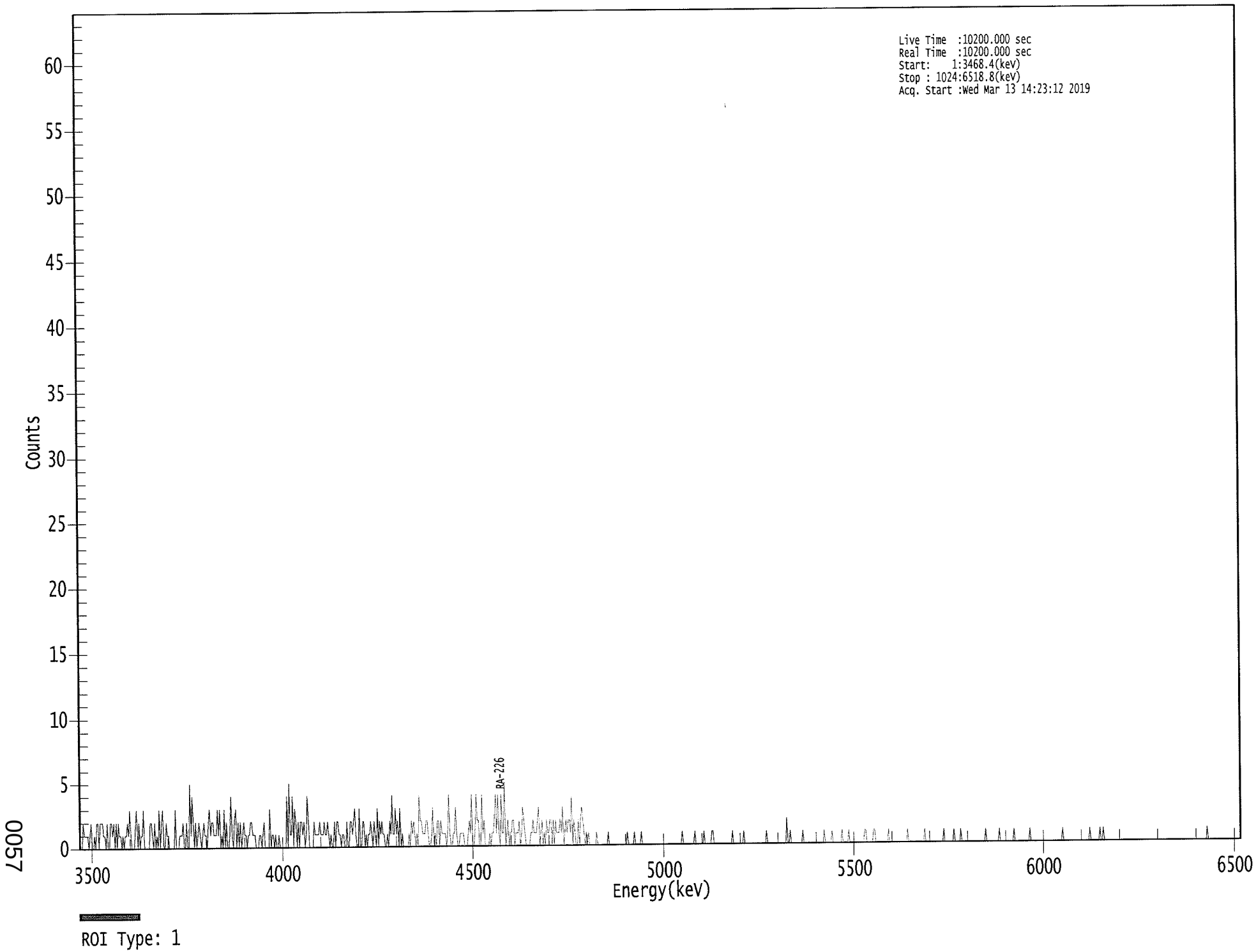
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.537	9.98	65.65	1.02	0.00E+000	3.0
RA-226	4.573	191.32	14.20	0.68	0.00E+000	3.4

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.972	5685.50*	5.20E-001 +/- 3.42E-001	3.28E-001 +/- 1.13E-002
RA-226	0.943	4785.00*	9.49E+000 +/- 1.39E+000	2.80E-001 +/- 9.61E-003

AG 3/14/19

0000236761.CNF



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

Sample Title: 01

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

369:	4	1	0	4	1	1	5	0

Sample Title: 01

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

801:	0	0	0	0	0	0	0	0

Sample Title: 01

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

Apex-Alpha™

KS 3/13/19

Sample Description: BLANK
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 02
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_034
Chamber Serial Number: 04026479B
Detector Serial Number: 91136
Env. Background: System Bkgd 238451
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 3/13/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:14 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1488 +/- 0.0026 on 2/22/2019 8:51:53 AM
Effective Efficiency: 0.1488 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

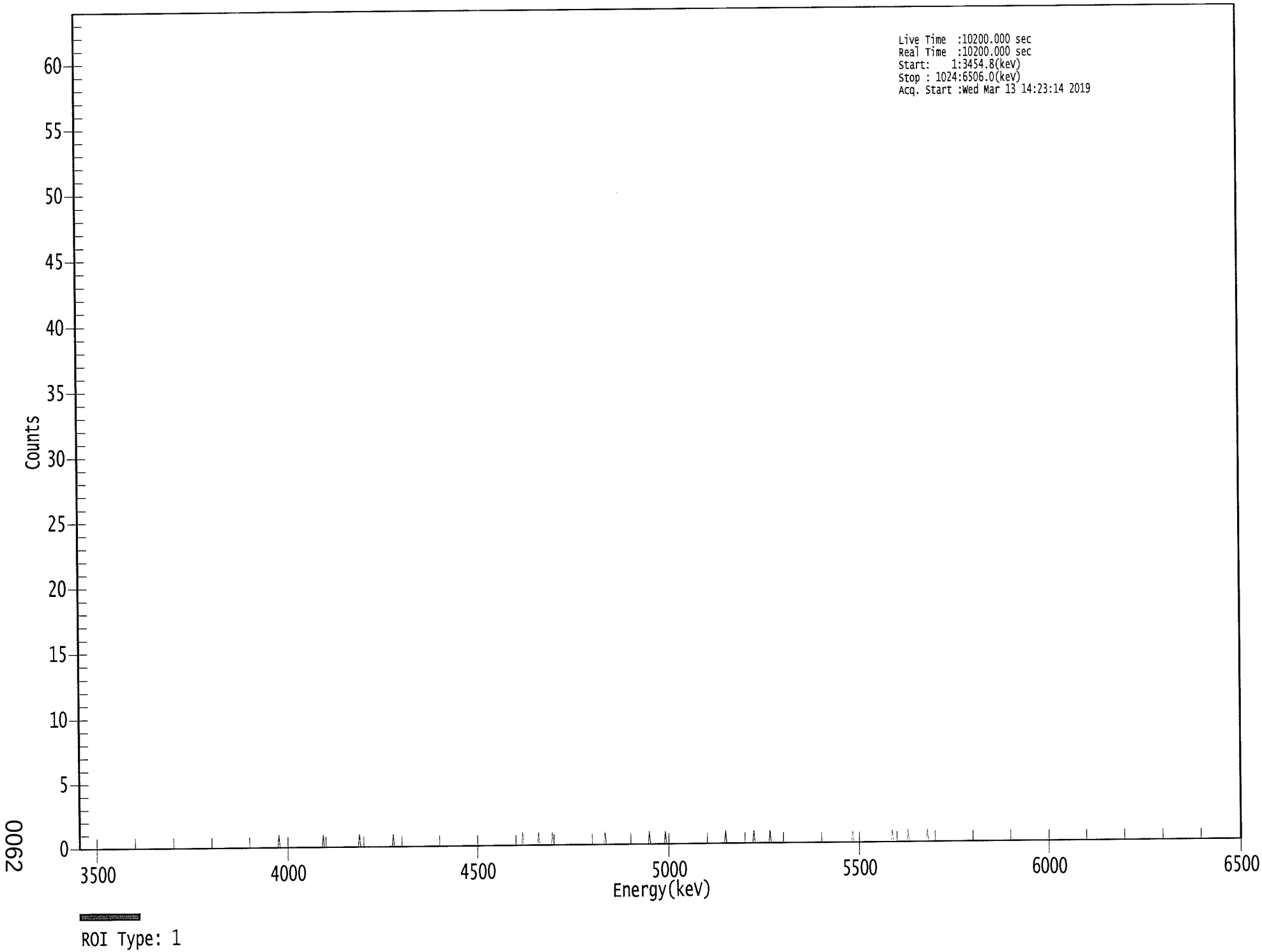
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.595	3.15	126.67	0.85	0.00E+000	3.0
RA-226	4.702	3.49	113.53	0.51	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.989	5685.50*	1.77E-001 +/- 2.24E-001	3.36E-001 +/- 1.16E-002
RA-226	0.991	4785.00*	1.86E-001 +/- 2.12E-001	2.80E-001 +/- 9.65E-003

AG 3/14/19

0000236752.CNF



0062

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

Sample Title: 02

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

369:	0	0	0	0	0	0	0	0

Sample Title: 02

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

801:	0	0	0	0	0	0	0	0

Sample Title: 02

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

Apex-Alpha™

ICB 3/13/19

Sample Description: BC 29A DUP
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 03
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_035
Chamber Serial Number: 04026477A
Detector Serial Number: 58771
Env. Background: System Bkgd 238452
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 2/14/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:16 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1265 +/- 0.0023 on 2/22/2019 8:51:52 AM
Effective Efficiency: 0.1265 +/- 0.0023

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

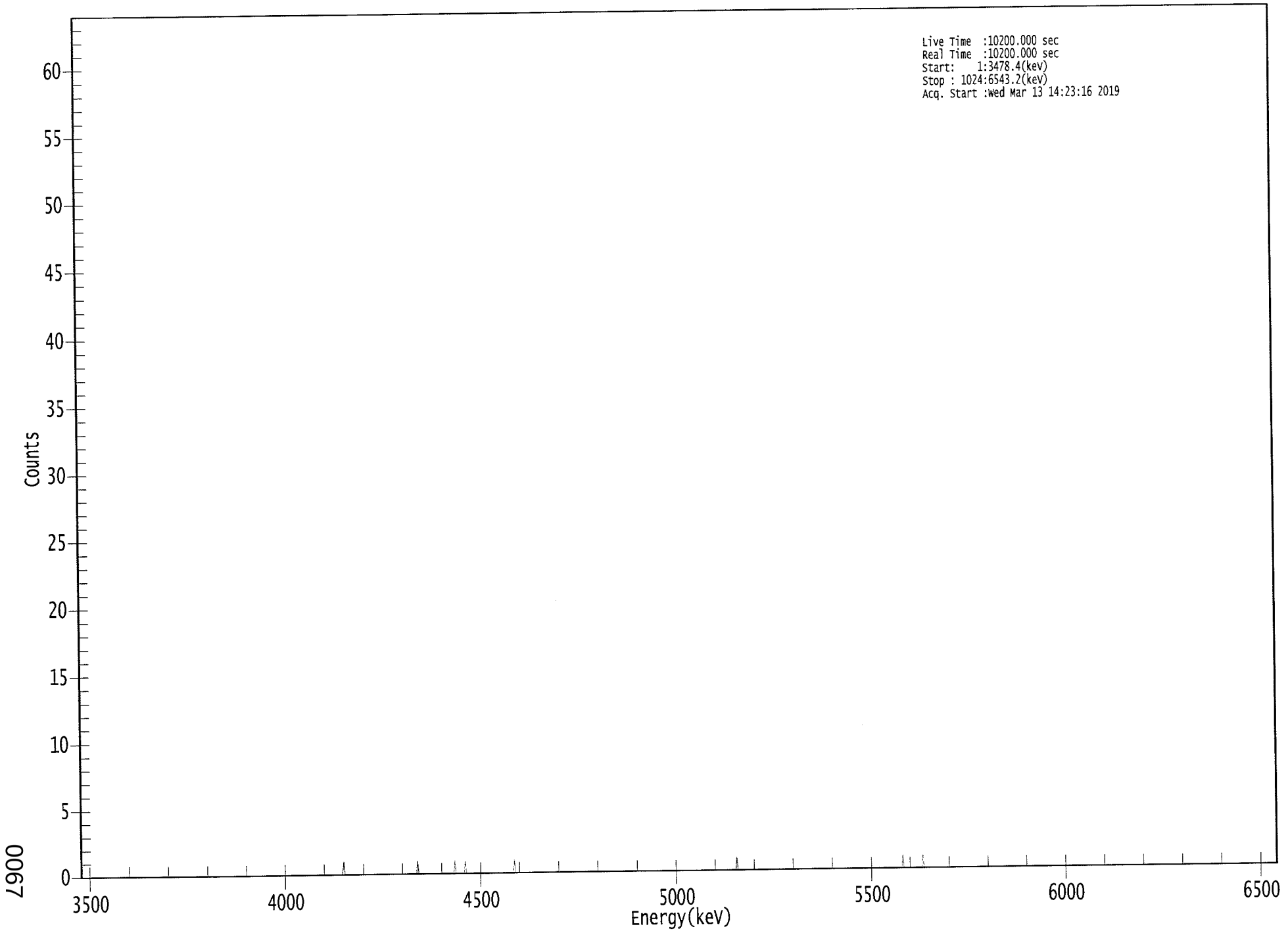
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.607	0.47	626.93	1.53	0.00E+000	3.0
RA-226	4.494	0.11	3329.3	2.89	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.992	5685.50*	3.13E-002 +/- 1.96E-001	4.74E-001 +/- 1.68E-002
RA-226	0.895	4785.00*	6.91E-003 +/- 2.30E-001	5.50E-001 +/- 1.95E-002

AG 3/14/19

0000236758.CNF



ROI Type: 1

0067

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

Sample Title: 03

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

369:	0	0	1	0	0	0	0	0

Sample Title: 03

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

801:	0	0	0	0	0	0	0	0

Sample Title: 03

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

Apex-Alpha™

Sample Description:	BC 29A
Spectrum File:	\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification:	1902131A-RA
Sample Identification:	04
Sample Geometry:	Shelf 2
Procedure Description:	Ra
Detector Name:	Alpha_036
Chamber Serial Number:	04026477B
Detector Serial Number:	84167
Env. Background:	System Bkgd 238453
Reagent Blank:	<not performed>
Sample Size:	1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor:	3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time:	2/14/2019 11:41:27 AM
Acquisition Date/Time:	3/13/2019 2:23:18 PM
Acquisition Live Time:	170.0 minutes
Acquisition Real Time:	170.0 minutes
Chem. Recovery Factor:	0.9074 +/- 0.0000
Counting Efficiency:	0.1687 +/- 0.0029 on 2/22/2019 8:51:50 AM
Effective Efficiency:	0.1531 +/- 0.0027
Peak Match Tolerance:	0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.431	1.32	215.97	0.68	0.00E+000	3.0
RA-226	4.827	0.15	1397.8	0.85	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.919	5685.50*	7.27E-002 +/- 1.57E-001	3.11E-001 +/- 1.06E-002
RA-226	0.998	4785.00*	7.79E-003 +/- 1.09E-001	3.11E-001 +/- 1.06E-002

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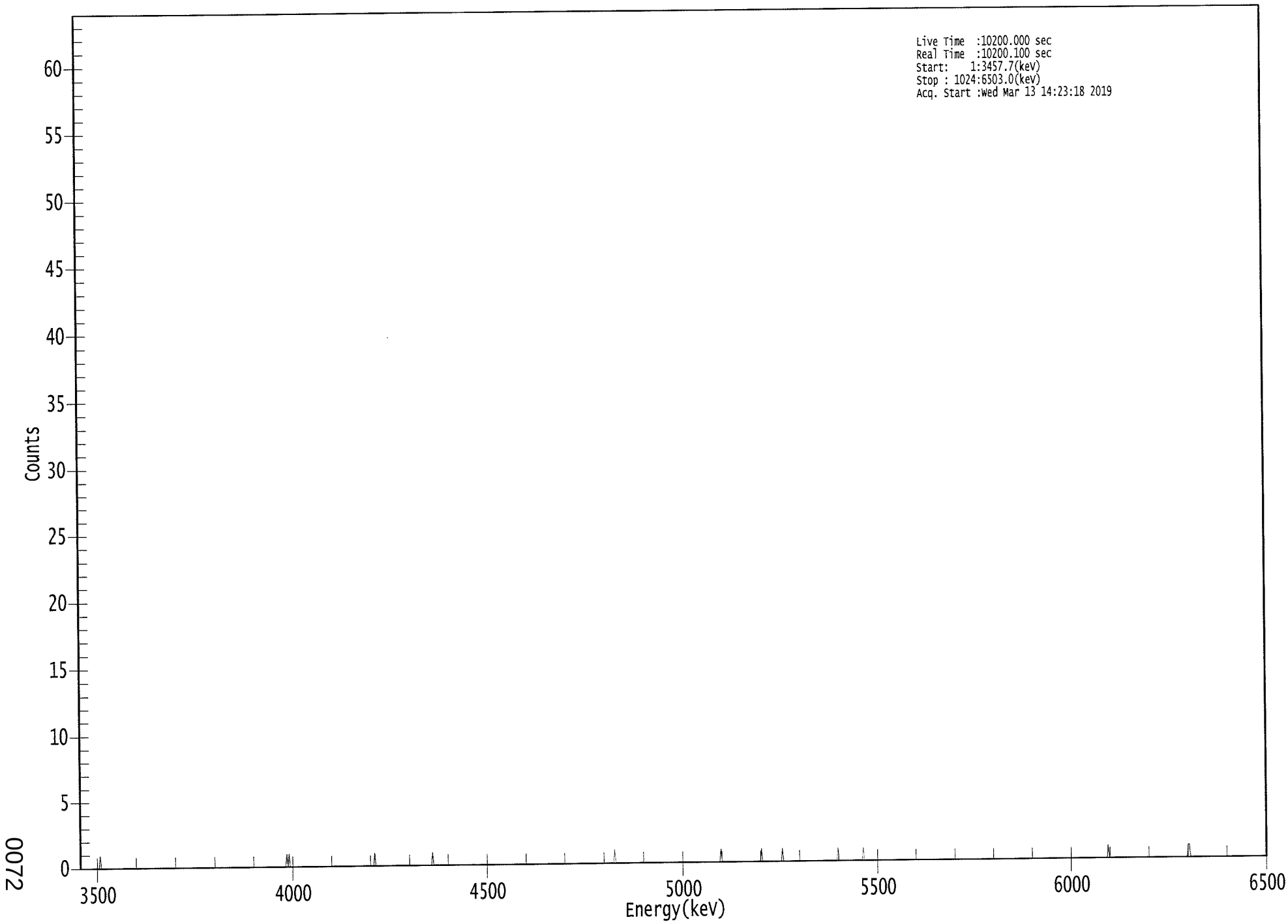
0000236754.CNF



ROI Type: 1

0072

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

Sample Title: 04

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

369:	0	0	0	0	0	0	0	0

Sample Title: 04

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

801:	0	0	0	0	0	0	0	0

Sample Title: 04

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	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	1	1	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

KD 3/13/19

Sample Description: BC 29B
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 05
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_037
Chamber Serial Number: 04026478A
Detector Serial Number: 91133
Env. Background: System Bkgd 238454
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.740E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 2/14/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:20 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1544 +/- 0.0027 on 2/22/2019 8:51:49 AM
Effective Efficiency: 0.1544 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.456	0.98	294.85	1.02	0.00E+000	3.0
RA-226	4.601	31.66	35.05	0.34	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.933	5685.50*	4.89E-002 +/- 1.44E-001	3.14E-001 +/- 1.08E-002
RA-226	0.957	4785.00*	1.49E+000 +/- 5.24E-001	2.25E-001 +/- 7.72E-003

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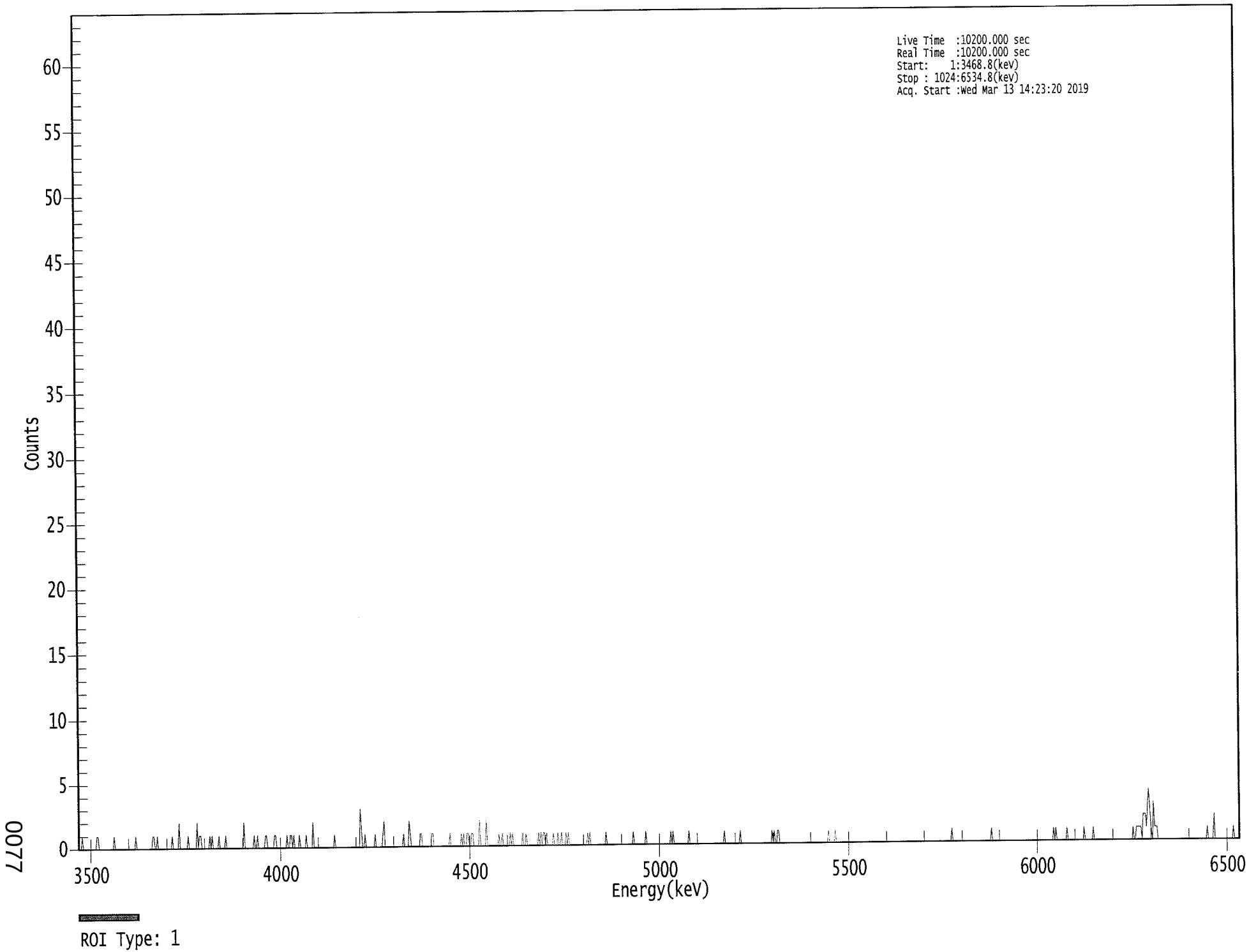
0000236755.CNF



0077

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

Sample Title: 05

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

369:	0	0	1	0	0	1	0	0

Sample Title: 05

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

801:	0	0	0	0	1	0	0	0

Sample Title: 05

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	1	0	1	0	0
865:	0	0	0	0	0	0	0	1
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	1	0
889:	0	0	0	0	0	0	1	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	1	0	0	1	1	1	1
937:	1	0	2	2	2	1	3	4
945:	2	1	0	3	1	1	1	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	1	0	0	0	0	0
1001:	2	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	1	0	0	0	0	0	0

Apex-Alpha™

KB 3/13/19

Sample Description: BC 20
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 06
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_038
Chamber Serial Number: 04026478B
Detector Serial Number: 91134
Env. Background: System Bkgd 238455
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 2/14/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:22 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1461 +/- 0.0026 on 2/22/2019 8:51:47 AM
Effective Efficiency: 0.1461 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

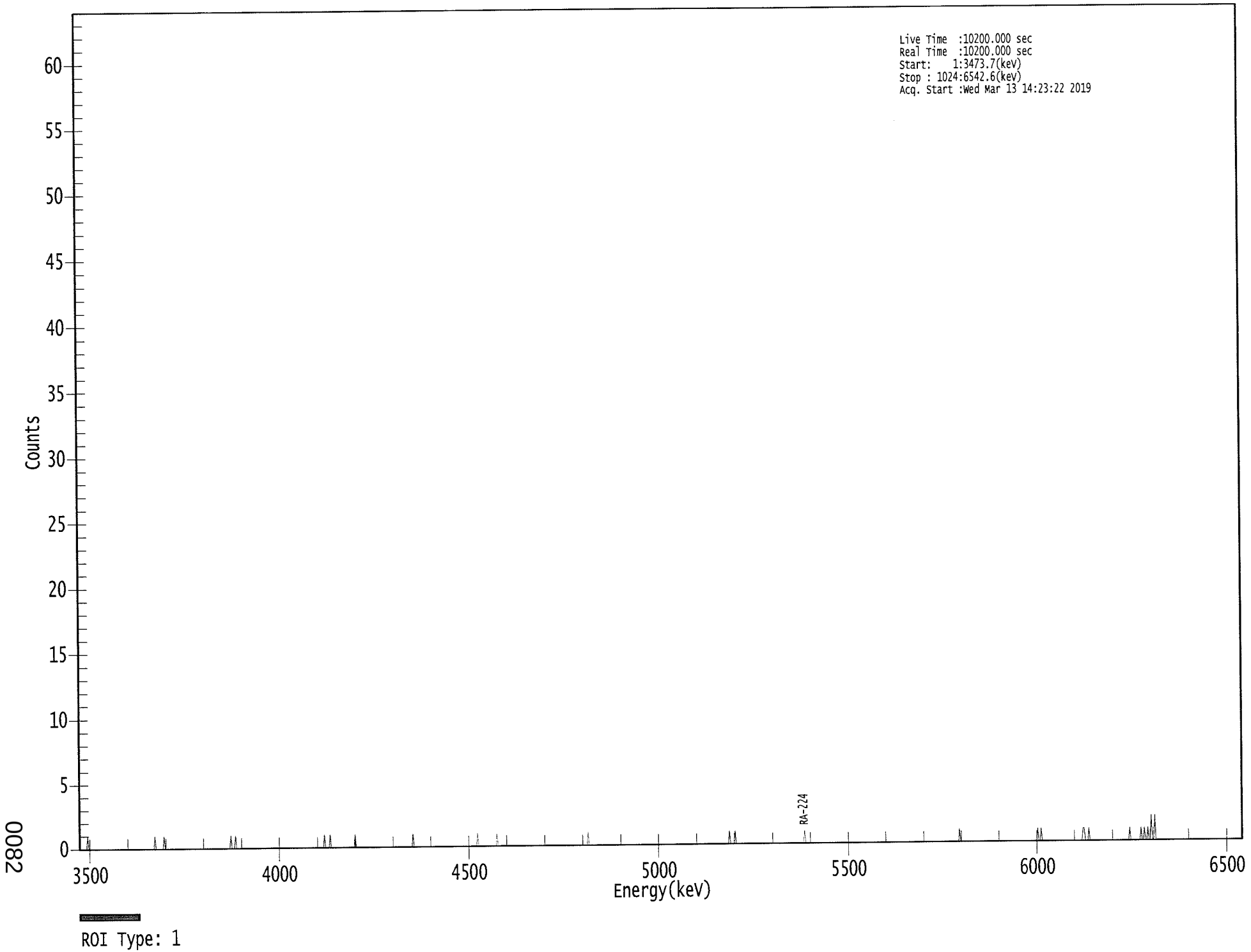
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.385	0.83	239.53	0.17	0.00E+000	3.0
RA-226	4.638	2.83	120.53	0.17	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.889	5685.50*	4.79E-002 +/- 1.15E-001	2.41E-001 +/- 8.36E-003
RA-226	0.972	4785.00*	1.54E-001 +/- 1.86E-001	2.27E-001 +/- 7.84E-003

AG 3/14/19

0000236756.CNF



2800

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

Sample Title: 06

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	1
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	1	0	0	0	0	0
73:	0	0	1	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	1	0	0
137:	0	1	0	0	0	0	0	0
145:	0	0	0	0	0	0	0	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	0	0	0	0	0
169:	0	0	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	1
217:	0	0	0	0	1	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	1	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	1	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	1	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	1

369:	0	0	0	0	0	0	0	0

Sample Title: 06

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

801:	0	0	0	0	0	0	0	0

Sample Title: 06

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	1	0	0	1	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	1	1	0	0	0
889:	1	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	1	0	0	0
929:	0	0	0	0	0	0	1	0
937:	0	1	0	0	1	0	0	2
945:	0	0	2	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	1

KB 3/13/19

Apex-Alpha™

Sample Description: BC18
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 07
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_039
Chamber Serial Number: 06027396A
Detector Serial Number: 83109
Env. Background: System Bkgd 238456
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.770E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 2/14/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:24 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.7777 +/- 0.0000
Counting Efficiency: 0.1503 +/- 0.0026 on 2/22/2019 8:51:44 AM
Effective Efficiency: 0.1169 +/- 0.0021

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.485	0.79	455.84	2.21	0.00E+000	3.0
RA-226	4.560	4.98	97.79	1.02	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.949	5685.50*	5.26E-002 +/- 2.40E-001	5.33E-001 +/- 1.84E-002
RA-226	0.936	4785.00*	3.13E-001 +/- 3.06E-001	3.96E-001 +/- 1.36E-002

AG
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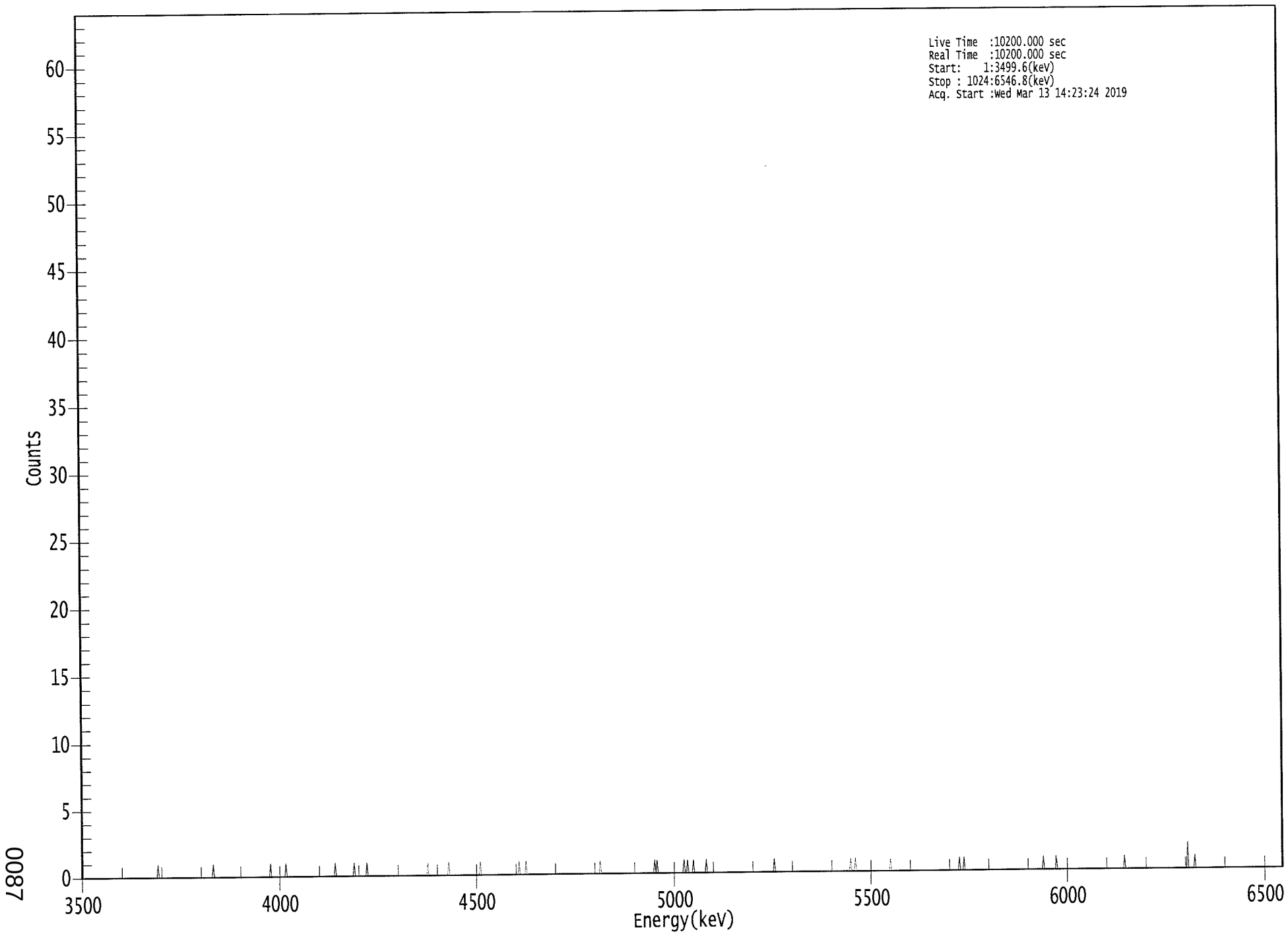
0000236759.CNF



0087

ROI Type: 1

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

Sample Title: 07

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	1	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	1
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:	1	0	0	0	0	0	0	0
169:	0	0	0	0	0	1	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	1
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	1
233:	0	0	0	0	0	0	0	0
241:	0	0	1	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	1	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	1	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	1	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	1	0	0	0

Sample Title: 07

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

801:	0	0	0	0	0	0	0	0

Sample Title: 07

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	1	0	0	0	0
825:	0	0	0	0	0	0	1	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	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:	1	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	2	0
945:	0	0	0	0	1	0	0	0
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

KB 3/13/19

Apex-Alpha™

Sample Description: BC 19
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 08
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_040
Chamber Serial Number: 06027396B
Detector Serial Number: 91135
Env. Background: System Bkgd 238457
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 2/14/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:27 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.9904 +/- 0.0000
Counting Efficiency: 0.1606 +/- 0.0028 on 2/22/2019 8:51:43 AM
Effective Efficiency: 0.1591 +/- 0.0028

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

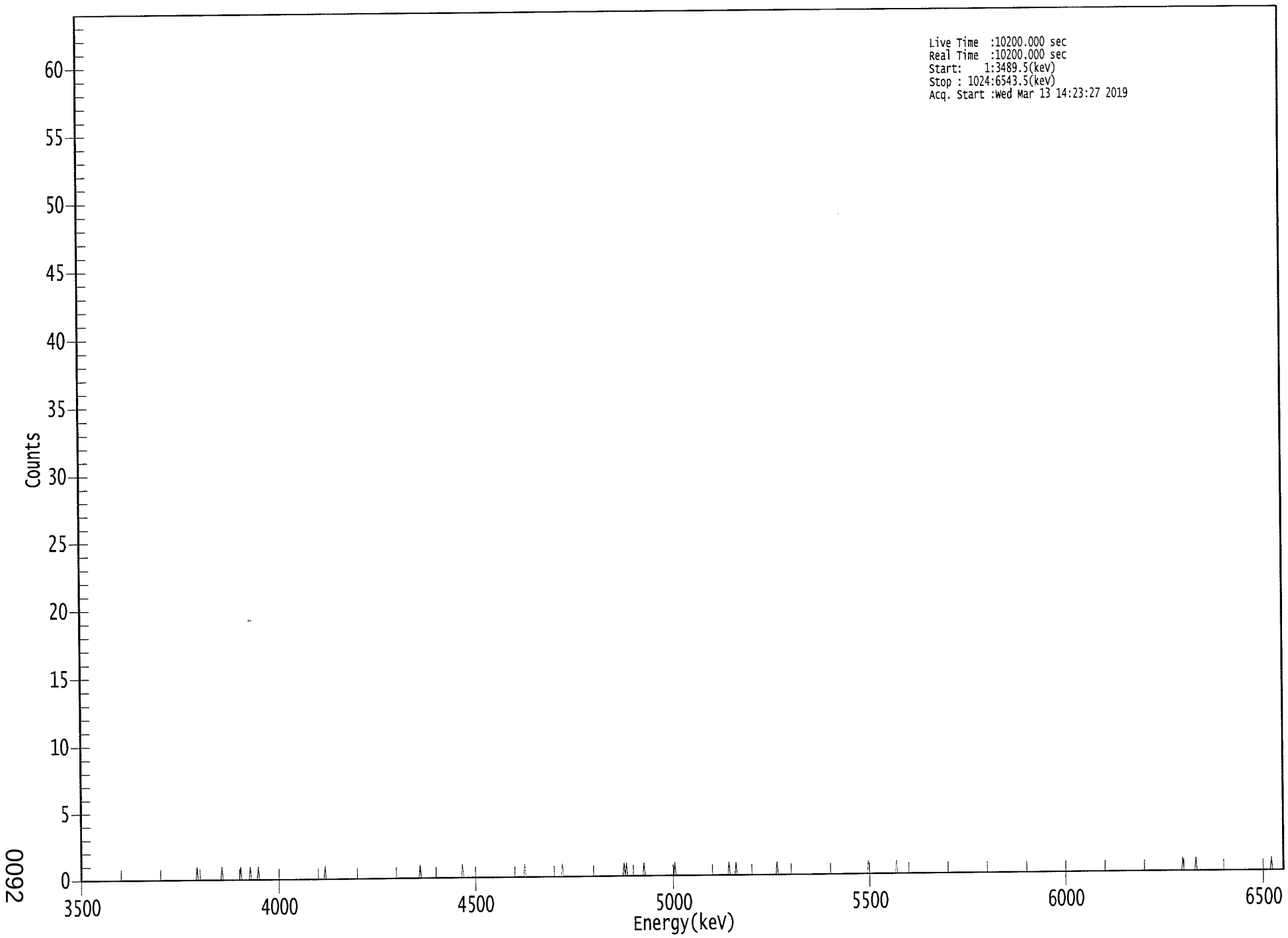
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.523	-0.55	555.92	2.55	0.00E+000	3.0
RA-226	4.594	-1.59	239.67	4.59	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.966	5685.50*	-2.92E-002 +/- 1.62E-001	4.45E-001 +/- 1.52E-002
RA-226	0.954	4785.00*	-7.95E-002 +/- 1.90E-001	5.16E-001 +/- 1.76E-002

AG 3/14/19

0000236760.CNF



2600

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

Sample Title: 08

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	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	1	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	1
137:	0	0	0	0	0	0	0	1
145:	0	0	0	0	0	0	1	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	1
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	1	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	1	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 08

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

801:	0	0	0	0	0	0	0	0

Sample Title: 08

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	1	0	0	0	0	0	0
945:	0	0	0	0	1	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	1	0	0	0
1017:	0	0	0	0	0	0	0	0

KB 3/13/19

Apex-Alpha™

Sample Description: BC 17A
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 09
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_041
Chamber Serial Number: 05026930A
Detector Serial Number: 91087
Env. Background: System Bkgd 238458
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 2/15/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:29 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1659 +/- 0.0029 on 2/22/2019 8:51:41 AM
Effective Efficiency: 0.1659 +/- 0.0029

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

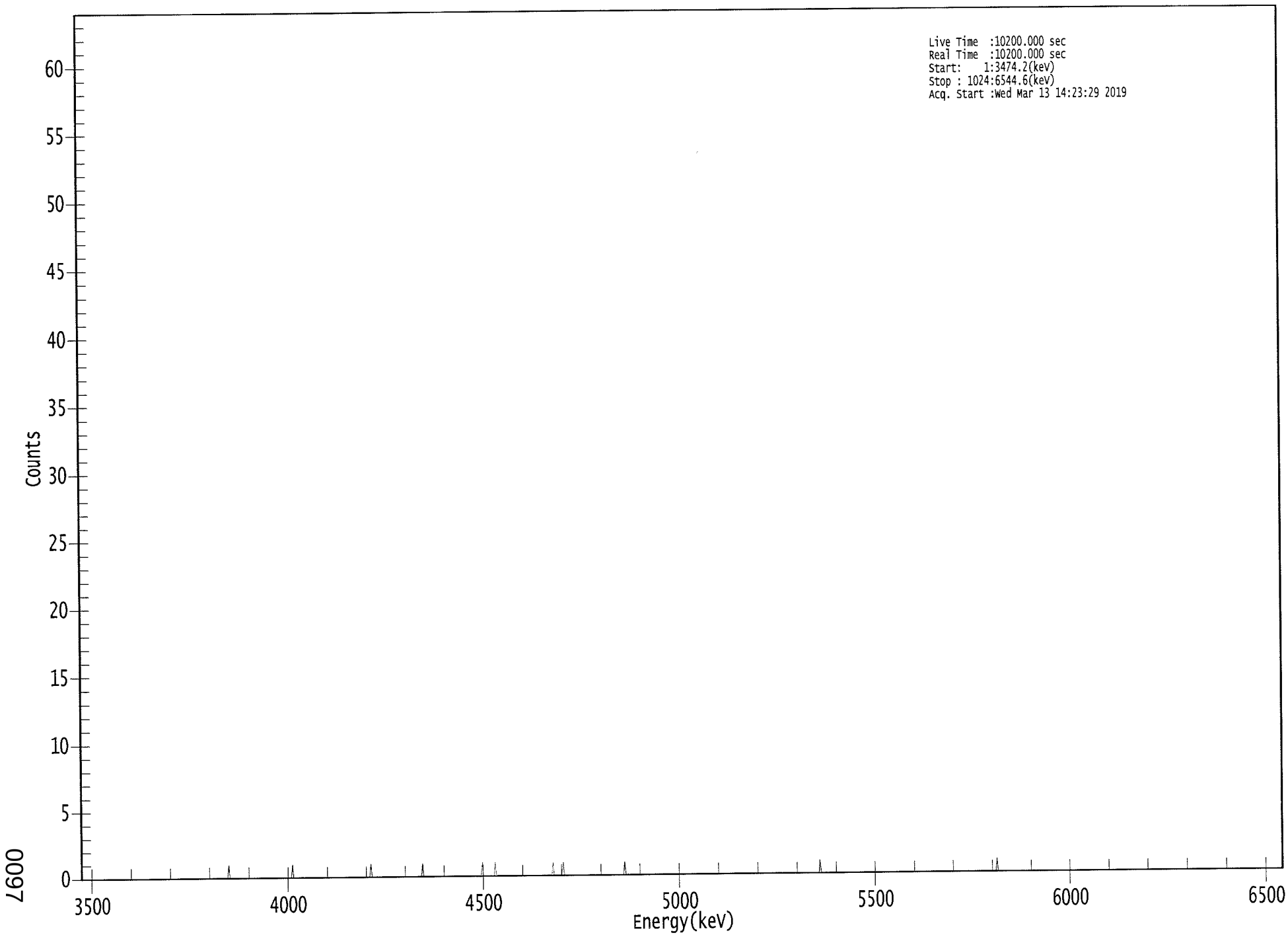
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.530	-0.51	400.63	0.51	0.00E+000	0.0
RA-226	4.603	2.47	163.78	1.53	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.969	5685.50*	-2.59E-002 +/- 1.04E-001	2.67E-001 +/- 9.09E-003
RA-226	0.958	4785.00*	1.18E-001 +/- 1.94E-001	3.41E-001 +/- 1.16E-002

AG 3/14/19

0000236757.CNF



ROI Type: 1

0097

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

Sample Title: 09

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	0	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	0	0	0	0	0	0	0	0
121:	0	0	0	0	0	1	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	1	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	1	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	1	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	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	1	0	0
345:	0	0	0	0	0	0	0	0
353:	1	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 09

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

801:	0	0	0	0	0	0	0	0

Sample Title: 09

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

Apex-Alpha™

KG 3/13/19

Sample Description: BC 17B
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002367
Batch Identification: 1902131A-RA
Sample Identification: 10
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_042
Chamber Serial Number: 05026930B
Detector Serial Number: 84185
Env. Background: System Bkgd 238459
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.820E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 2/15/2019 11:41:27 AM
Acquisition Date/Time: 3/13/2019 2:23:32 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1620 +/- 0.0028 on 2/22/2019 8:51:39 AM
Effective Efficiency: 0.1620 +/- 0.0028

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

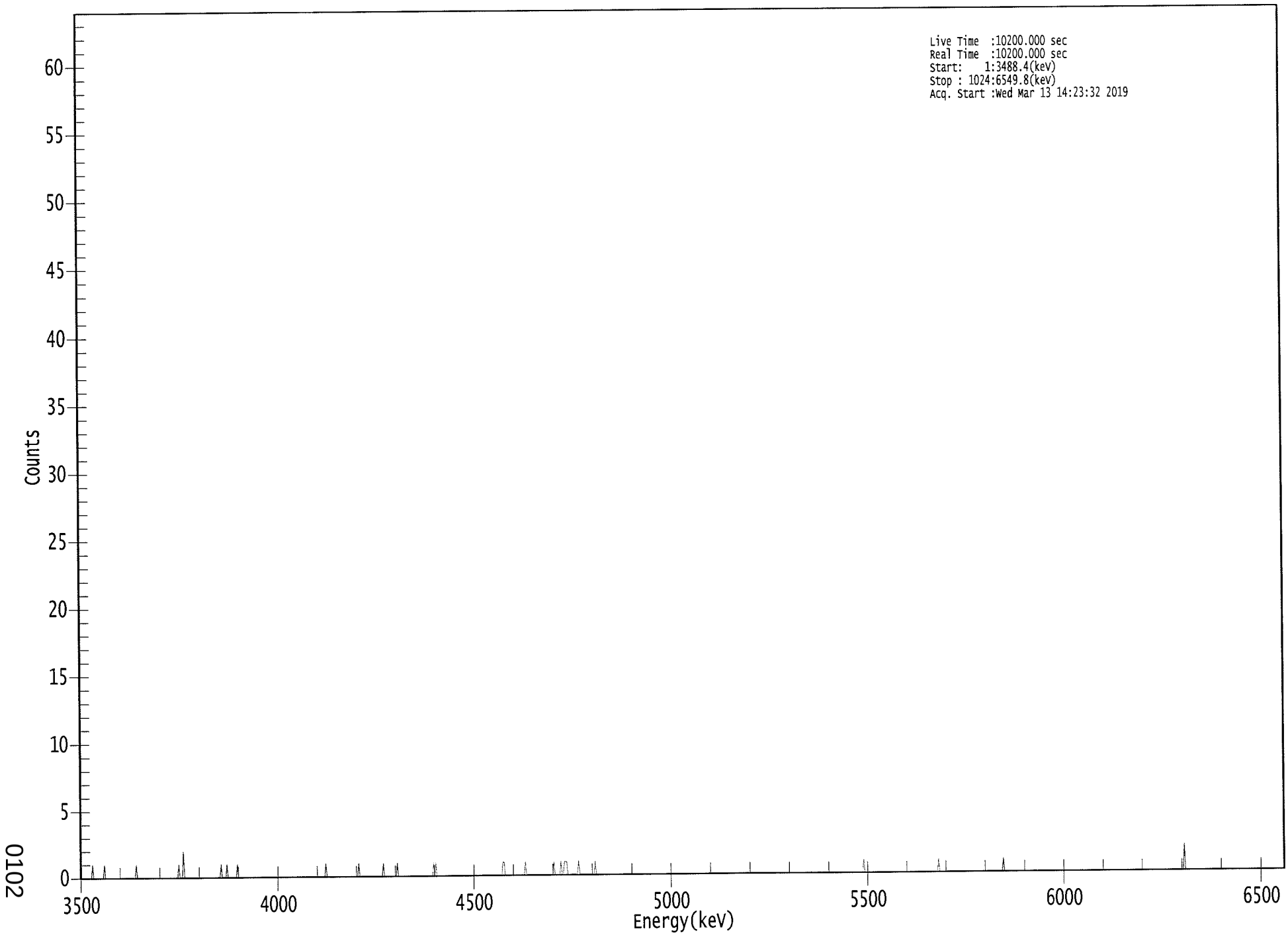
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.574	-1.06	293.54	3.06	0.00E+000	3.0
RA-226	4.637	10.30	66.71	1.70	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.984	5685.50*	-5.19E-002 +/- 1.52E-001	4.37E-001 +/- 1.49E-002
RA-226	0.972	4785.00*	4.75E-001 +/- 3.17E-001	3.39E-001 +/- 1.15E-002

AG 3/14/19

0000236751.CNF



0102

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

Sample Title: 10

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	1	0	0	0	0	0
17:	0	0	0	0	1	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	1
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	1	0	0	0	2
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	1	0	0	0
129:	0	0	0	0	0	1	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:	1	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	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	1	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	1	0	1	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	1
361:	1	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 10

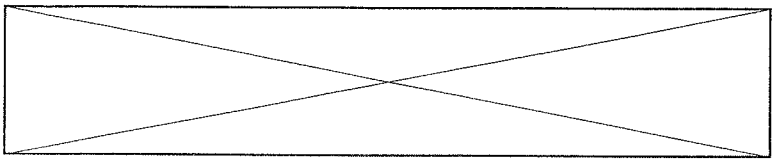
Channel								
377:	0	0	1	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	1	0	0	0	0	0
409:	1	0	0	1	1	1	0	0
417:	0	0	0	0	0	0	0	1
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	1	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0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

801:	0	0	0	0	0	0	0	0

Sample Title: 10

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	0	0	0	0	0	0	0
889:	0	0	0	0	0	0	0	0
897:	0	0	0	0	0	0	0	0
905:	0	0	0	0	0	0	0	0
913:	0	0	0	0	0	0	0	0
921:	0	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	2	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

3/13/2019 5:37:10 AM



QA SUMMARY REPORT

Review Of QA Results - Pulser Check

Date : 3/13/2019
Time : 5:37:10 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_001	21f	ALL	Not Done	
Alpha_002	21f	ALL	Not Done	
Alpha_003	21f	ALL	Passed	3/13/2019 5:23:14 AM
Alpha_004	21f	ALL	Passed	3/13/2019 5:23:15 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	3/13/2019 5:23:15 AM
Alpha_011	21f	ALL	Passed	3/13/2019 5:23:16 AM
Alpha_012	21f	ALL	Passed	3/13/2019 5:23:17 AM
Alpha_013	21f	ALL	Not Done	
Alpha_014	21f	ALL	Passed	3/13/2019 5:23:18 AM
Alpha_015	21f	Peak Energy	Action	3/13/2019 5:23:19 AM
Alpha_016	21f	ALL	Not Done	
Alpha_033	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:20 AM
Alpha_034	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:21 AM
Alpha_035	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:23 AM
Alpha_036	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:25 AM
Alpha_037	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:27 AM
Alpha_038	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:28 AM
Alpha_039	Alpha Analyst100DC	Peak FWHM	Action	3/13/2019 5:23:30 AM
Alpha_040	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:32 AM
Alpha_041	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:34 AM
Alpha_042	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:37 AM
Alpha_043	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:39 AM
Alpha_044	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:41 AM
Alpha_045	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:44 AM
Alpha_046	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:47 AM
Alpha_047	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:49 AM
Alpha_048	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:51 AM
Alpha_049	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:54 AM
Alpha_050	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:56 AM
Alpha_051	Alpha Analyst100DC	ALL	Not Done	
Alpha_052	Alpha Analyst100DC	ALL	Not Done	
Alpha_053	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:23:59 AM
Alpha_054	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:24:02 AM
Alpha_055	Alpha Analyst100DC	Peak FWHM	Action	3/13/2019 5:24:05 AM
Alpha_056	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:24:07 AM
Alpha_057	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:24:10 AM
Alpha_058	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:24:13 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_059	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:24:16 AM
Alpha_060	Alpha Analyst100DC	ALL	Passed	3/13/2019 5:24:18 AM

APPROVED BY: KP

APPROVAL DATE: 3/13/19

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

Nuclide Library Title: Radium

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

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

* = key line

TOTALS: 3 Nuclides 3 Energy Lines

SECTION IX

ANALYTICAL DATA (RADIUM-228)

19-02131
Ra228
Run 1

Work Order	19-02131
Analysis Code	Ra228
Run	1
Date Received	2/21/2019
Lab Deadline	3/6/2019
Client	Michael Pisani & Associates, Inc.
Project	HERO LANDS
Report Level	4
Activity Units	pCi
Aliquot Units	l
Matrix	WA
Method	EPA 904.0
Instrument Type	Alpha/Beta GPC
Radiometric Tracer	Ba-133
Radiometric Sol#	Ba-6a
Tracer Act (dpm/g)	459.31
Carrier	Yttrium
Carrier Conc (mg/ml)	31.8

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		02/21/19 00:00	1.0000E+00
02	MBL	BLANK		02/21/19 00:00	1.0000E+00
03	DUP	BC 29A	42	02/14/19 09:35	1.0000E+00
04	DO	BC 29A	42	02/14/19 09:35	1.0000E+00
05	TRG	BC 29B	29	02/14/19 10:45	1.0000E+00
06	TRG	BC 20	37	02/14/19 12:25	1.0000E+00
07	TRG	BC 18	32	02/14/19 14:55	1.0000E+00
08	TRG	BC 19	32	02/14/19 15:40	1.0000E+00
09	TRG	BC 17A	37	02/15/19 07:55	1.0000E+00
10	TRG	BC 17B	43	02/15/19 11:00	1.0000E+00

0110

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

19-02131
Ra228
Run 1

Internal Fraction	Sample Desc	Tracer Aliquot (g)	Tracer Total ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	Grav Carrier Added (ml)	Grav Filter Tare (g)	Grav Filter Final (g)	Grav Filter Net (g)	Grav % Rec	Mean % Rec	SAF 1*	SAF 2*
01	LCS	2.1894	1005.6	793.0	175.06	2.150	0.0757	0.1440	0.0683	99.90	109.89	1.00	1.00
02	MBL	2.1898	1005.8	515.0	113.67	2.100	0.0757	0.1412	0.0655	98.08	107.89	1.00	1.00
03	DUP	2.1902	1006.0	485.0	107.03	2.000	0.0758	0.1373	0.0615	96.70	103.50	1.00	1.00
04	DO	2.1922	1006.9	412.0	90.84	2.050	0.0761	0.1402	0.0641	98.33	89.32	1.00	1.00
05	TRG	2.1904	1006.1	525.0	115.85	2.000	0.0759	0.1392	0.0633	99.53	109.48	1.00	1.00
06	TRG	2.1886	1005.2	503.0	111.08	2.000	0.0758	0.1386	0.0628	98.74	108.62	1.00	1.00
07	TRG	2.1853	1003.7	352.0	77.85	2.000	0.0757	0.1376	0.0619	97.33	75.77	1.00	1.00
08	TRG	2.1840	1003.1	448.0	99.15	2.000	0.0763	0.1380	0.0617	97.01	96.18	1.00	1.00
09	TRG	2.1787	1000.7	688.0	152.63	2.000	0.0763	0.1372	0.0609	95.75	105.33	1.00	1.00
10	TRG	2.1799	1001.2	699.0	154.98	2.050	0.0761	0.1406	0.0645	98.94	108.84	1.00	1.00

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

19-02131
Ra228
Run 1

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
02	MBL			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
03	DUP			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
04	DO			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
05	TRG			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
06	TRG			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
07	TRG			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
08	TRG			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
09	TRG			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY
10	TRG			03/14/19 12:07	JBAILEY	03/13/19 10:21	JBAILEY	03/14/19 12:12	JBAILEY

0112

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

Preliminary Data Report & Analytical Calculations

Work Order: 19-02131-Ra228-1

Client: Michael Pisani & Associates, Inc.
Eberline Analytical Work Order: 19-02131
Analysis Code: Ra228
Run: 1

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-228	LCS	LCS	pCi/l	8.36E+00	7.21E-01	8.67E-01	9.07E+00	92.18	OK		OK	
02	RA-228	MBL	BLANK	pCi/l	1.15E-01	3.88E-01	8.18E-01					OK	OK
03	RA-228	DUP	BC 29A	pCi/l	3.17E-01	4.41E-01	9.08E-01				NA	OK	
04	RA-228	DO	BC 29A	pCi/l	4.38E-01	4.89E-01	9.96E-01					OK	
05	RA-228	TRG	BC 29B	pCi/l	1.88E+00	4.28E-01	7.05E-01					OK	
06	RA-228	TRG	BC 20	pCi/l	4.20E-01	4.14E-01	8.39E-01					OK	
07	RA-228	TRG	BC 18	pCi/l	1.81E+00	5.47E-01	9.47E-01					OK	
08	RA-228	TRG	BC 19	pCi/l	1.24E+00	4.47E-01	8.14E-01					OK	
09	RA-228	TRG	BC 17A	pCi/l	4.83E-01	4.02E-01	8.07E-01					OK	
10	RA-228	TRG	BC 17B	pCi/l	6.32E-01	3.73E-01	7.25E-01					OK	

Client: Michael Pisani & Associates, Inc.
Eberline Analytical Work Order: 19-02131
Analysis Code: Ra228
Run: 1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	RA-228	LCS	02/21/19 00:00	1.00E+00	175.06	99.90	109.89	1.00	3/13/2019 10:21	3/14/2019 12:12
02	RA-228	MBL	02/21/19 00:00	1.00E+00	113.67	98.08	107.89	1.00	3/13/2019 10:21	3/14/2019 12:12
03	RA-228	DUP	02/14/19 09:35	1.00E+00	107.03	96.70	103.50	1.00	3/13/2019 10:21	3/14/2019 12:12
04	RA-228	DO	02/14/19 09:35	1.00E+00	90.84	98.33	89.32	1.00	3/13/2019 10:21	3/14/2019 12:12
05	RA-228	TRG	02/14/19 10:45	1.00E+00	115.85	99.53	109.48	1.00	3/13/2019 10:21	3/14/2019 12:12
06	RA-228	TRG	02/14/19 12:25	1.00E+00	111.08	98.74	108.62	1.00	3/13/2019 10:21	3/14/2019 12:12
07	RA-228	TRG	02/14/19 14:55	1.00E+00	77.85	97.33	75.77	1.00	3/13/2019 10:21	3/14/2019 12:12
08	RA-228	TRG	02/14/19 15:40	1.00E+00	99.15	97.01	96.18	1.00	3/13/2019 10:21	3/14/2019 12:12
09	RA-228	TRG	02/15/19 07:55	1.00E+00	152.63	95.75	105.33	1.00	3/13/2019 10:21	3/14/2019 12:12
10	RA-228	TRG	02/15/19 11:00	1.00E+00	154.98	98.94	108.84	1.00	3/13/2019 10:21	3/14/2019 12:12

Client	Eberline Analytical Work Order	Analysis Code	Run
Michael Pisani & Associates, Inc.	19-02131	Ra228	1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-228	LCS	03/14/19 13:48		LB4110A	A1	120	928	1.45	0.4803
02	RA-228	MBL	03/14/19 13:48		LB4110A	A3	120	185	1.45	0.4719
03	RA-228	DUP	03/14/19 13:48		LB4110A	A4	120	212	1.533333333	0.4548
04	RA-228	DO	03/14/19 13:48		LB4110A	B1	120	204	1.416666667	0.4626
05	RA-228	TRG	03/14/19 13:48		LB4110A	B4	120	305	1.05	0.4619
06	RA-228	TRG	03/14/19 13:48		LB4110A	C1	120	222	1.516666667	0.4667
07	RA-228	TRG	03/14/19 13:48		LB4110A	C2	120	224	0.883333333	0.4578
08	RA-228	TRG	03/14/19 13:48		LB4110A	C4	120	239	1.116666667	0.4692
09	RA-228	TRG	03/14/19 13:48		LB4110A	D1	120	223	1.466666667	0.4924
10	RA-228	TRG	03/14/19 13:48		LB4110A	D3	120	199	1.15	0.4719

Count Room Report
Client: Michael Pisani Associat

19-02131-Ra228-1 (pCi/l) in WA
Tracer ID: Ba-6a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	02/21/19 00:00	1.0000	2.1894	1005.6133	793.0000	175.06	1.00	1.00
02	MBL	BLANK	02/21/19 00:00	1.0000	2.1898	1005.7970	515.0000	113.67	1.00	1.00
03	DUP	BC 29A	02/14/19 09:35	1.0000	2.1902	1005.9808	485.0000	107.03	1.00	1.00
04	DO	BC 29A	02/14/19 09:35	1.0000	2.1922	1006.8994	412.0000	90.84	1.00	1.00
05	TRG	BC 29B	02/14/19 10:45	1.0000	2.1904	1006.0726	525.0000	115.85	1.00	1.00
06	TRG	BC 20	02/14/19 12:25	1.0000	2.1886	1005.2459	503.0000	111.08	1.00	1.00
07	TRG	BC 18	02/14/19 14:55	1.0000	2.1853	1003.7301	352.0000	77.85	1.00	1.00
08	TRG	BC 19	02/14/19 15:40	1.0000	2.1840	1003.1330	448.0000	99.15	1.00	1.00
09	TRG	BC 17A	02/15/19 07:55	1.0000	2.1787	1000.6987	688.0000	152.63	1.00	1.00
10	TRG	BC 17B	02/15/19 11:00	1.0000	2.1799	1001.2499	699.0000	154.98	1.00	1.00

Spike and Tracer Worksheet

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
19-02131	1	Ra228	3/14/2019 12:06	JBAILEY	JS	

LCS & Matrix Spikes					LCS	MS	LCSD	MSD	LCS		MS		LCSD		MSD	
Isotope	*Sol #*	*Activity dpm/g*	*Solution Date*	*Approx Addition*	*Volume Used (g)*	*Volume Used (g)*	*Volume Used (g)*	*Volume Used (g)*	*Known pCi*	*Error Estimate*	*Added pCi*	*Error Estimate*	*Known pCi*	*Error Estimate*	*Added pCi*	*Error Estimate*
Ra-228	Ra-12	50.280	3/14/2019	0.400	0.4004				9.07	0.462	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	*Isotope*	*Sol #*	*Activity dpm/g*	*Solution Date*	*Volume Used (g)*	*Approx Addition*
01	Ba-133	Ba-6a	459.310	3/14/2019	2.1894	2.2100
02	Ba-133	Ba-6a	459.310	3/14/2019	2.1898	2.2100
03	Ba-133	Ba-6a	459.310	3/14/2019	2.1902	2.2100
04	Ba-133	Ba-6a	459.310	3/14/2019	2.1922	2.2100
05	Ba-133	Ba-6a	459.310	3/14/2019	2.1904	2.2100
06	Ba-133	Ba-6a	459.310	3/14/2019	2.1886	2.2100
07	Ba-133	Ba-6a	459.310	3/14/2019	2.1853	2.2100
08	Ba-133	Ba-6a	459.310	3/14/2019	2.1840	2.2100
09	Ba-133	Ba-6a	459.310	3/14/2019	2.1787	2.2100
10	Ba-133	Ba-6a	459.310	3/14/2019	2.1799	2.2100

Balance Printer Tapes

Tracer

LCS

Matrix Spike

01117

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 3/8/2019 9:02 AM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
19-02131	1	Ra228	liters	3/6/2019	JHARVEY

Lab Fraction	Michael Pisani & Associates, Inc. Client ID	Sample Type	Muffle Data Ratio Post/Pre	Dilution Data No of Dils	Dil Factor	Ratio	Aliquot Data Aliquot	Net Equiv	MS Aliquot Data Aliquot	Net Equiv	H-3 Solids Only Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	BC 29A	DUP					1.0000E+00	1.0000E+00				
04	BC 29A	DO					1.0000E+00	1.0000E+00				
05	BC 29B	TRG					1.0000E+00	1.0000E+00				
06	BC 20	TRG					1.0000E+00	1.0000E+00				
07	BC 18	TRG					1.0000E+00	1.0000E+00				
08	BC 19	TRG					1.0000E+00	1.0000E+00				
09	BC 17A	TRG					1.0000E+00	1.0000E+00				
10	BC 17B	TRG					1.0000E+00	1.0000E+00				

Comments	

0118

Technician: J Harvey Date: 3/8/19

Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
19-02131	1	Ra228	Yttrium	31.8000	JBAILEY

TRetec	Michael Pisani & Associates, Inc.	Sample	Carrier Data	Filter Data			Gravimetric
Fraction	Client ID	Type	Carrier Added (ml)	Filter Tare (g)	Filter Final (g)	Filter Net (g)	% Recovery
01	LCS	LCS	2.1500	0.0757	0.1440	0.0683	99.90
02	BLANK	MBL	2.1000	0.0757	0.1412	0.0655	98.08
03	DUP	DUP	2.0000	0.0758	0.1373	0.0615	96.70
04	BC 29A	DO	2.0500	0.0761	0.1402	0.0641	98.33
05	BC 29B	TRG	2.0000	0.0759	0.1392	0.0633	99.53
06	BC 20	TRG	2.0000	0.0758	0.1386	0.0628	98.74
07	BC 18	TRG	2.0000	0.0757	0.1376	0.0619	97.33
08	BC 19	TRG	2.0000	0.0763	0.1380	0.0617	97.01
09	BC 17A	TRG	2.0000	0.0763	0.1372	0.0609	95.75
10	BC 17B	TRG	2.0500	0.0761	0.1406	0.0645	98.94

0119

Technician: _____ Date: 3 / 14 / 19

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
A1	1902131-01	43	928	120	1410	3/14/2019 1:48:08 PM
A3	1902131-02	13	185	120	1410	3/14/2019 1:48:08 PM
A4	1902131-03	25	212	120	1410	3/14/2019 1:48:08 PM
B1	1902131-04	33	204	120	1410	3/14/2019 1:48:08 PM
B4	1902131-05	13	305	120	1410	3/14/2019 1:48:08 PM
C1	1902131-06	26	222	120	1410	3/14/2019 1:48:08 PM
C2	1902131-07	14	224	120	1410	3/14/2019 1:48:09 PM
C4	1902131-08	30	239	120	1410	3/14/2019 1:48:09 PM
D1	1902131-09	27	223	120	1410	3/14/2019 1:48:09 PM
D3	1902131-10	12	199	120	1410	3/14/2019 1:48:09 PM

NB 3/14/19

GPC Detector Report
(ALL Backgrounds)

KP
3/14/19

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2017	3/14/2019	8.33E-02	P	-3.77E-02	1.00E-01	2.38E-01
LB4110A - A2	Alpha	11/2/2017	3/14/2019	2.50E-01	P	-4.08E-02	1.06E-01	2.53E-01
LB4110A - A3	Alpha	11/2/2017	3/14/2019	1.33E-01	P	-3.53E-02	1.07E-01	2.50E-01
LB4110A - A4	Alpha	11/2/2017	3/14/2019	2.00E-01	P	-4.29E-02	1.05E-01	2.54E-01
LB4110A - B1	Alpha	11/2/2017	3/14/2019	1.67E-01	P	-4.07E-02	1.28E-01	2.96E-01
LB4110A - B2	Alpha	11/2/2017	3/14/2019	2.83E-01	P	-2.31E-02	1.37E-01	2.97E-01
LB4110A - B3	Alpha	11/2/2017	3/14/2019	2.17E-01	P	-5.02E-02	8.13E-02	2.13E-01
LB4110A - B4	Alpha	11/2/2017	3/14/2019	1.33E-01	P	-4.15E-02	8.44E-02	2.10E-01
LB4110A - C1	Alpha	11/2/2017	3/14/2019	8.33E-02	P	-2.60E-02	8.73E-02	2.01E-01
LB4110A - C2	Alpha	11/2/2017	3/14/2019	5.00E-02	P	-3.85E-02	6.83E-02	1.75E-01
LB4110A - C3	Alpha	11/2/2017	3/14/2019	1.67E-02	P	-5.05E-02	6.86E-02	1.88E-01
LB4110A - C4	Alpha	11/2/2017	3/14/2019	1.33E-01	P	-3.80E-02	9.27E-02	2.23E-01
LB4110A - D1	Alpha	11/2/2017	3/14/2019	2.00E-01	P	-2.02E-02	1.48E-01	3.17E-01
LB4110A - D2	Alpha	11/2/2017	3/14/2019	1.00E-01	P	-2.41E-02	1.19E-01	2.61E-01
LB4110A - D3	Alpha	11/2/2017	3/14/2019	3.33E-02	P	-3.32E-02	1.05E-01	2.43E-01
LB4110A - D4	Alpha	11/2/2017	3/14/2019	1.00E-01	P	-8.68E-03	1.54E-01	3.16E-01
LB4110A - E1	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-4.29E-02	1.10E-01	2.62E-01
LB4110A - E2	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-3.09E-02	6.37E-02	1.58E-01
LB4110A - E3	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-8.81E-02	9.11E-02	2.70E-01
LB4110A - E4	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-4.55E-02	7.04E-02	1.86E-01
LB4110A - F1	Alpha	11/2/2017	3/14/2019	1.00E-01	P	-3.73E-02	7.23E-02	1.82E-01
LB4110A - F2	Alpha	11/2/2017	3/14/2019	0.00E+00	P	-3.94E-02	4.88E-02	1.37E-01
LB4110A - F3	Alpha	11/2/2017	3/14/2019	8.33E-02	P	-4.40E-02	5.88E-02	1.62E-01
LB4110A - F4	Alpha	11/2/2017	3/14/2019	6.67E-02	P	-3.74E-02	6.62E-02	1.70E-01
LB4110A - G1	Alpha	11/2/2017	3/14/2019	8.33E-02	P	-4.62E-02	6.42E-02	1.75E-01
LB4110A - G2	Alpha	11/2/2017	3/14/2019	5.00E-02	P	-4.14E-02	7.70E-02	1.95E-01
LB4110A - G3	Alpha	11/2/2017	3/14/2019	6.67E-02	P	-4.27E-02	8.15E-02	2.06E-01
LB4110A - G4	Alpha	11/2/2017	3/14/2019	1.00E-01	P	-3.88E-02	8.57E-02	2.10E-01

GPC Detector Report
(ALL Backgrounds)

KP 3/14/19

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2017	3/14/2019	1.45E+00	P	8.81E-01	1.38E+00	1.87E+00
LB4110A - A2	Beta	11/2/2017	3/14/2019	2.03E+00	F	9.53E-01	1.53E+00	2.10E+00
LB4110A - A3	Beta	11/2/2017	3/14/2019	1.45E+00	P	1.01E+00	1.49E+00	1.97E+00
LB4110A - A4	Beta	11/2/2017	3/14/2019	1.53E+00	P	9.74E-01	1.42E+00	1.88E+00
LB4110A - B1	Beta	11/2/2017	3/14/2019	1.42E+00	P	1.05E+00	1.53E+00	2.00E+00
LB4110A - B2	Beta	11/2/2017	3/14/2019	1.32E+00	P	6.59E-01	1.46E+00	2.27E+00
LB4110A - B3	Beta	11/2/2017	3/14/2019	1.42E+00	P	9.22E-01	1.36E+00	1.80E+00
LB4110A - B4	Beta	11/2/2017	3/14/2019	1.05E+00	P	7.36E-01	1.33E+00	1.92E+00
LB4110A - C1	Beta	11/2/2017	3/14/2019	1.52E+00	P	8.40E-01	1.27E+00	1.69E+00
LB4110A - C2	Beta	11/2/2017	3/14/2019	8.83E-01	P	-1.89E-01	1.21E+00	2.60E+00
LB4110A - C3	Beta	11/2/2017	3/14/2019	2.72E+00	F	2.21E-01	1.81E+00	3.39E+00
LB4110A - C4	Beta	11/2/2017	3/14/2019	1.12E+00	P	8.17E-01	1.24E+00	1.66E+00
LB4110A - D1	Beta	11/2/2017	3/14/2019	1.47E+00	P	8.88E-01	1.33E+00	1.76E+00
LB4110A - D2	Beta	11/2/2017	3/14/2019	2.17E+01	F	-2.62E+01	2.95E+00	3.21E+01
LB4110A - D3	Beta	11/2/2017	3/14/2019	1.15E+00	P	7.92E-01	1.26E+00	1.74E+00
LB4110A - D4	Beta	11/2/2017	3/14/2019	1.25E+00	P	9.61E-01	1.45E+00	1.93E+00
LB4110A - E1	Beta	11/2/2017	3/23/2018	3.33E-02	P	7.66E-01	1.32E+00	1.88E+00
LB4110A - E2	Beta	11/2/2017	3/23/2018	1.67E-02	P	5.45E-01	9.58E-01	1.37E+00
LB4110A - E3	Beta	11/2/2017	3/23/2018	6.67E-02	P	4.98E-01	1.20E+00	1.91E+00
LB4110A - E4	Beta	11/2/2017	3/23/2018	0.00E+00	P	5.67E-01	1.04E+00	1.50E+00
LB4110A - F1	Beta	11/2/2017	3/14/2019	1.30E+00	P	7.29E-01	1.30E+00	1.88E+00
LB4110A - F2	Beta	11/2/2017	3/14/2019	9.67E-01	P	4.46E-01	8.81E-01	1.32E+00
LB4110A - F3	Beta	11/2/2017	3/14/2019	1.38E+00	P	1.77E-01	1.16E+00	2.14E+00
LB4110A - F4	Beta	11/2/2017	3/14/2019	1.28E+00	P	5.29E-01	1.09E+00	1.65E+00
LB4110A - G1	Beta	11/2/2017	3/14/2019	1.33E+00	P	5.93E-01	1.28E+00	1.97E+00
LB4110A - G2	Beta	11/2/2017	3/14/2019	1.57E+00	P	1.05E+00	1.77E+00	2.48E+00
LB4110A - G3	Beta	11/2/2017	3/14/2019	1.32E+00	P	6.42E-01	1.40E+00	2.15E+00
LB4110A - G4	Beta	11/2/2017	3/14/2019	1.33E+00	P	-1.76E+00	1.48E+00	4.71E+00

GPC Detector Report
(ALL Efficiencies)

KP 3/14/19

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2017	3/14/2019	0.2263	P	0.2123	0.2257	0.2390
LB4110A - A2	Alpha	11/2/2017	3/14/2019	0.2033	P	0.1911	0.2101	0.2290
LB4110A - A3	Alpha	11/2/2017	3/14/2019	0.1904	P	0.1821	0.1992	0.2162
LB4110A - A4	Alpha	11/2/2017	3/14/2019	0.2215	P	0.2026	0.2251	0.2476
LB4110A - B1	Alpha	11/2/2017	3/14/2019	0.2284	P	0.2061	0.2238	0.2415
LB4110A - B2	Alpha	11/2/2017	3/14/2019	0.1984	P	0.1855	0.2004	0.2154
LB4110A - B3	Alpha	11/2/2017	3/14/2019	0.2370	P	0.2196	0.2350	0.2503
LB4110A - B4	Alpha	11/2/2017	3/14/2019	0.2276	P	0.2051	0.2228	0.2406
LB4110A - C1	Alpha	11/2/2017	3/14/2019	0.2043	P	0.1948	0.2071	0.2194
LB4110A - C2	Alpha	11/2/2017	3/14/2019	0.2176	P	-0.0417	0.2223	0.4863
LB4110A - C3	Alpha	11/2/2017	3/14/2019	0.2389	P	0.2246	0.2413	0.2579
LB4110A - C4	Alpha	11/2/2017	3/14/2019	0.2180	P	0.1993	0.2155	0.2317
LB4110A - D1	Alpha	11/2/2017	3/14/2019	0.2213	P	0.2092	0.2215	0.2339
LB4110A - D2	Alpha	11/2/2017	3/14/2019	0.2367	P	0.2224	0.2474	0.2725
LB4110A - D3	Alpha	11/2/2017	3/14/2019	0.2551	P	0.2292	0.2484	0.2676
LB4110A - D4	Alpha	11/2/2017	3/14/2019	0.1845	P	0.1715	0.1947	0.2179
LB4110A - E1	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1687	0.2258	0.2830
LB4110A - E2	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1518	0.2051	0.2584
LB4110A - E3	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1547	0.2075	0.2603
LB4110A - E4	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1747	0.2355	0.2963
LB4110A - F1	Alpha	11/2/2017	3/14/2019	0.2175	P	0.1532	0.2121	0.2710
LB4110A - F2	Alpha	11/2/2017	3/14/2019	0.1863	P	0.1405	0.1818	0.2231
LB4110A - F3	Alpha	11/2/2017	3/14/2019	0.2296	P	0.1762	0.2321	0.2880
LB4110A - F4	Alpha	11/2/2017	3/14/2019	0.2134	P	0.1586	0.2092	0.2599
LB4110A - G1	Alpha	11/2/2017	3/14/2019	0.1882	P	0.1787	0.1953	0.2119
LB4110A - G2	Alpha	11/2/2017	3/14/2019	0.1854	W	0.1835	0.1992	0.2150
LB4110A - G3	Alpha	11/2/2017	3/14/2019	0.2191	P	0.2024	0.2208	0.2391
LB4110A - G4	Alpha	11/2/2017	3/14/2019	0.1884	P	0.1700	0.1934	0.2168

GPC Detector Report
(ALL Efficiencies)

KP
3/14/19

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2017	3/14/2019	0.5401	P	0.5045	0.5402	0.5758
LB4110A - A2	Beta	11/2/2017	3/14/2019	0.4309	P	0.4028	0.4617	0.5205
LB4110A - A3	Beta	11/2/2017	3/14/2019	0.4745	P	0.4322	0.4789	0.5257
LB4110A - A4	Beta	11/2/2017	3/14/2019	0.5419	P	0.4948	0.5409	0.5869
LB4110A - B1	Beta	11/2/2017	3/14/2019	0.5550	P	0.5042	0.5416	0.5789
LB4110A - B2	Beta	11/2/2017	3/14/2019	0.5038	P	0.4670	0.5000	0.5330
LB4110A - B3	Beta	11/2/2017	3/14/2019	0.5891	P	0.5497	0.5837	0.6176
LB4110A - B4	Beta	11/2/2017	3/14/2019	0.5582	P	0.5048	0.5476	0.5903
LB4110A - C1	Beta	11/2/2017	3/14/2019	0.4724	P	0.4463	0.4790	0.5118
LB4110A - C2	Beta	11/2/2017	3/14/2019	0.5222	P	0.4861	0.5195	0.5530
LB4110A - C3	Beta	11/2/2017	3/14/2019	0.5779	P	0.5506	0.5963	0.6420
LB4110A - C4	Beta	11/2/2017	3/14/2019	0.5208	P	0.4844	0.5236	0.5629
LB4110A - D1	Beta	11/2/2017	3/14/2019	0.6502	P	0.6090	0.6397	0.6703
LB4110A - D2	Beta	11/2/2017	3/14/2019	0.5699	P	0.5442	0.6306	0.7170
LB4110A - D3	Beta	11/2/2017	3/14/2019	0.6529	P	0.5884	0.6388	0.6892
LB4110A - D4	Beta	11/2/2017	3/14/2019	0.4815	P	0.4535	0.5019	0.5504
LB4110A - E1	Beta	11/2/2017	3/23/2018	0.0436	F	0.4162	0.5409	0.6655
LB4110A - E2	Beta	11/2/2017	3/23/2018	0.0428	F	0.3730	0.4913	0.6097
LB4110A - E3	Beta	11/2/2017	3/23/2018	0.0551	F	0.3852	0.4994	0.6137
LB4110A - E4	Beta	11/2/2017	3/23/2018	0.0569	F	0.4534	0.5890	0.7247
LB4110A - F1	Beta	11/2/2017	3/14/2019	0.5399	P	0.4292	0.5301	0.6310
LB4110A - F2	Beta	11/2/2017	3/14/2019	0.4660	P	0.4047	0.4562	0.5077
LB4110A - F3	Beta	11/2/2017	3/14/2019	0.5846	P	0.4715	0.5988	0.7261
LB4110A - F4	Beta	11/2/2017	3/14/2019	0.5471	P	0.4349	0.5310	0.6272
LB4110A - G1	Beta	11/2/2017	3/14/2019	0.4435	P	0.4274	0.4548	0.4823
LB4110A - G2	Beta	11/2/2017	3/14/2019	0.4500	P	0.4362	0.4771	0.5180
LB4110A - G3	Beta	11/2/2017	3/14/2019	0.5334	P	0.4834	0.5322	0.5809
LB4110A - G4	Beta	11/2/2017	3/14/2019	0.4473	P	0.4065	0.4696	0.5327

SECTION X

BARIUM-133 ANALYTICAL TRACER DATA

MP
3/13/19

Apex-Gamma

Analysis Report for 1902131-01
SPIKE

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-01
Sample Description	: SPIKE
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 8:59:28AM
Acquisition Started	: 3/13/2019 11:48:35AM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 927.0 seconds
Dead Time	: 2.91 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/24/2018
Efficiency Calibration Used Done On	: 11/9/2014
Efficiency Calibration Description	:
Sample Number	: 78687

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:04:04PM

Peak Analysis From Channel : 1
Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-01

SPIKE

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
m	1	20.84	15 -	23	19.90	1.00E+02	46.68	3.22E+02	2.24
M	2	31.01	24 -	39	30.07	2.26E+03	100.84	2.09E+02	1.94
m	3	35.29	24 -	39	34.35	6.21E+02	76.81	1.25E+02	2.02
	4	53.51	48 -	56	52.59	7.25E+01	39.69	1.97E+02	2.32
M	5	61.86	57 -	73	60.94	2.25E+02	42.51	1.51E+02	2.31
m	6	66.01	57 -	73	65.10	1.09E+02	39.54	1.70E+02	2.32
	7	81.09	74 -	85	80.19	9.15E+02	77.23	2.88E+02	2.14
M	8	112.09	107 -	120	111.22	1.62E+02	37.86	1.42E+02	2.37
m	9	116.09	107 -	120	115.22	4.05E+01	33.37	1.11E+02	2.33
	10	160.06	155 -	164	159.21	5.33E+01	35.11	1.47E+02	3.24
	11	189.79	184 -	193	188.97	4.30E+01	32.83	1.28E+02	6.99
	12	224.84	222 -	227	224.05	1.89E+01	18.95	5.61E+01	2.22
	13	275.90	269 -	281	275.15	7.03E+01	32.49	9.13E+01	2.65
	14	303.05	297 -	307	302.32	1.18E+02	37.17	1.21E+02	1.93
	15	334.68	328 -	339	333.98	7.04E+01	30.85	8.33E+01	1.98
	16	356.32	350 -	361	355.64	5.06E+02	48.58	4.30E+01	2.27
M	17	384.39	380 -	397	383.73	1.05E+02	27.78	1.36E+01	2.71
m	18	387.33	380 -	397	386.68	8.66E+01	28.23	9.99E+00	2.30
m	19	391.34	380 -	397	390.70	4.14E+01	24.51	1.03E+01	3.00
M	20	415.42	407 -	428	414.79	2.77E+01	14.63	1.00E+01	3.46
m	21	419.41	407 -	428	418.78	2.07E+01	14.85	9.00E+00	3.15
	22	437.32	431 -	440	436.71	6.80E+01	18.49	1.00E+01	1.83
	23	468.34	462 -	472	467.75	1.64E+01	13.67	1.53E+01	2.80
	24	584.89	579 -	588	584.41	9.43E+00	10.30	9.14E+00	3.25
	25	726.35	722 -	728	726.00	6.00E+00	4.90	0.00E+00	2.87
	26	840.24	837 -	842	840.00	7.00E+00	5.29	0.00E+00	1.92

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:04:04PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078530.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	1	20.84	1.00E+02	46.68			1.00E+02	4.67E+01
M	2	31.01	2.26E+03	100.84			2.26E+03	1.01E+02
m	3	35.29	6.21E+02	76.81			6.21E+02	7.68E+01

Analysis Report for 1902131-01

SPIKE

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	4	53.51	7.25E+01	39.69			7.25E+01	3.97E+01
M	5	61.86	2.25E+02	42.51	1.20E+01	2.19E+00	2.13E+02	4.26E+01
m	6	66.01	1.09E+02	39.54			1.09E+02	3.95E+01
	7	81.09	9.15E+02	77.23			9.15E+02	7.72E+01
M	8	112.09	1.62E+02	37.86			1.62E+02	3.79E+01
m	9	116.09	4.05E+01	33.37			4.05E+01	3.34E+01
	10	160.06	5.33E+01	35.11			5.33E+01	3.51E+01
	11	189.79	4.30E+01	32.83			4.30E+01	3.28E+01
	12	224.84	1.89E+01	18.95			1.89E+01	1.89E+01
	13	275.90	7.03E+01	32.49			7.03E+01	3.25E+01
	14	303.05	1.18E+02	37.17			1.18E+02	3.72E+01
	15	334.68	7.04E+01	30.85			7.04E+01	3.09E+01
	16	356.32	5.06E+02	48.58			5.06E+02	4.86E+01
M	17	384.39	1.05E+02	27.78			1.05E+02	2.78E+01
m	18	387.33	8.66E+01	28.23			8.66E+01	2.82E+01
m	19	391.34	4.14E+01	24.51			4.14E+01	2.45E+01
M	20	415.42	2.77E+01	14.63			2.77E+01	1.46E+01
m	21	419.41	2.07E+01	14.85			2.07E+01	1.48E+01
	22	437.32	6.80E+01	18.49			6.80E+01	1.85E+01
	23	468.34	1.64E+01	13.67			1.64E+01	1.37E+01
	24	584.89	9.43E+00	10.30	1.11E+00	1.01E+00	8.32E+00	1.03E+01
	25	726.35	6.00E+00	4.90			6.00E+00	4.90E+00
	26	840.24	7.00E+00	5.29			7.00E+00	5.29E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.94	255.12		1.93		
		391.69	*	61.90	6.51E+01	3.96E+01
I-125	0.99	35.49	*	6.49	5.56E+02	7.01E+01
BA-133	0.99	30.80	*	97.60	1.03E+02	4.98E+00
		302.84	*	17.80	5.84E+02	2.57E+02
		356.01	*	60.00	7.93E+02	1.29E+02

Analysis Report for 1902131-01
SPIKE

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
TH-234	0.96	63.29	*	3.80	9.05E+02	1.92E+02

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.944	6.51E+01	3.96E+01	
	I-125	0.999	5.56E+02	7.01E+01	
X	I-129	0.849			
	BA-133	0.999	1.04E+02	4.98E+00	
	TH-234	0.961	9.05E+02	1.92E+02	
X	NP-237	0.563			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-01

SPIKE

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:04:04PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
m	1	20.84	1.11135E-01	23.33	Tol.	PA-234M
	4	53.51	8.05263E-02	27.38		
m	6	66.01	1.21113E-01	18.14	Sum	
	7	81.09	1.01653E+00	4.22		
M	8	112.09	1.79977E-01	11.69	Tol.	U-237
m	9	116.09	4.49785E-02	41.22		
	10	160.06	5.92082E-02	32.95		
	11	189.79	4.77466E-02	38.20		
	12	224.84	2.10402E-02	50.03		
	13	275.90	7.81609E-02	23.09		
	15	334.68	7.81746E-02	21.93	Sum	
M	17	384.39	1.16357E-01	13.27		
m	18	387.33	9.62363E-02	16.29	Sum	
M	20	415.42	3.07649E-02	26.42		
m	21	419.41	2.29837E-02	35.89	Sum	
	22	437.32	7.55556E-02	13.60		
	23	468.34	1.81944E-02	41.73		
	24	584.89	9.24437E-03	62.17		
	25	726.35	6.66667E-03	40.82		
	26	840.24	7.77778E-03	37.80		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 1902131-01

SPIKE

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	5.43E-03	5.43E-03	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.71E+01	1.71E+01	-3.49E+00	7.91E+00
		136.48		10.60	1.69E+02		4.43E+00	7.85E+01
	NI-59	6.92		29.80	5.77E-02	5.77E-02	-1.39E-02	2.51E-02
	MO-93	16.59		52.90	1.34E+00	1.34E+00	1.36E-01	6.45E-01
		18.60		10.00	1.08E+01		1.61E+01	5.22E+00
	NB-93M	16.57		9.43	7.51E+00	7.51E+00	7.63E-01	3.61E+00
	CD-109	88.03		3.72	3.29E+02	3.29E+02	-5.02E+01	1.55E+02
+	SN-113	255.12		1.93	1.34E+03	4.63E+01	3.35E+02	6.15E+02
		391.69	*	61.90	4.63E+01		6.51E+01	2.10E+01
	SN-119M	23.87		16.10	1.11E+01	8.25E+00	-1.99E+01	5.35E+00
		25.10		22.70	8.25E+00		-1.36E+02	3.96E+00
+	I-125	35.49	*	6.49	9.94E+01	9.94E+01	5.56E+02	4.85E+01
	I-129	29.78	*	57.00	8.81E+00	8.81E+00	1.76E+02	4.30E+00
		33.60	*	13.20	4.88E+01		2.73E+02	2.38E+01
		39.58		7.52	5.07E+01		6.22E+00	2.40E+01
+	BA-133	30.80	*	97.60	5.14E+00	5.14E+00	1.03E+02	2.51E+00
		302.84	*	17.80	2.57E+02		5.84E+02	1.22E+02
		356.01	*	60.00	5.17E+01		7.93E+02	2.37E+01
	CE-139	165.85		80.35	3.04E+01	3.04E+01	3.38E+00	1.42E+01
	CE-144	133.54		10.80	1.57E+02	1.57E+02	-5.15E+01	7.27E+01
	HG-203	279.19		77.30	4.99E+01	4.99E+01	5.46E+01	2.35E+01
	PB-210	46.50		4.25	1.04E+02	1.04E+02	8.09E+00	4.89E+01
	PA-231	9.28		42.00	1.82E-01	1.82E-01	2.15E-02	8.42E-02
		10.11		20.20	5.89E-01		3.59E-01	2.77E-01
		283.67		1.60	1.54E+03		4.39E+02	6.97E+02
		302.67		2.30	2.36E+03		5.04E+03	1.13E+03
	TH-231	25.64		14.70	1.43E+01	1.43E+01	-4.98E+02	6.87E+00
		84.21		6.40	5.47E+02		2.65E+03	2.68E+02
	PA-234M	9.89		89.00	1.25E-01	1.25E-01	7.64E-02	5.89E-02
		21.72		64.90	2.36E+00		2.42E+00	1.14E+00
		37.93		23.75	3.26E+01		1.19E+02	1.59E+01
		131.42		20.40	8.43E+01		1.75E+01	3.92E+01
+	TH-234	63.29	*	3.80	4.36E+02	4.36E+02	9.05E+02	2.12E+02
	NP-237	29.37	*	14.00	3.59E+01	3.59E+01	7.17E+02	1.75E+01
		86.50		12.60	9.49E+01		2.59E+01	4.46E+01
	U-237	97.08		16.30	8.00E+01	5.15E+01	-4.88E+01	3.74E+01
		101.07		26.30	5.15E+01		-2.50E+01	2.40E+01
		114.00		12.30	2.43E+02		6.04E+02	1.17E+02
		208.01		22.00	1.30E+02		-8.17E+00	6.06E+01
	AM-241	59.54		35.90	3.56E+01	3.56E+01	6.95E+01	1.72E+01
	AM-243	74.67		66.00	1.56E+01	1.56E+01	-1.14E+02	7.34E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

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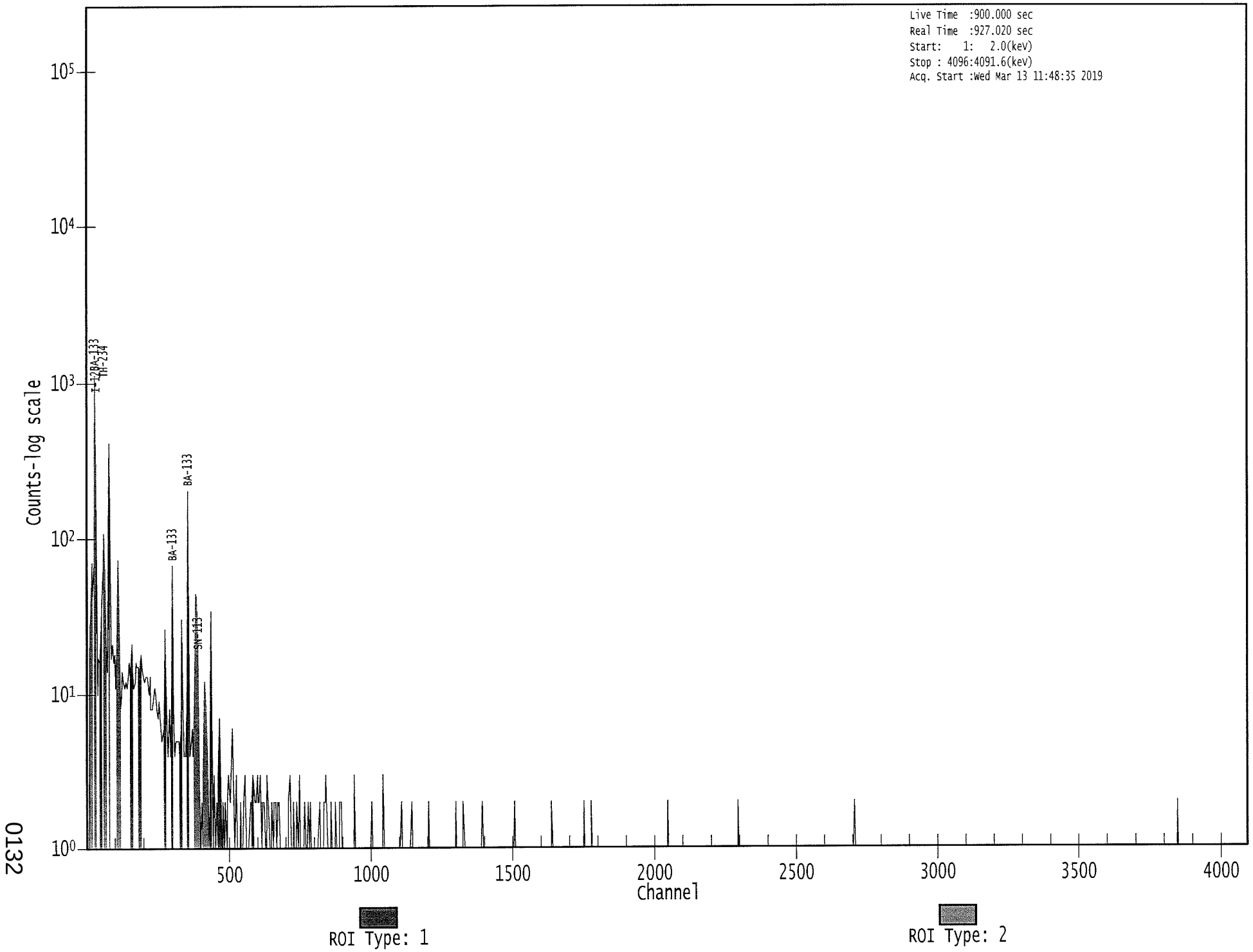

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KP 3/13/19

Apex-Gamma

Analysis Report for 1902131-02

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GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-02
Sample Description	: BLANK
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 8:59:35AM
Acquisition Started	: 3/13/2019 12:04:19PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE1
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.3 seconds
Dead Time	: 0.03 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 18 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 6/16/2018
Efficiency Calibration Used Done On	: 2/17/2018
Efficiency Calibration Description	:
Sample Number	: 78689

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:19:22PM

Peak Analysis From Channel : 1

Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-02

BLANK

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	30.79	26 -	39	31.17	2.12E+03	109.45	5.31E+02	2.59
m	2	35.27	26 -	39	35.64	4.20E+02	87.74	5.60E+02	2.49
	3	53.02	50 -	57	53.39	4.54E+01	41.52	2.59E+02	2.22
M	4	62.18	58 -	74	62.55	2.25E+02	50.40	2.65E+02	2.70
m	5	65.78	58 -	74	66.15	1.19E+02	52.50	2.36E+02	2.71
	6	81.31	77 -	88	81.67	8.45E+02	86.95	5.23E+02	2.43
M	7	111.91	107 -	125	112.26	1.98E+02	44.90	2.10E+02	2.54
m	8	116.16	107 -	125	116.51	3.69E+01	35.26	1.46E+02	2.10
	9	146.48	143 -	150	146.82	2.53E+01	30.59	1.37E+02	2.62
	10	276.88	273 -	281	277.19	7.41E+01	24.87	4.97E+01	1.62
	11	283.81	282 -	287	284.12	1.78E+01	14.76	2.83E+01	2.72
M	12	303.20	298 -	314	303.50	1.73E+02	32.86	5.17E+01	2.52
M	13	333.71	329 -	345	334.01	5.91E+01	24.06	4.28E+01	2.32
m	14	338.12	329 -	345	338.42	1.50E+01	20.27	3.78E+01	2.32
	15	356.10	350 -	361	356.40	6.10E+02	56.46	8.60E+01	2.74
	16	364.50	362 -	368	364.79	1.89E+01	22.67	7.82E+01	1.09
M	17	384.37	381 -	391	384.66	1.19E+02	35.26	5.80E+01	2.85
m	18	387.12	381 -	391	387.40	1.41E+02	43.12	1.51E+02	2.85
M	19	415.17	410 -	425	415.45	2.15E+01	17.39	3.71E+01	2.38
m	20	420.72	410 -	425	421.00	1.83E+01	12.97	1.62E+01	1.79
	21	437.50	432 -	444	437.77	1.01E+02	25.99	3.01E+01	2.65
	22	447.39	445 -	450	447.67	9.73E+00	7.28	2.55E+00	2.38
	23	469.37	465 -	479	469.64	2.66E+01	19.52	2.49E+01	3.75
	24	840.47	838 -	842	840.67	6.00E+00	4.90	0.00E+00	1.47
	25	921.39	919 -	924	921.57	7.00E+00	5.29	0.00E+00	2.22

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:19:22PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078527.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	30.79	2.12E+03	109.45			2.12E+03	1.09E+02
m	2	35.27	4.20E+02	87.74			4.20E+02	8.77E+01
	3	53.02	4.54E+01	41.52			4.54E+01	4.15E+01
M	4	62.18	2.25E+02	50.40	2.17E+01	2.18E+00	2.03E+02	5.04E+01

Analysis Report for 1902131-02

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	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	5	65.78	1.19E+02	52.50			1.19E+02	5.25E+01
	6	81.31	8.45E+02	86.95			8.45E+02	8.69E+01
M	7	111.91	1.98E+02	44.90			1.98E+02	4.49E+01
m	8	116.16	3.69E+01	35.26			3.69E+01	3.53E+01
	9	146.48	2.53E+01	30.59			2.53E+01	3.06E+01
	10	276.88	7.41E+01	24.87			7.41E+01	2.49E+01
	11	283.81	1.78E+01	14.76			1.78E+01	1.48E+01
M	12	303.20	1.73E+02	32.86			1.73E+02	3.29E+01
M	13	333.71	5.91E+01	24.06			5.91E+01	2.41E+01
m	14	338.12	1.50E+01	20.27			1.50E+01	2.03E+01
	15	356.10	6.10E+02	56.46			6.10E+02	5.65E+01
	16	364.50	1.89E+01	22.67			1.89E+01	2.27E+01
M	17	384.37	1.19E+02	35.26			1.19E+02	3.53E+01
m	18	387.12	1.41E+02	43.12			1.41E+02	4.31E+01
M	19	415.17	2.15E+01	17.39			2.15E+01	1.74E+01
m	20	420.72	1.83E+01	12.97			1.83E+01	1.30E+01
	21	437.50	1.01E+02	25.99			1.01E+02	2.60E+01
	22	447.39	9.73E+00	7.28			9.73E+00	7.28E+00
	23	469.37	2.66E+01	19.52			2.66E+01	1.95E+01
	24	840.47	6.00E+00	4.90			6.00E+00	4.90E+00
	25	921.39	7.00E+00	5.29			7.00E+00	5.29E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-125	0.99	35.49	*	6.49	4.13E+00	8.63E-01
BA-133	1.00	30.80	*	97.60	3.93E-01	2.03E-02
		302.84	*	17.80	7.64E+02	3.64E+02
		356.01	*	60.00	5.15E+02	7.37E+01
PA-231	1.00	9.28		42.00		
		10.11		20.20		
		283.67	*	1.60	1.01E+03	9.77E+02
		302.67	*	2.30	5.91E+03	2.82E+03

Analysis Report for 1902131-02

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Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
TH-234	0.96	63.29	*	3.80	2.32E+02	5.79E+01

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	I-125	0.999	4.13E+00	8.63E-01	
X	I-129	0.749			
	BA-133	1.000	3.93E-01	2.03E-02	
	PA-231	1.000	1.54E+03	9.23E+02	
	TH-234	0.964	2.32E+02	5.79E+01	
X	NP-237	0.937			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-02

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UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:19:22PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	3	53.02	5.04698E-02	45.71		
m	5	65.78	1.31977E-01	22.10	Sum	
	6	81.31	9.39376E-01	5.14		
M	7	111.91	2.20455E-01	11.31		
m	8	116.16	4.10224E-02	47.75		
	9	146.48	2.81147E-02	60.46		
	10	276.88	8.23625E-02	16.78		
M	13	333.71	6.56908E-02	20.35	Sum	
m	14	338.12	1.66955E-02	67.46	Sum	
	16	364.50	2.09866E-02	60.00	Sum	
M	17	384.37	1.32322E-01	14.80		
m	18	387.12	1.56275E-01	15.33	Sum	
M	19	415.17	2.38802E-02	40.45		
m	20	420.72	2.03145E-02	35.47		
	21	437.50	1.12170E-01	12.87		
	22	447.39	1.08081E-02	37.42		
	23	469.37	2.95014E-02	36.76		
	24	840.47	6.66667E-03	40.82		
	25	921.39	7.77778E-03	37.80		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 1902131-02

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	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	1.90E-13	1.90E-13	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.78E+01	2.78E+01	-2.65E+01	1.27E+01
		136.48		10.60	3.01E+02		-3.47E+01	1.38E+02
	NI-59	6.92		29.80	2.77E-12	2.77E-12	0.00E+00	0.00E+00
	MO-93	16.59		52.90	7.31E-06	7.31E-06	-7.55E-06	3.21E-06
		18.60		10.00	3.83E-04		-2.15E-04	1.82E-04
	NB-93M	16.57		9.43	4.04E-05	4.04E-05	-4.17E-05	1.78E-05
	CD-109	88.03		3.72	3.58E+02	3.58E+02	2.88E+01	1.70E+02
	SN-113	255.12		1.93	1.65E+03	2.85E+01	-1.99E+02	7.50E+02
		391.69		61.90	2.85E+01		1.15E+01	1.34E+01
	SN-119M	23.87		16.10	7.06E-03	7.06E-03	1.27E-02	3.42E-03
		25.10		22.70	7.83E-03		9.69E-03	3.78E-03
+	I-125	35.49	*	6.49	1.47E+00	1.47E+00	4.13E+00	7.20E-01
	I-129	29.78	*	57.00	4.72E-02	4.72E-02	6.74E-01	2.32E-02
		33.60		13.20	5.39E-01		-2.42E-01	2.65E-01
		39.58		7.52	1.49E+00		8.46E-02	7.15E-01
+	BA-133	30.80	*	97.60	2.76E-02	2.76E-02	3.93E-01	1.35E-02
		302.84	*	17.80	2.46E+02		7.64E+02	1.17E+02
		356.01	*	60.00	6.39E+01		5.15E+02	3.08E+01
	CE-139	165.85		80.35	6.21E+01	6.21E+01	-2.97E+01	2.90E+01
	CE-144	133.54		10.80	2.71E+02	2.71E+02	-1.41E+02	1.24E+02
	HG-203	279.19		77.30	5.52E+01	5.52E+01	3.77E+01	2.60E+01
	PB-210	46.50		4.25	5.95E+00	5.95E+00	-2.23E+00	2.78E+00
+	PA-231	9.28		42.00	2.61E-10	2.61E-10	0.00E+00	0.00E+00
		10.11		20.20	2.08E-09		0.00E+00	0.00E+00
		283.67	*	1.60	1.28E+03		1.01E+03	5.63E+02
		302.67	*	2.30	1.91E+03		5.91E+03	9.07E+02
	TH-231	25.64		14.70	1.25E-02	1.25E-02	-2.58E-03	5.98E-03
		84.21		6.40	2.59E+02		-4.57E+02	1.25E+02
	PA-234M	9.89		89.00	3.36E-10	3.36E-10	0.00E+00	0.00E+00
		21.72		64.90	6.46E-04		1.77E-03	3.13E-04
		37.93		23.75	5.07E-01		7.30E-01	2.46E-01
		131.42		20.40	1.58E+02		7.06E+01	7.32E+01
+	TH-234	63.29	*	3.80	1.37E+02	1.37E+02	2.32E+02	6.72E+01
	NP-237	29.37	*	14.00	1.92E-01	1.92E-01	2.74E+00	9.43E-02
		86.50		12.60	1.00E+02		-2.54E+02	4.75E+01
	U-237	97.08		16.30	9.67E+01	6.10E+01	-5.29E+01	4.53E+01
		101.07		26.30	6.10E+01		-1.82E+01	2.83E+01
		114.00		12.30	3.81E+02		5.76E+02	1.84E+02
		208.01		22.00	2.14E+02		-6.67E+00	9.91E+01
	AM-241	59.54		35.90	6.26E+00	6.26E+00	-9.99E-01	3.00E+00
	AM-243	74.67		66.00	8.14E+00	8.14E+00	5.57E-01	3.83E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

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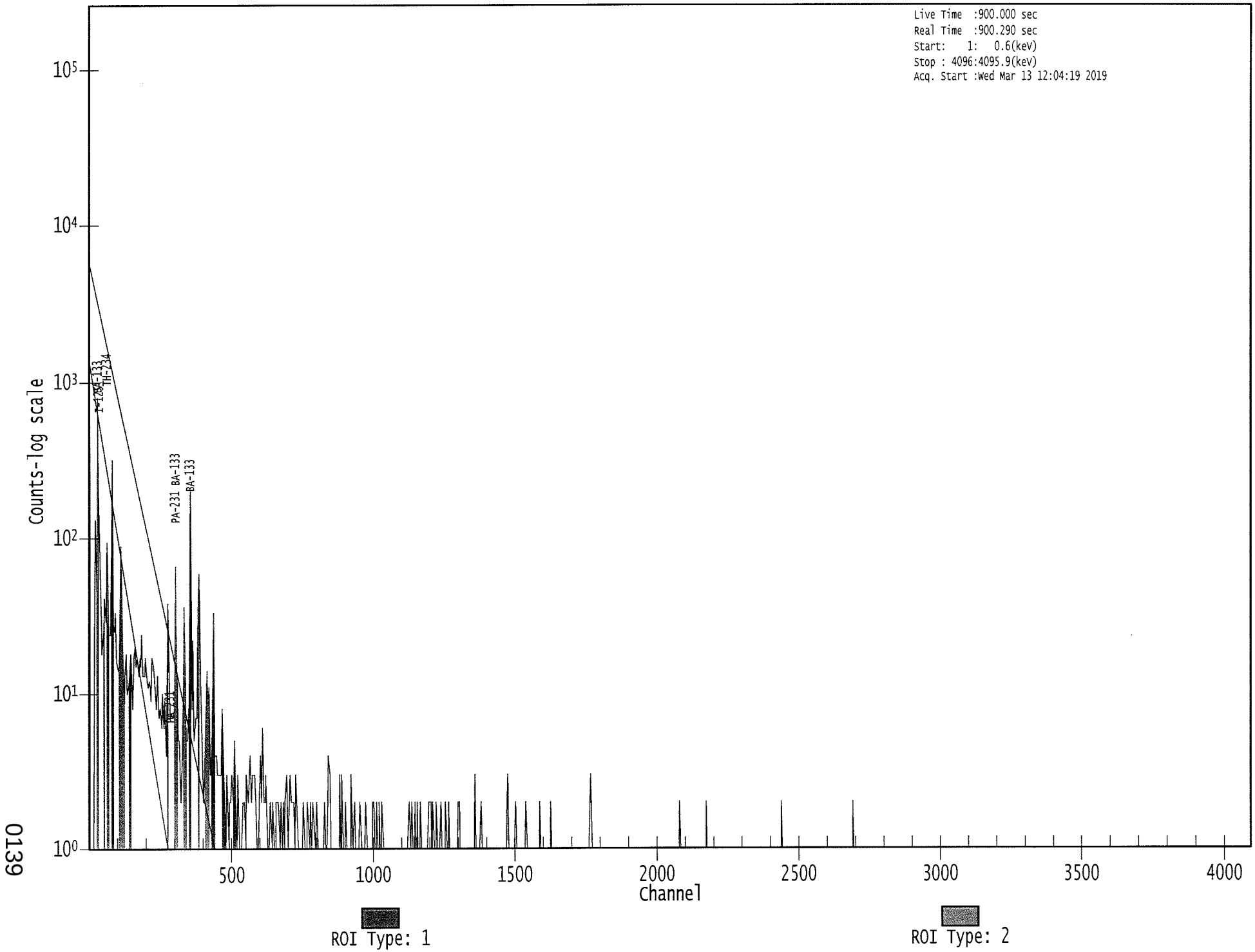

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KP 3/13/19

Apex-Gamma

Analysis Report for 1902131-03

BC 29A

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-03
Sample Description	: BC 29A
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 8:59:44AM
Acquisition Started	: 3/13/2019 12:04:27PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE2
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.2 seconds
Dead Time	: 0.02 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 28 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/17/2018
Efficiency Calibration Used Done On	: 2/24/2018
Efficiency Calibration Description	:
Sample Number	: 78690

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:19:38PM

Peak Analysis From Channel : 1

Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-03

BC 29A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.72	35 -	38	35.50	3.73E+02	56.78	2.26E+02	2.40
	2	53.52	50 -	56	53.30	5.64E+01	30.01	1.23E+02	2.23
M	3	62.33	57 -	71	62.10	1.39E+02	29.15	6.00E+01	1.13
m	4	66.13	57 -	71	65.90	6.93E+01	22.23	6.00E+01	1.14
	5	81.31	77 -	83	81.07	8.26E+02	64.87	1.63E+02	1.26
	6	112.00	108 -	114	111.75	1.63E+02	36.67	1.25E+02	1.34
	7	191.94	189 -	195	191.65	2.15E+01	25.60	1.01E+02	3.40
	8	276.46	272 -	280	276.13	6.10E+01	26.53	6.79E+01	1.73
	9	302.81	299 -	305	302.47	1.30E+02	28.77	5.59E+01	1.91
	10	333.65	330 -	335	333.29	6.44E+01	19.82	2.71E+01	1.91
	11	355.93	350 -	359	355.56	6.16E+02	51.03	2.00E+01	1.89
	12	364.30	361 -	366	363.92	1.34E+01	11.36	1.53E+01	1.86
M	13	383.85	380 -	393	383.46	8.32E+01	28.88	2.10E+01	1.96
m	14	386.94	380 -	393	386.55	1.73E+02	30.68	1.41E+01	1.76
m	15	391.00	380 -	393	390.62	3.48E+01	16.31	1.27E+01	1.97
	16	415.28	411 -	419	414.88	3.65E+01	20.94	4.49E+01	1.56
	17	436.89	432 -	440	436.48	7.58E+01	21.20	2.23E+01	1.92
	18	468.34	464 -	472	467.91	2.01E+01	10.40	3.82E+00	2.05
M	19	507.80	506 -	514	507.36	6.68E+00	3.61	1.90E+00	3.29

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:19:38PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078528.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.72	3.73E+02	56.78			3.73E+02	5.68E+01
	2	53.52	5.64E+01	30.01			5.64E+01	3.00E+01
M	3	62.33	1.39E+02	29.15			1.39E+02	2.92E+01
m	4	66.13	6.93E+01	22.23			6.93E+01	2.22E+01
	5	81.31	8.26E+02	64.87			8.26E+02	6.49E+01
	6	112.00	1.63E+02	36.67			1.63E+02	3.67E+01
	7	191.94	2.15E+01	25.60			2.15E+01	2.56E+01
	8	276.46	6.10E+01	26.53			6.10E+01	2.65E+01
	9	302.81	1.30E+02	28.77			1.30E+02	2.88E+01
	10	333.65	6.44E+01	19.82			6.44E+01	1.98E+01

Analysis Report for 1902131-03

BC 29A

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	11	355.93	6.16E+02	51.03			6.16E+02	5.10E+01
	12	364.30	1.34E+01	11.36			1.34E+01	1.14E+01
M	13	383.85	8.32E+01	28.88			8.32E+01	2.89E+01
m	14	386.94	1.73E+02	30.68			1.73E+02	3.07E+01
m	15	391.00	3.48E+01	16.31			3.48E+01	1.63E+01
	16	415.28	3.65E+01	20.94			3.65E+01	2.09E+01
	17	436.89	7.58E+01	21.20			7.58E+01	2.12E+01
	18	468.34	2.01E+01	10.40			2.01E+01	1.04E+01
M	19	507.80	6.68E+00	3.61			6.68E+00	3.61E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.95	255.12		1.93		
		391.69	*	61.90	2.14E+01	1.02E+01
I-125	0.99	35.49	*	6.49	1.42E+01	2.16E+00
PA-231	1.00	9.28		42.00		
		10.11		20.20		
		283.67		1.60		
		302.67	*	2.30	3.83E+03	1.44E+03
TH-234	0.97	63.29	*	3.80	2.36E+02	4.98E+01

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

Analysis Report for 1902131-03

BC 29A

INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
SN-113	0.956	2.14E+01	1.02E+01	
I-125	0.999	1.42E+01	2.16E+00	
PA-231	1.000	3.83E+03	1.44E+03	
TH-234	0.976	2.36E+02	4.98E+01	

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-03

BC 29A

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:19:38PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	53.52	6.26789E-02	26.60		
m	4	66.13	7.69803E-02	16.04		
	5	81.31	9.18313E-01	3.92		
	6	112.00	1.81509E-01	11.23	Tol.	U-237
	7	191.94	2.38580E-02	59.62		
	8	276.46	6.78187E-02	21.74		
	10	333.65	7.15883E-02	15.38		
	11	355.93	6.84444E-01	4.14	Tol.	BA-133
	12	364.30	1.48413E-02	42.52	Sum	
M	13	383.85	9.24429E-02	17.36		
m	14	386.94	1.91853E-01	8.89		
	16	415.28	4.05932E-02	28.66		
	17	436.89	8.42656E-02	13.97		
	18	468.34	2.23232E-02	25.89		
M	19	507.80	7.42290E-03	26.99		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)

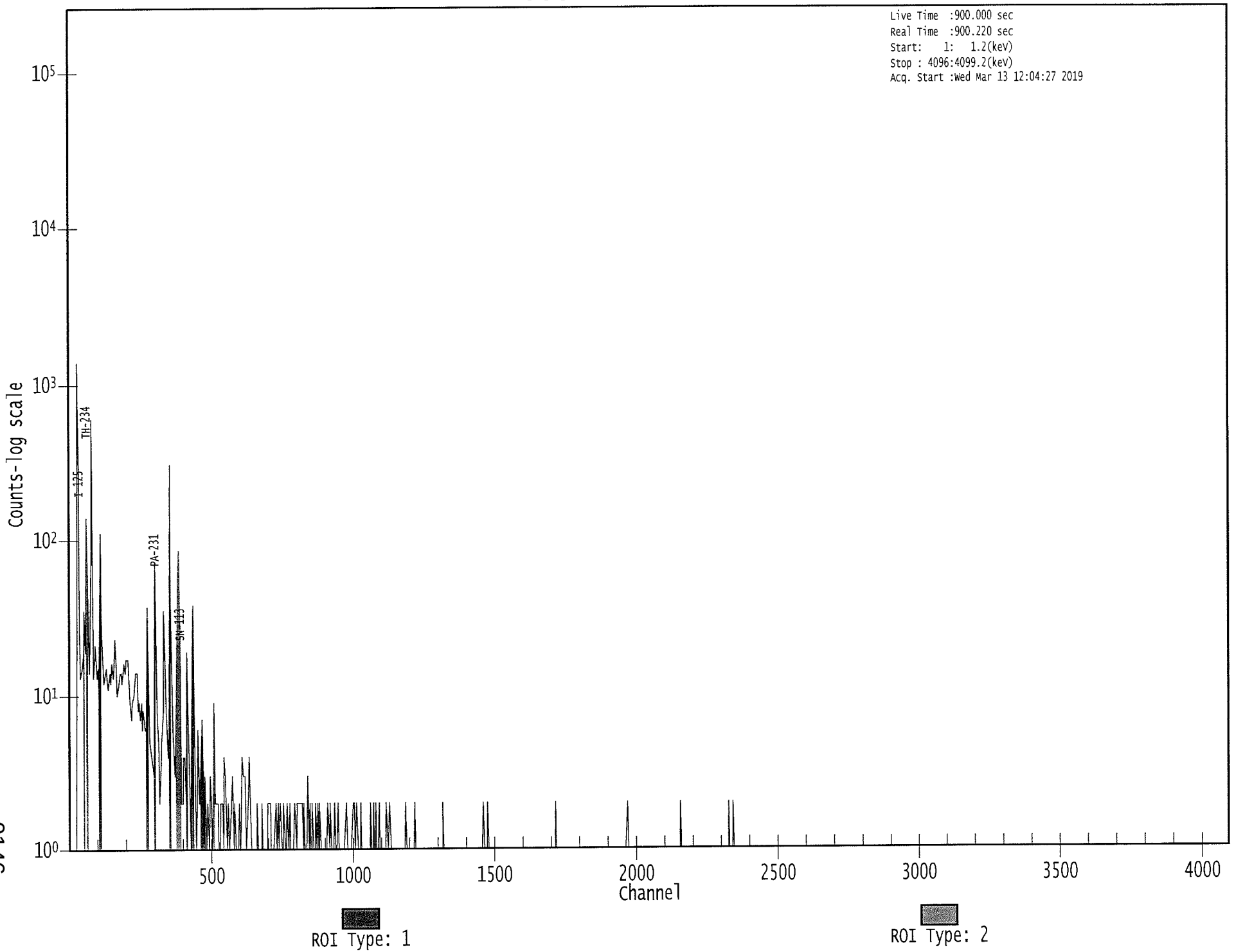
Analysis Report for 1902131-03

BC 29A

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	1.20E-10	1.20E-10	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.39E+01	2.39E+01	4.94E+00	1.10E+01
		136.48		10.60	2.60E+02		6.14E+01	1.21E+02
	NI-59	6.92		29.80	9.43E-10	9.43E-10	0.00E+00	0.00E+00
	MO-93	16.59		52.90	1.78E-05	1.78E-05	0.00E+00	0.00E+00
		18.60		10.00	2.91E-04		0.00E+00	0.00E+00
	NB-93M	16.57		9.43	9.85E-05	9.85E-05	0.00E+00	0.00E+00
	CD-109	88.03		3.72	2.66E+02	2.66E+02	5.53E+01	1.24E+02
+	SN-113	255.12		1.93	1.24E+03	1.97E+01	8.92E+02	5.59E+02
		391.69	*	61.90	1.97E+01		2.14E+01	9.04E+00
	SN-119M	23.87		16.10	1.78E-03	1.78E-03	0.00E+00	0.00E+00
		25.10		22.70	1.93E-03		0.00E+00	0.00E+00
+	I-125	35.49	*	6.49	2.71E+00	2.71E+00	1.42E+01	1.30E+00
	I-129	29.78		57.00	2.15E-01	2.15E-01	1.30E+00	1.06E-01
		33.60		13.20	1.21E+00		-7.13E+00	5.87E-01
		39.58		7.52	1.85E+00		-2.57E-02	8.38E-01
	BA-133	30.80		97.60	1.78E-01	1.78E-01	1.59E+00	8.80E-02
		302.84		17.80	2.27E+02		4.95E+02	1.09E+02
		356.01		60.00	9.49E+01		4.85E+02	4.64E+01
	CE-139	165.85		80.35	4.38E+01	4.38E+01	2.05E+01	2.03E+01
	CE-144	133.54		10.80	2.59E+02	2.59E+02	6.46E+01	1.20E+02
	HG-203	279.19		77.30	2.90E+01	2.90E+01	-4.49E+00	1.31E+01
	PB-210	46.50		4.25	9.38E+00	9.38E+00	1.80E+00	4.26E+00
+	PA-231	9.28		42.00	3.13E-08	3.13E-08	0.00E+00	0.00E+00
		10.11		20.20	1.87E-07		0.00E+00	0.00E+00
		283.67		1.60	9.17E+02		-2.39E+02	3.95E+02
		302.67	*	2.30	9.30E+02		3.83E+03	4.25E+02
	TH-231	25.64		14.70	3.57E-03	3.57E-03	0.00E+00	0.00E+00
		84.21		6.40	2.47E+02		3.94E+01	1.19E+02
	PA-234M	9.89		89.00	3.24E-08	3.24E-08	0.00E+00	0.00E+00
		21.72		64.90	1.91E-04		0.00E+00	0.00E+00
		37.93		23.75	5.43E-01		-1.58E+00	2.50E-01
		131.42		20.40	1.27E+02		-4.13E+01	5.90E+01
+	TH-234	63.29	*	3.80	1.40E+02	1.40E+02	2.36E+02	6.78E+01
	NP-237	29.37		14.00	3.06E-01	3.06E-01	-6.29E+00	1.47E-01
		86.50		12.60	7.57E+01		-6.14E+00	3.52E+01
	U-237	97.08		16.30	7.12E+01	5.97E+01	-3.04E+01	3.27E+01
		101.07		26.30	5.97E+01		2.38E+01	2.78E+01
		114.00		12.30	2.91E+02		3.19E+01	1.39E+02
		208.01		22.00	1.65E+02		4.36E+01	7.62E+01
	AM-241	59.54		35.90	6.97E+00	6.97E+00	-3.96E+01	3.29E+00
	AM-243	74.67		66.00	8.28E+00	8.28E+00	2.76E+00	3.85E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

0000078690.CNF



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3/13/19

Apex-Gamma

Analysis Report for 1902131-04
BC 29A

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-04
Sample Description	: BC 29A
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 8:59:56AM
Acquisition Started	: 3/13/2019 12:04:42PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE3
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 902.8 seconds
Dead Time	: 0.31 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 7/21/2018
Efficiency Calibration Used Done On	: 7/21/2018
Efficiency Calibration Description	:
Sample Number	: 78691

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:19:50PM

Peak Analysis From Channel : 1
Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-04

BC 29A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.73	16 -	24	21.10	9.86E+01	50.58	3.33E+02	3.49
M	2	30.92	25 -	40	31.29	2.07E+03	101.47	2.60E+02	2.66
m	3	35.11	25 -	40	35.48	5.50E+02	99.56	2.12E+02	2.67
	4	52.97	49 -	57	53.33	5.12E+01	45.61	2.90E+02	3.83
M	5	61.60	58 -	73	61.95	2.42E+02	46.95	2.46E+02	3.00
m	6	66.41	58 -	73	66.76	1.17E+02	49.27	2.54E+02	2.64
	7	81.01	75 -	88	81.35	8.67E+02	87.30	4.61E+02	3.06
M	8	111.97	108 -	120	112.30	2.30E+02	44.14	1.73E+02	2.83
m	9	116.68	108 -	120	117.00	3.99E+01	30.03	1.13E+02	2.13
	10	276.55	271 -	281	276.80	5.81E+01	29.15	8.18E+01	1.98
	11	303.37	299 -	310	303.62	1.41E+02	37.95	1.14E+02	2.61
	12	334.62	330 -	340	334.86	5.85E+01	32.57	1.11E+02	2.06
	13	355.75	349 -	363	355.97	4.74E+02	52.53	9.35E+01	2.63
M	14	383.87	380 -	395	384.09	1.05E+02	32.00	5.59E+01	3.44
m	15	387.11	380 -	395	387.32	1.57E+02	37.97	4.67E+01	3.44
m	16	391.55	380 -	395	391.76	4.12E+01	24.66	1.27E+01	2.59
M	17	408.80	408 -	425	409.00	1.24E+01	2.29	2.01E+00	2.36
m	18	418.80	408 -	425	419.00	1.66E+01	14.74	1.85E+01	2.37
m	19	422.30	408 -	425	422.50	1.85E+01	13.01	2.02E+01	2.87
	20	436.54	433 -	440	436.74	7.87E+01	19.70	1.26E+01	3.26
	21	480.91	476 -	485	481.08	8.66E+00	11.79	1.47E+01	2.34
	22	534.70	532 -	537	534.86	5.64E+00	6.08	2.71E+00	2.99
	23	609.42	607 -	611	609.55	5.44E+00	7.40	7.11E+00	1.62

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:19:50PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078529.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.73	9.86E+01	50.58			9.86E+01	5.06E+01
M	2	30.92	2.07E+03	101.47			2.07E+03	1.01E+02
m	3	35.11	5.50E+02	99.56			5.50E+02	9.96E+01
	4	52.97	5.12E+01	45.61			5.12E+01	4.56E+01
M	5	61.60	2.42E+02	46.95	1.60E+01	3.04E+00	2.26E+02	4.71E+01
m	6	66.41	1.17E+02	49.27			1.17E+02	4.93E+01

Analysis Report for 1902131-04

BC 29A

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	7	81.01	8.67E+02	87.30			8.67E+02	8.73E+01
M	8	111.97	2.30E+02	44.14			2.30E+02	4.41E+01
m	9	116.68	3.99E+01	30.03			3.99E+01	3.00E+01
	10	276.55	5.81E+01	29.15			5.81E+01	2.92E+01
	11	303.37	1.41E+02	37.95			1.41E+02	3.79E+01
	12	334.62	5.85E+01	32.57			5.85E+01	3.26E+01
	13	355.75	4.74E+02	52.53			4.74E+02	5.25E+01
M	14	383.87	1.05E+02	32.00			1.05E+02	3.20E+01
m	15	387.11	1.57E+02	37.97	0.00E+00	0.00E+00	1.57E+02	3.80E+01
m	16	391.55	4.12E+01	24.66			4.12E+01	2.47E+01
M	17	408.80	1.24E+01	2.29			1.24E+01	2.29E+00
m	18	418.80	1.66E+01	14.74			1.66E+01	1.47E+01
m	19	422.30	1.85E+01	13.01			1.85E+01	1.30E+01
	20	436.54	7.87E+01	19.70			7.87E+01	1.97E+01
	21	480.91	8.66E+00	11.79			8.66E+00	1.18E+01
	22	534.70	5.64E+00	6.08			5.64E+00	6.08E+00
	23	609.42	5.44E+00	7.40			5.44E+00	7.40E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.96	255.12		1.93		
		391.69	*	61.90	2.87E+01	1.74E+01
I-125	0.99	35.49	*	6.49	2.50E+01	4.53E+00
BA-133	0.99	30.80	*	97.60	2.72E+00	1.34E-01
		302.84	*	17.80	5.28E+02	2.38E+02
		356.01	*	60.00	4.12E+02	6.58E+01
TH-234	0.95	63.29	*	3.80	3.47E+02	7.33E+01

Analysis Report for 1902131-04

BC 29A

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.964	2.87E+01	1.74E+01	
	I-125	0.997	2.50E+01	4.53E+00	
X	I-129	0.906			
	BA-133	0.999	2.72E+00	1.34E-01	
	TH-234	0.950	3.47E+02	7.33E+01	
X	NP-237	0.888			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-04

BC 29A

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:19:50PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	20.73	1.09505E-01	25.66	Tol.	PA-234M
	4	52.97	5.68708E-02	44.55		
m	6	66.41	1.30472E-01	20.98	Sum	
	7	81.01	9.62903E-01	5.04		
M	8	111.97	2.55967E-01	9.58		
m	9	116.68	4.43847E-02	37.59		
	10	276.55	6.45286E-02	25.10		
	12	334.62	6.50487E-02	27.82	Sum	
M	14	383.87	1.16666E-01	15.24		
m	15	387.11	1.74175E-01	12.11	Sum	
M	17	408.80	1.37925E-02	9.23		
m	18	418.80	1.84657E-02	44.34	Sum	
m	19	422.30	2.05438E-02	35.18	Sum	
	20	436.54	8.74248E-02	12.52		
	21	480.91	9.61806E-03	68.10		
	22	534.70	6.26984E-03	53.90		
	23	609.42	6.04938E-03	67.95		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 1902131-04

BC 29A

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	4.26E-09	4.26E-09	-1.76E-08	1.35E-09
	CO-57	122.06		85.51	2.63E+01	2.63E+01	7.82E+00	1.24E+01
		136.48		10.60	2.49E+02		-3.31E+00	1.17E+02
	NI-59	6.92		29.80	9.11E-08	9.11E-08	-4.10E-08	4.09E-08
	MO-93	16.59		52.90	1.14E-03	1.14E-03	9.75E-05	5.45E-04
		18.60		10.00	1.86E-02		1.14E-02	8.93E-03
	NB-93M	16.57		9.43	6.32E-03	6.32E-03	5.41E-04	3.02E-03
	CD-109	88.03		3.72	3.19E+02	3.19E+02	2.93E+01	1.51E+02
+	SN-113	255.12		1.93	1.14E+03	3.14E+01	-7.82E+02	5.13E+02
		391.69	*	61.90	3.14E+01		2.87E+01	1.48E+01
	SN-119M	23.87		16.10	8.82E-02	8.82E-02	-2.81E-01	4.24E-02
		25.10		22.70	9.17E-02		-1.25E+00	4.41E-02
+	I-125	35.49	*	6.49	5.08E+00	5.08E+00	2.50E+01	2.48E+00
	I-129	29.78	*	57.00	2.55E-01	2.55E-01	4.66E+00	1.24E-01
		33.60	*	13.20	2.49E+00		1.23E+01	1.22E+00
		39.58		7.52	5.39E+00		5.35E-01	2.58E+00
+	BA-133	30.80	*	97.60	1.49E-01	1.49E-01	2.72E+00	7.26E-02
		302.84	*	17.80	1.93E+02		5.28E+02	9.14E+01
		356.01	*	60.00	4.43E+01		4.12E+02	2.10E+01
	CE-139	165.85		80.35	4.24E+01	4.24E+01	-9.59E+00	1.99E+01
	CE-144	133.54		10.80	2.26E+02	2.26E+02	-4.58E+01	1.06E+02
	HG-203	279.19		77.30	4.06E+01	4.06E+01	3.55E+01	1.90E+01
	PB-210	46.50		4.25	1.84E+01	1.84E+01	3.43E+00	8.72E+00
	PA-231	9.28		42.00	3.81E-06	3.81E-06	4.50E-06	1.81E-06
		10.11		20.20	2.00E-05		2.37E-05	9.51E-06
		283.67		1.60	1.21E+03		2.35E+02	5.45E+02
		302.67		2.30	1.79E+03		3.36E+03	8.54E+02
	TH-231	25.64		14.70	1.89E-01	1.89E-01	-3.75E+00	9.14E-02
		84.21		6.40	3.19E+02		4.74E+02	1.56E+02
	PA-234M	9.89		89.00	3.59E-06	3.59E-06	4.24E-06	1.70E-06
		21.72		64.90	1.07E-02		8.08E-03	5.15E-03
		37.93		23.75	2.23E+00		5.02E+00	1.09E+00
		131.42		20.40	1.16E+02		1.35E+01	5.44E+01
+	TH-234	63.29	*	3.80	1.80E+02	1.80E+02	3.47E+02	8.81E+01
	NP-237	29.37	*	14.00	1.04E+00	1.04E+00	1.90E+01	5.06E-01
		86.50		12.60	9.54E+01		4.94E+00	4.55E+01
	U-237	97.08		16.30	9.00E+01	5.60E+01	1.82E+00	4.25E+01
		101.07		26.30	5.60E+01		-4.01E+01	2.63E+01
		114.00		12.30	3.05E+02		7.51E+02	1.48E+02
		208.01		22.00	1.59E+02		-5.38E+01	7.43E+01
	AM-241	59.54		35.90	1.23E+01	1.23E+01	1.94E+01	5.98E+00
	AM-243	74.67		66.00	9.95E+00	9.95E+00	-7.59E+01	4.72E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

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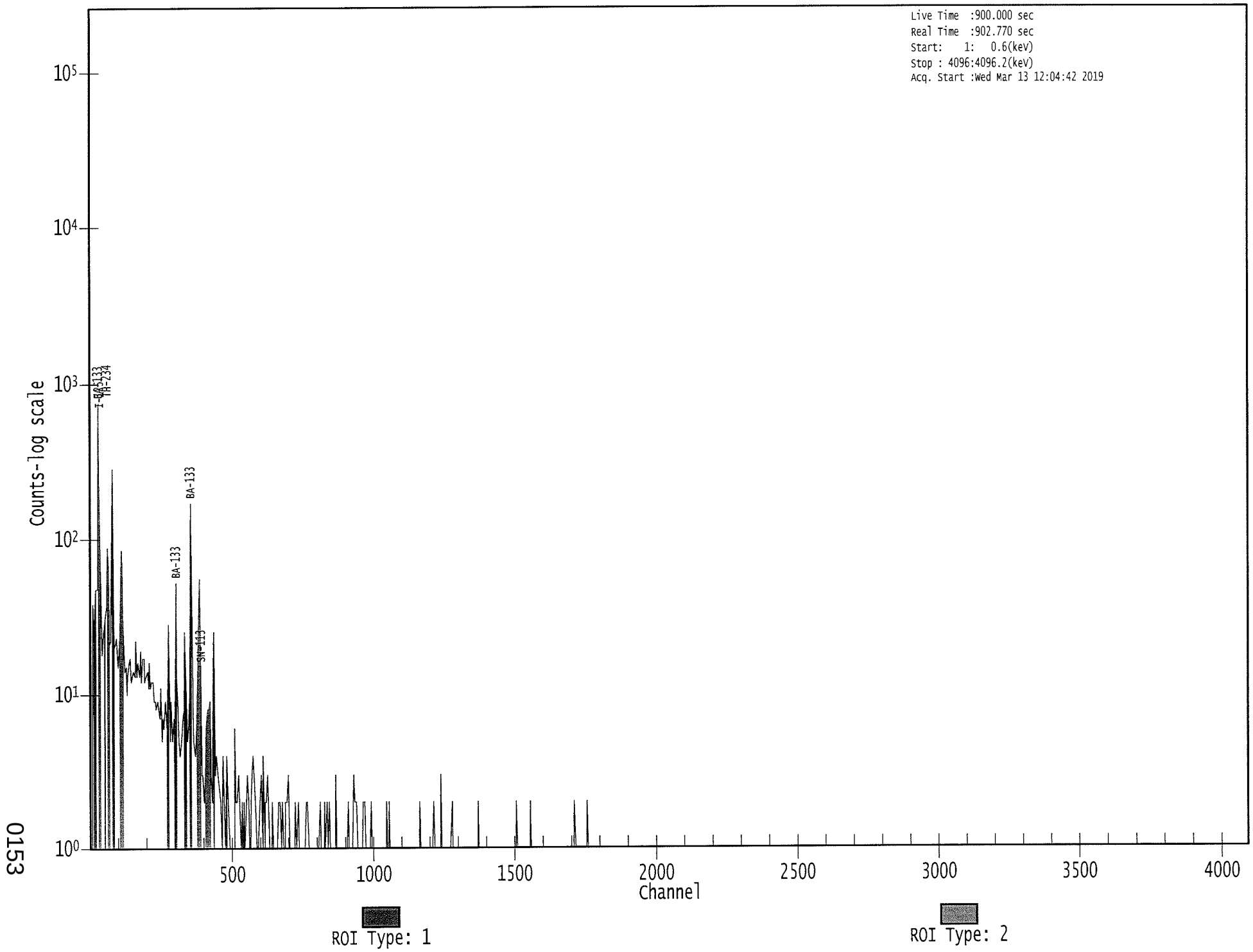

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KP 3/13/19

Apex-Gamma

Analysis Report for 1902131-05
BC 29B

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-05
Sample Description	: BC 29B
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 9:00:05AM
Acquisition Started	: 3/13/2019 12:04:51PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 912.7 seconds
Dead Time	: 1.39 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/24/2018
Efficiency Calibration Used Done On	: 11/9/2014
Efficiency Calibration Description	:
Sample Number	: 78692

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:20:06PM

Peak Analysis From Channel : 1
Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-05

BC 29B

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	21.13	16 -	23	20.19	5.63E+01	42.90	2.63E+02	2.21
M	2	30.98	24 -	38	30.04	1.83E+03	90.76	1.25E+02	2.19
m	3	35.23	24 -	38	34.29	4.22E+02	65.87	7.48E+01	2.12
	4	52.96	49 -	56	52.04	5.66E+01	30.40	1.17E+02	1.87
M	5	61.81	57 -	72	60.90	1.72E+02	42.58	1.51E+02	2.90
m	6	66.12	57 -	72	65.21	7.04E+01	39.45	1.47E+02	2.80
	7	81.26	74 -	85	80.36	7.02E+02	70.85	2.78E+02	2.07
	8	93.01	88 -	96	92.12	4.37E+01	28.02	9.26E+01	2.47
M	9	112.14	106 -	118	111.26	1.35E+02	37.19	1.27E+02	2.83
m	10	116.62	106 -	118	115.74	2.39E+01	22.98	6.48E+01	2.06
	11	165.25	162 -	168	164.41	1.80E+01	23.11	8.40E+01	2.39
	12	223.47	217 -	228	222.68	3.47E+01	30.13	9.66E+01	5.50
M	13	276.83	271 -	290	276.09	5.01E+01	20.00	3.52E+01	2.82
m	14	281.44	271 -	290	280.70	1.71E+01	19.84	1.82E+01	3.05
M	15	303.21	298 -	316	302.48	9.78E+01	24.98	3.29E+01	2.56
m	16	314.42	298 -	316	313.71	1.07E+01	11.66	1.85E+01	2.79
	17	334.05	327 -	339	333.35	5.24E+01	24.41	4.53E+01	2.86
	18	356.31	350 -	361	355.63	3.34E+02	40.89	4.16E+01	1.95
M	19	384.15	381 -	394	383.49	6.57E+01	18.19	9.09E+00	2.43
m	20	387.25	381 -	394	386.60	1.00E+02	26.17	1.01E+01	2.38
m	21	391.16	381 -	394	390.51	2.32E+01	22.91	1.01E+01	2.85
	22	415.04	410 -	420	414.41	3.28E+01	13.20	6.44E+00	1.26
	23	436.79	431 -	439	436.18	5.30E+01	17.34	1.40E+01	1.80

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:20:06PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078530.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	21.13	5.63E+01	42.90			5.63E+01	4.29E+01
M	2	30.98	1.83E+03	90.76			1.83E+03	9.08E+01
m	3	35.23	4.22E+02	65.87			4.22E+02	6.59E+01
	4	52.96	5.66E+01	30.40			5.66E+01	3.04E+01
M	5	61.81	1.72E+02	42.58	1.20E+01	2.19E+00	1.60E+02	4.26E+01
m	6	66.12	7.04E+01	39.45			7.04E+01	3.94E+01

Analysis Report for 1902131-05

BC 29B

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	7	81.26	7.02E+02	70.85			7.02E+02	7.09E+01
	8	93.01	4.37E+01	28.02	1.45E+01	1.97E+00	2.91E+01	2.81E+01
M	9	112.14	1.35E+02	37.19			1.35E+02	3.72E+01
m	10	116.62	2.39E+01	22.98			2.39E+01	2.30E+01
	11	165.25	1.80E+01	23.11			1.80E+01	2.31E+01
	12	223.47	3.47E+01	30.13			3.47E+01	3.01E+01
M	13	276.83	5.01E+01	20.00	0.00E+00	0.00E+00	5.01E+01	2.00E+01
m	14	281.44	1.71E+01	19.84			1.71E+01	1.98E+01
M	15	303.21	9.78E+01	24.98			9.78E+01	2.50E+01
m	16	314.42	1.07E+01	11.66			1.07E+01	1.17E+01
	17	334.05	5.24E+01	24.41			5.24E+01	2.44E+01
	18	356.31	3.34E+02	40.89			3.34E+02	4.09E+01
M	19	384.15	6.57E+01	18.19			6.57E+01	1.82E+01
m	20	387.25	1.00E+02	26.17			1.00E+02	2.62E+01
m	21	391.16	2.32E+01	22.91			2.32E+01	2.29E+01
	22	415.04	3.28E+01	13.20			3.28E+01	1.32E+01
	23	436.79	5.30E+01	17.34			5.30E+01	1.73E+01

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.94	255.12		1.93		
		391.69	*	61.90	3.64E+01	3.64E+01
I-125	0.99	35.49	*	6.49	3.76E+02	5.95E+01
BA-133	0.99	30.80	*	97.60	8.28E+01	4.41E+00
		302.84	*	17.80	4.82E+02	1.93E+02
		356.01	*	60.00	5.25E+02	9.38E+01
CE-139	0.99	165.85	*	80.35	1.27E+01	1.66E+01
HG-203	0.90	279.19	*	77.30	1.87E+01	2.24E+01
TH-234	0.95	63.29	*	3.80	6.80E+02	1.87E+02

Analysis Report for 1902131-05

BC 29B

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.941	3.64E+01	3.64E+01	
	I-125	0.999	3.76E+02	5.95E+01	
X	I-129	0.850			
	BA-133	0.999	8.40E+01	4.40E+00	
	CE-139	0.993	1.27E+01	1.66E+01	
	HG-203	0.907	1.87E+01	2.24E+01	
	TH-234	0.959	6.80E+02	1.87E+02	
X	NP-237	0.563			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-05

BC 29B

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:20:06PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	21.13	6.25059E-02	38.13		
	4	52.96	6.29227E-02	26.84		
m	6	66.12	7.82336E-02	28.01	Sum	
	7	81.26	7.80088E-01	5.05		
	8	93.01	3.23858E-02	48.19	Sum	
M	9	112.14	1.49675E-01	13.80		
m	10	116.62	2.65152E-02	48.14		
	12	223.47	3.85810E-02	43.39		
M	13	276.83	5.57054E-02	19.95		
m	16	314.42	1.19323E-02	54.30	Sum	
	17	334.05	5.81778E-02	23.31	Sum	
M	19	384.15	7.30385E-02	13.83		
m	20	387.25	1.11540E-01	13.03	Sum	
	22	415.04	3.64198E-02	20.14		
	23	436.79	5.89167E-02	16.35		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)

Analysis Report for 1902131-05

BC 29B

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	5.43E-03	5.43E-03	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.63E+01	1.63E+01	3.75E+00	7.49E+00
		136.48		10.60	1.88E+02		1.71E+02	8.81E+01
	NI-59	6.92		29.80	5.60E-02	5.60E-02	-1.67E-02	2.42E-02
	MO-93	16.59		52.90	1.14E+00	1.14E+00	2.63E-01	5.44E-01
		18.60		10.00	9.19E+00		1.16E+01	4.41E+00
	NB-93M	16.57		9.43	6.38E+00	6.38E+00	1.47E+00	3.04E+00
	CD-109	88.03		3.72	2.77E+02	2.77E+02	-4.64E+01	1.29E+02
+	SN-113	255.12		1.93	9.92E+02	3.77E+01	-7.37E+01	4.40E+02
		391.69	*	61.90	3.77E+01		3.64E+01	1.67E+01
	SN-119M	23.87		16.10	9.07E+00	6.87E+00	-2.17E+01	4.32E+00
		25.10		22.70	6.87E+00		-1.20E+02	3.27E+00
+	I-125	35.49	*	6.49	6.99E+01	6.99E+01	3.76E+02	3.37E+01
	I-129	29.78	*	57.00	6.23E+00	6.23E+00	1.42E+02	3.01E+00
		33.60	*	13.20	3.43E+01		1.84E+02	1.66E+01
		39.58		7.52	4.37E+01		-1.54E+00	2.05E+01
+	BA-133	30.80	*	97.60	3.64E+00	3.64E+00	8.28E+01	1.76E+00
		302.84	*	17.80	2.41E+02		4.82E+02	1.14E+02
		356.01	*	60.00	5.15E+01		5.25E+02	2.36E+01
+	CE-139	165.85	*	80.35	2.69E+01	2.69E+01	1.27E+01	1.25E+01
	CE-144	133.54		10.80	1.66E+02	1.66E+02	4.18E+01	7.72E+01
+	HG-203	279.19	*	77.30	5.18E+01	5.18E+01	1.87E+01	2.44E+01
	PB-210	46.50		4.25	9.21E+01	9.21E+01	-9.21E+00	4.29E+01
	PA-231	9.28		42.00	1.80E-01	1.80E-01	5.87E-02	8.34E-02
		10.11		20.20	5.61E-01		4.21E-01	2.63E-01
		283.67		1.60	1.35E+03		-2.76E+02	6.03E+02
		302.67		2.30	2.03E+03		3.49E+03	9.63E+02
	TH-231	25.64		14.70	1.21E+01	1.21E+01	-3.44E+02	5.80E+00
		84.21		6.40	4.98E+02		2.37E+03	2.44E+02
	PA-234M	9.89		89.00	1.19E-01	1.19E-01	8.97E-02	5.60E-02
		21.72		64.90	1.95E+00		2.31E+00	9.31E-01
		37.93		23.75	2.69E+01		1.02E+00	1.31E+01
		131.42		20.40	7.87E+01		-1.24E+01	3.64E+01
+	TH-234	63.29	*	3.80	3.68E+02	3.68E+02	6.80E+02	1.78E+02
	NP-237	29.37	*	14.00	2.53E+01	2.53E+01	5.77E+02	1.22E+01
		86.50		12.60	8.25E+01		-1.34E+01	3.84E+01
	U-237	97.08		16.30	7.32E+01	5.12E+01	-1.34E+01	3.39E+01
		101.07		26.30	5.12E+01		2.40E+01	2.39E+01
		114.00		12.30	2.10E+02		4.22E+02	1.00E+02
		208.01		22.00	1.20E+02		4.78E+01	5.59E+01
	AM-241	59.54		35.90	2.93E+01	2.93E+01	5.05E+01	1.41E+01
	AM-243	74.67		66.00	1.45E+01	1.45E+01	-6.85E+01	6.80E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

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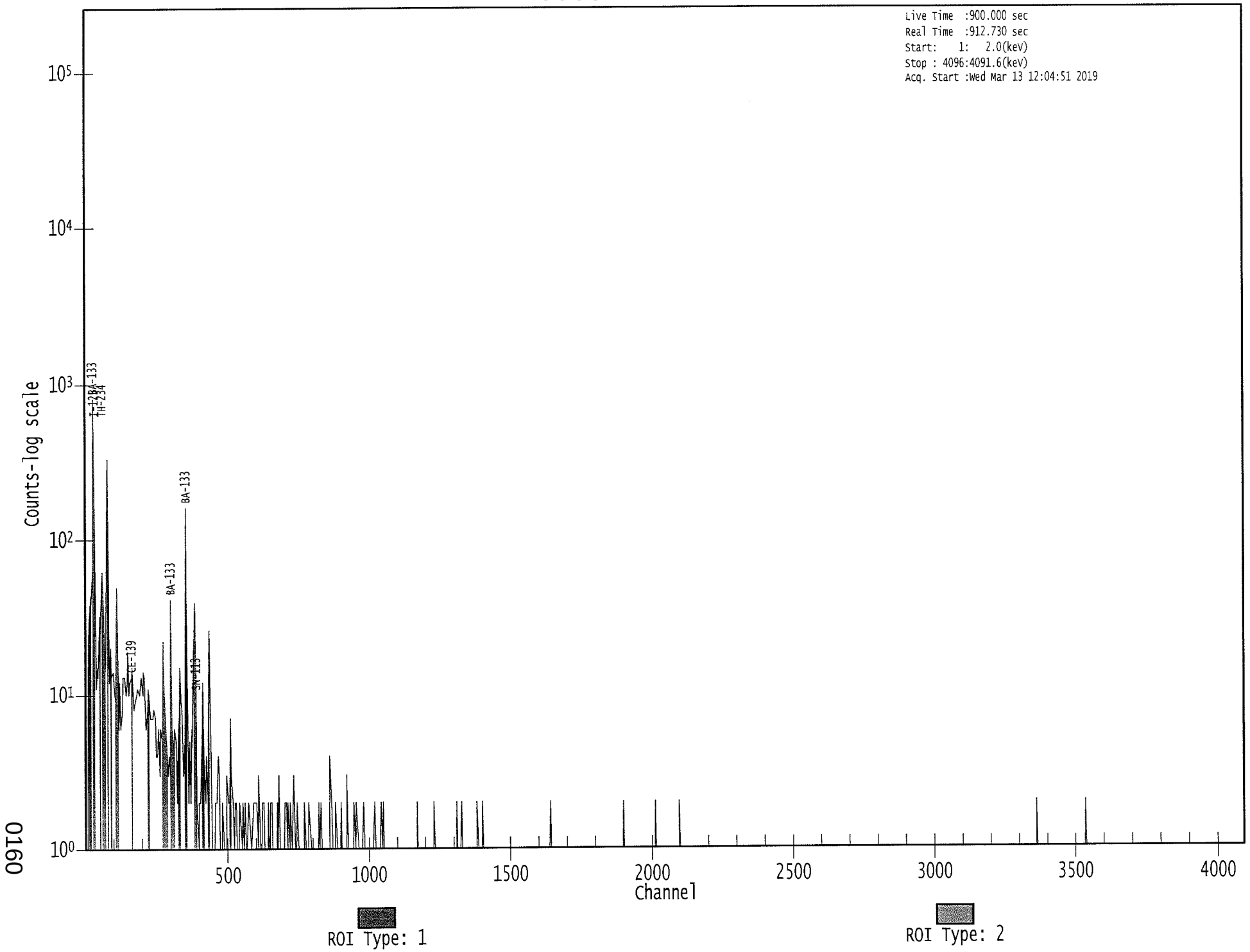

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KP 3/13/19

Apex-Gamma

Analysis Report for 1902131-06

BC 20

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-06
Sample Description	: BC 20
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 9:00:14AM
Acquisition Started	: 3/13/2019 12:20:03PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE1
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.3 seconds
Dead Time	: 0.03 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 18 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 6/16/2018
Efficiency Calibration Used Done On	: 2/17/2018
Efficiency Calibration Description	:
Sample Number	: 78693

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:35:06PM

Peak Analysis From Channel : 1

Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-06

BC 20

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	30.76	26 -	39	31.13	2.12E+03	105.41	4.67E+02	2.48
m	2	35.11	26 -	39	35.48	5.14E+02	111.26	6.50E+02	2.90
	3	52.75	49 -	57	53.12	5.51E+01	43.85	2.64E+02	4.28
M	4	61.93	58 -	72	62.30	2.65E+02	48.16	2.18E+02	2.44
m	5	66.16	58 -	72	66.52	1.09E+02	45.20	2.05E+02	2.46
	6	81.09	76 -	87	81.45	8.14E+02	80.70	4.03E+02	2.65
M	7	112.01	107 -	121	112.37	1.91E+02	45.30	1.92E+02	2.55
m	8	115.68	107 -	121	116.03	3.16E+01	44.14	1.88E+02	2.55
	9	239.88	236 -	244	240.20	2.42E+01	27.60	9.96E+01	3.29
	10	277.11	272 -	283	277.43	7.47E+01	27.86	5.87E+01	3.12
	11	303.76	298 -	310	304.07	1.82E+02	40.15	1.04E+02	2.55
	12	333.59	331 -	338	333.89	5.17E+01	28.21	1.03E+02	2.06
	13	356.14	350 -	361	356.43	5.97E+02	56.57	1.01E+02	2.46
	14	364.67	362 -	368	364.96	3.84E+01	21.82	5.73E+01	3.94
M	15	387.15	380 -	399	387.44	2.09E+02	41.37	6.11E+01	2.85
m	16	391.48	380 -	399	391.76	4.67E+01	35.43	3.82E+01	2.86
	17	406.14	402 -	410	406.43	1.34E+01	16.91	3.53E+01	3.78
	18	415.52	411 -	424	415.81	4.96E+01	31.11	9.08E+01	3.15
	19	437.39	434 -	441	437.67	9.22E+01	23.15	2.76E+01	2.35
	20	468.14	463 -	471	468.41	1.51E+01	15.41	2.79E+01	3.55
	21	616.76	614 -	619	617.00	5.75E+00	8.19	8.50E+00	1.06
	22	866.20	864 -	868	866.40	6.00E+00	6.67	4.00E+00	1.07
	23	1074.68	1072 -	1076	1074.83	6.00E+00	4.90	0.00E+00	1.12

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:35:06PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078527.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	30.76	2.12E+03	105.41			2.12E+03	1.05E+02
m	2	35.11	5.14E+02	111.26			5.14E+02	1.11E+02
	3	52.75	5.51E+01	43.85			5.51E+01	4.38E+01
M	4	61.93	2.65E+02	48.16	2.17E+01	2.18E+00	2.43E+02	4.82E+01
m	5	66.16	1.09E+02	45.20			1.09E+02	4.52E+01
	6	81.09	8.14E+02	80.70			8.14E+02	8.07E+01

Analysis Report for 1902131-06

BC 20

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	7	112.01	1.91E+02	45.30			1.91E+02	4.53E+01
m	8	115.68	3.16E+01	44.14			3.16E+01	4.41E+01
	9	239.88	2.42E+01	27.60			2.42E+01	2.76E+01
	10	277.11	7.47E+01	27.86			7.47E+01	2.79E+01
	11	303.76	1.82E+02	40.15			1.82E+02	4.01E+01
	12	333.59	5.17E+01	28.21			5.17E+01	2.82E+01
	13	356.14	5.97E+02	56.57			5.97E+02	5.66E+01
	14	364.67	3.84E+01	21.82			3.84E+01	2.18E+01
M	15	387.15	2.09E+02	41.37			2.09E+02	4.14E+01
m	16	391.48	4.67E+01	35.43			4.67E+01	3.54E+01
	17	406.14	1.34E+01	16.91			1.34E+01	1.69E+01
	18	415.52	4.96E+01	31.11			4.96E+01	3.11E+01
	19	437.39	9.22E+01	23.15			9.22E+01	2.32E+01
	20	468.14	1.51E+01	15.41			1.51E+01	1.54E+01
	21	616.76	5.75E+00	8.19			5.75E+00	8.19E+00
	22	866.20	6.00E+00	6.67			6.00E+00	6.67E+00
	23	1074.68	6.00E+00	4.90			6.00E+00	4.90E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.97	255.12		1.93		
		391.69	*	61.90	2.77E+01	2.11E+01
I-125	0.99	35.49	*	6.49	4.86E+00	1.05E+00
BA-133	0.99	30.80	*	97.60	3.88E-01	1.93E-02
		302.84	*	17.80	8.00E+02	3.88E+02
		356.01	*	60.00	5.03E+02	7.28E+01
PA-231	0.99	9.28		42.00		
		10.11		20.20		
		283.67		1.60		
		302.67	*	2.30	6.19E+03	3.00E+03
TH-234	0.94	63.29	*	3.80	2.71E+02	5.42E+01

Analysis Report for 1902131-06

BC 20

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.970	2.77E+01	2.11E+01	
	I-125	0.996	4.86E+00	1.05E+00	
X	I-129	0.750			
	BA-133	0.997	3.88E-01	1.93E-02	
	PA-231	0.999	6.19E+03	3.00E+03	
	TH-234	0.946	2.71E+02	5.42E+01	
X	NP-237	0.939			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-06

BC 20

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:35:06PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	3	52.75	6.12210E-02	39.79		
m	5	66.16	1.21610E-01	20.65	Sum	
	6	81.09	9.04996E-01	4.95		
M	7	112.01	2.11985E-01	11.87	Tol.	U-237
m	8	115.68	3.50735E-02	69.91	Tol.	U-237
	9	239.88	2.68994E-02	57.00		
	10	277.11	8.29487E-02	18.66		
	12	333.59	5.74865E-02	27.27	Sum	
	14	364.67	4.26202E-02	28.45	Sum	
M	15	387.15	2.32272E-01	9.90	Sum	
	17	406.14	1.48566E-02	63.24		
	18	415.52	5.51345E-02	31.35		
	19	437.39	1.02427E-01	12.56		
	20	468.14	1.67433E-02	51.14		
	21	616.76	6.38889E-03	71.18		
	22	866.20	6.66667E-03	55.59		
	23	1074.68	6.66667E-03	40.82		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

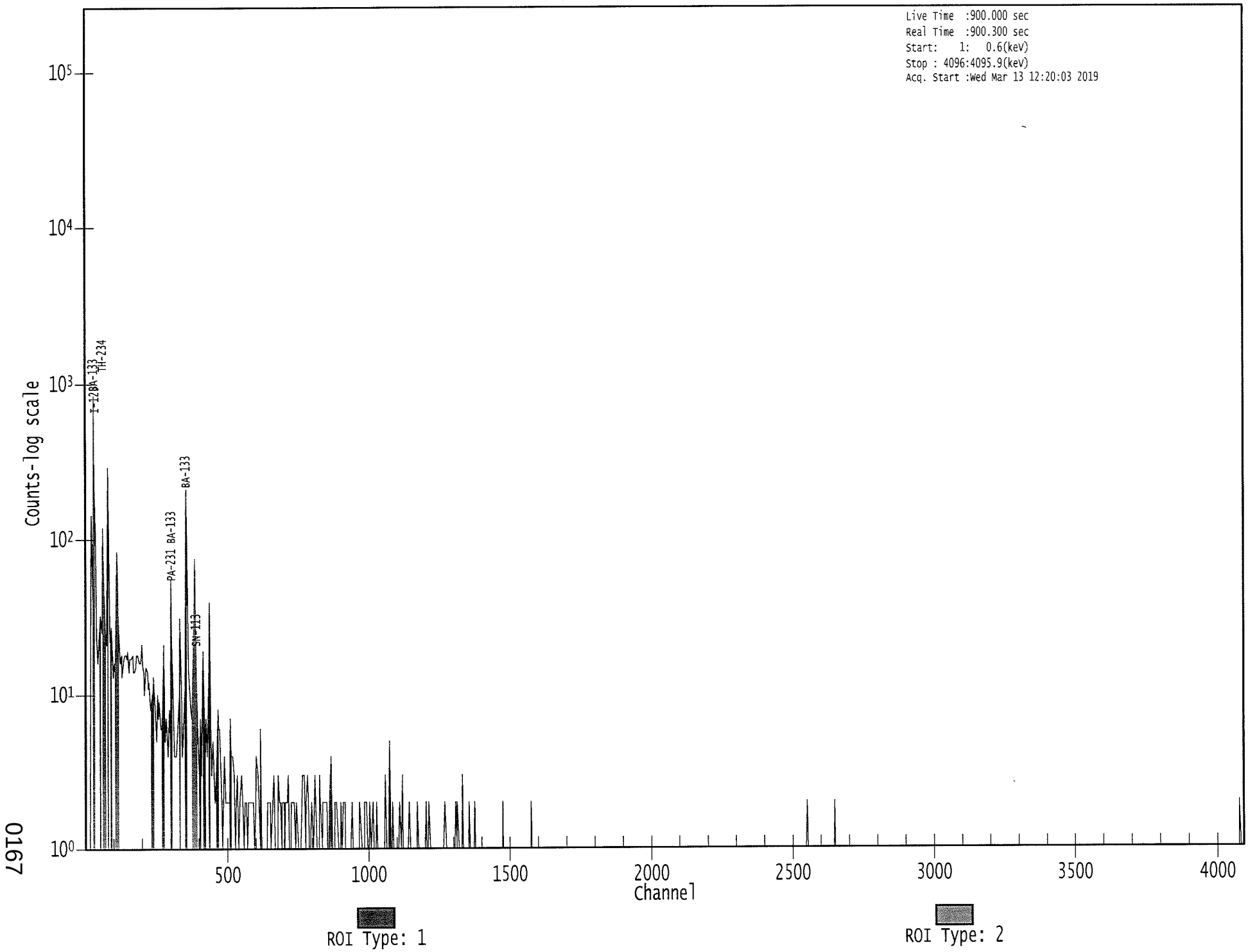
Analysis Report for 1902131-06

BC 20

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	1.90E-13	1.90E-13	0.00E+00	0.00E+00
	CO-57	122.06		85.51	3.33E+01	3.33E+01	2.30E+00	1.55E+01
		136.48		10.60	3.30E+02		-1.33E+02	1.53E+02
	NI-59	6.92		29.80	2.77E-12	2.77E-12	0.00E+00	0.00E+00
	MO-93	16.59		52.90	7.49E-06	7.49E-06	-7.87E-06	3.30E-06
		18.60		10.00	3.95E-04		-4.33E-05	1.88E-04
	NB-93M	16.57		9.43	4.14E-05	4.14E-05	-4.35E-05	1.82E-05
	CD-109	88.03		3.72	3.14E+02	3.14E+02	4.16E+01	1.48E+02
+	SN-113	255.12		1.93	1.86E+03	3.91E+01	7.30E+02	8.56E+02
		391.69	*	61.90	3.91E+01		2.77E+01	1.88E+01
	SN-119M	23.87		16.10	7.09E-03	7.09E-03	1.20E-02	3.43E-03
		25.10		22.70	8.07E-03		1.10E-02	3.90E-03
+	I-125	35.49	*	6.49	1.42E+00	1.42E+00	4.86E+00	6.96E-01
	I-129	29.78	*	57.00	4.60E-02	4.60E-02	6.65E-01	2.26E-02
		33.60		13.20	5.40E-01		-6.04E-01	2.66E-01
		39.58		7.52	1.50E+00		-6.26E-02	7.17E-01
+	BA-133	30.80	*	97.60	2.69E-02	2.69E-02	3.88E-01	1.32E-02
		302.84	*	17.80	2.27E+02		8.00E+02	1.07E+02
		356.01	*	60.00	4.19E+01		5.03E+02	1.98E+01
	CE-139	165.85		80.35	6.34E+01	6.34E+01	-3.88E+00	2.96E+01
	CE-144	133.54		10.80	3.16E+02	3.16E+02	1.00E+02	1.47E+02
	HG-203	279.19		77.30	5.00E+01	5.00E+01	4.20E+01	2.34E+01
	PB-210	46.50		4.25	5.99E+00	5.99E+00	-5.53E-01	2.80E+00
+	PA-231	9.28		42.00	2.61E-10	2.61E-10	0.00E+00	0.00E+00
		10.11		20.20	2.08E-09		0.00E+00	0.00E+00
		283.67		1.60	1.60E+03		3.96E+02	7.21E+02
		302.67	*	2.30	1.76E+03		6.19E+03	8.32E+02
	TH-231	25.64		14.70	1.25E-02	1.25E-02	-6.04E-03	5.98E-03
		84.21		6.40	2.27E+02		-3.22E+02	1.09E+02
	PA-234M	9.89		89.00	3.36E-10	3.36E-10	0.00E+00	0.00E+00
		21.72		64.90	6.47E-04		1.63E-03	3.14E-04
		37.93		23.75	5.07E-01		6.13E-01	2.46E-01
		131.42		20.40	1.54E+02		-7.29E+01	7.11E+01
+	TH-234	63.29	*	3.80	1.19E+02	1.19E+02	2.71E+02	5.78E+01
	NP-237	29.37	*	14.00	1.87E-01	1.87E-01	2.71E+00	9.19E-02
		86.50		12.60	8.42E+01		-3.45E+00	3.96E+01
	U-237	97.08		16.30	8.54E+01	6.55E+01	-6.10E+01	3.96E+01
		101.07		26.30	6.55E+01		2.40E+01	3.05E+01
		114.00		12.30	3.81E+02		5.87E+02	1.84E+02
		208.01		22.00	2.13E+02		6.09E+01	9.82E+01
	AM-241	59.54		35.90	6.98E+00	6.98E+00	5.72E+00	3.36E+00
	AM-243	74.67		66.00	8.14E+00	8.14E+00	-1.80E+00	3.83E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

0000078693.CNF



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KP 3/13/19

Apex-Gamma

Analysis Report for 1902131-07

BC 18

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-07
Sample Description	: BC 18
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 9:00:24AM
Acquisition Started	: 3/13/2019 12:20:11PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE2
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.2 seconds
Dead Time	: 0.02 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 28 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/17/2018
Efficiency Calibration Used Done On	: 2/24/2018
Efficiency Calibration Description	:
Sample Number	: 78694

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:35:22PM

Peak Analysis From Channel : 1

Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-07

BC 18

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.71	35 -	39	35.49	3.80E+02	63.50	2.57E+02	2.41
	2	46.80	44 -	49	46.57	2.46E+01	21.84	7.67E+01	3.13
	3	53.44	50 -	56	53.21	5.47E+01	27.40	9.46E+01	1.99
	4	62.09	58 -	64	61.86	1.30E+02	39.62	1.88E+02	1.34
	5	66.42	65 -	69	66.18	4.49E+01	29.11	1.40E+02	1.55
	6	81.36	77 -	84	81.12	6.65E+02	63.09	2.20E+02	1.26
M	7	112.02	107 -	121	111.77	1.17E+02	28.04	6.00E+01	1.65
m	8	116.03	107 -	121	115.78	3.17E+01	22.05	6.00E+01	1.66
M	9	265.19	261 -	283	264.87	8.08E+00	9.59	9.73E+00	1.48
m	10	276.36	261 -	283	276.03	4.21E+01	15.36	1.80E+01	1.50
M	11	302.82	299 -	313	302.48	1.74E+02	27.22	3.02E+01	1.70
m	12	307.37	299 -	313	307.02	1.95E+01	24.71	2.68E+01	2.47
m	13	311.37	299 -	313	311.02	1.15E+01	17.51	2.28E+01	2.48
	14	322.96	321 -	325	322.61	8.07E+00	9.34	1.19E+01	1.77
	15	333.38	330 -	337	333.03	3.32E+01	25.38	8.75E+01	1.32
	16	356.04	352 -	360	355.68	4.32E+02	44.93	4.34E+01	1.72
M	17	383.71	379 -	389	383.33	5.73E+01	22.76	3.54E+01	1.96
m	18	386.90	379 -	389	386.51	7.06E+01	27.02	4.83E+01	1.90
M	19	414.25	410 -	420	413.85	1.73E+01	11.53	8.53E+00	1.65
m	20	417.55	410 -	420	417.15	8.91E+00	10.05	1.33E+01	1.66
	21	436.95	433 -	441	436.54	5.72E+01	19.32	2.16E+01	1.92
	22	468.73	464 -	472	468.30	1.42E+01	10.61	7.56E+00	2.23
	23	2612.65	2607 -	2613	2610.80	5.00E+00	4.47	0.00E+00	2.75

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:35:22PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078528.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
1	35.71	3.80E+02	63.50			3.80E+02	6.35E+01
2	46.80	2.46E+01	21.84	7.76E+00	1.46E+00	1.69E+01	2.19E+01
3	53.44	5.47E+01	27.40			5.47E+01	2.74E+01
4	62.09	1.30E+02	39.62			1.30E+02	3.96E+01
5	66.42	4.49E+01	29.11			4.49E+01	2.91E+01
6	81.36	6.65E+02	63.09			6.65E+02	6.31E+01

Analysis Report for 1902131-07

BC 18

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	7	112.02	1.17E+02	28.04			1.17E+02	2.80E+01
m	8	116.03	3.17E+01	22.05			3.17E+01	2.20E+01
M	9	265.19	8.08E+00	9.59			8.08E+00	9.59E+00
m	10	276.36	4.21E+01	15.36			4.21E+01	1.54E+01
M	11	302.82	1.74E+02	27.22			1.74E+02	2.72E+01
m	12	307.37	1.95E+01	24.71			1.95E+01	2.47E+01
m	13	311.37	1.15E+01	17.51			1.15E+01	1.75E+01
	14	322.96	8.07E+00	9.34			8.07E+00	9.34E+00
	15	333.38	3.32E+01	25.38			3.32E+01	2.54E+01
	16	356.04	4.32E+02	44.93			4.32E+02	4.49E+01
M	17	383.71	5.73E+01	22.76			5.73E+01	2.28E+01
m	18	386.90	7.06E+01	27.02			7.06E+01	2.70E+01
M	19	414.25	1.73E+01	11.53			1.73E+01	1.15E+01
m	20	417.55	8.91E+00	10.05			8.91E+00	1.00E+01
	21	436.95	5.72E+01	19.32			5.72E+01	1.93E+01
	22	468.73	1.42E+01	10.61			1.42E+01	1.06E+01
	23	2612.65	5.00E+00	4.47	1.40E+00	3.96E-01	3.60E+00	4.49E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-125	0.99	35.49	*	6.49	1.44E+01	2.41E+00
PB-210	0.99	46.50	*	4.25	5.58E+00	7.24E+00
PA-231	1.00	9.28		42.00		
		10.11		20.20		
		283.67		1.60		
		302.67	*	2.30	5.14E+03	1.76E+03

Analysis Report for 1902131-07

BC 18

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
I-125	0.999	1.44E+01	2.41E+00	
PB-210	0.998	5.58E+00	7.24E+00	
PA-231	1.000	5.14E+03	1.76E+03	

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-07

BC 18

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:35:22PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	3	53.44	6.07843E-02	25.05		
	4	62.09	1.44392E-01	15.24	Tol.	TH-234
	5	66.42	4.98841E-02	32.42		
	6	81.36	7.38971E-01	4.74	Sum	
M	7	112.02	1.30035E-01	11.98	Tol.	U-237
m	8	116.03	3.52356E-02	34.76		
M	9	265.19	8.97374E-03	59.38		
m	10	276.36	4.67290E-02	18.26		
m	12	307.37	2.16742E-02	63.35		
m	13	311.37	1.28259E-02	75.86		
	14	322.96	8.96825E-03	57.86		
	15	333.38	3.69192E-02	38.19		
	16	356.04	4.80343E-01	5.20		
M	17	383.71	6.36984E-02	19.85		
m	18	386.90	7.84186E-02	19.14		
M	19	414.25	1.91804E-02	33.40		
m	20	417.55	9.90406E-03	56.37		
	21	436.95	6.35784E-02	16.88		
	22	468.73	1.58025E-02	37.29		
	23	2612.65	3.99642E-03	62.41		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Analysis Report for 1902131-07

BC 18

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	1.20E-10	1.20E-10	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.04E+01	2.04E+01	5.53E+00	9.24E+00
		136.48		10.60	2.35E+02		7.15E+00	1.08E+02
	NI-59	6.92		29.80	9.43E-10	9.43E-10	0.00E+00	0.00E+00
	MO-93	16.59		52.90	1.78E-05	1.78E-05	0.00E+00	0.00E+00
		18.60		10.00	2.91E-04		0.00E+00	0.00E+00
	NB-93M	16.57		9.43	9.85E-05	9.85E-05	0.00E+00	0.00E+00
	CD-109	88.03		3.72	2.37E+02	2.37E+02	-5.69E+01	1.09E+02
	SN-113	255.12		1.93	1.07E+03	1.59E+01	2.97E+02	4.76E+02
		391.69		61.90	1.59E+01		7.98E+00	7.12E+00
	SN-119M	23.87		16.10	1.78E-03	1.78E-03	0.00E+00	0.00E+00
		25.10		22.70	1.93E-03		0.00E+00	0.00E+00
+	I-125	35.49	*	6.49	3.24E+00	3.24E+00	1.44E+01	1.57E+00
	I-129	29.78		57.00	2.05E-01	2.05E-01	1.13E+00	1.01E-01
		33.60		13.20	1.19E+00		-6.87E+00	5.80E-01
		39.58		7.52	1.80E+00		-5.26E-01	8.10E-01
	BA-133	30.80		97.60	1.71E-01	1.71E-01	1.46E+00	8.44E-02
		302.84		17.80	2.40E+02		5.73E+02	1.15E+02
		356.01		60.00	8.16E+01		3.52E+02	3.97E+01
	CE-139	165.85		80.35	3.93E+01	3.93E+01	5.04E+00	1.81E+01
	CE-144	133.54		10.80	2.00E+02	2.00E+02	-1.40E+01	9.13E+01
	HG-203	279.19		77.30	2.40E+01	2.40E+01	-2.38E+01	1.06E+01
+	PB-210	46.50	*	4.25	1.19E+01	1.19E+01	5.58E+00	5.52E+00
+	PA-231	9.28		42.00	3.13E-08	3.13E-08	0.00E+00	0.00E+00
		10.11		20.20	1.87E-07		0.00E+00	0.00E+00
		283.67		1.60	8.86E+02		1.57E+01	3.79E+02
		302.67	*	2.30	1.34E+03		5.14E+03	6.32E+02
	TH-231	25.64		14.70	3.57E-03	3.57E-03	0.00E+00	0.00E+00
		84.21		6.40	2.34E+02		-2.76E+01	1.13E+02
	PA-234M	9.89		89.00	3.24E-08	3.24E-08	0.00E+00	0.00E+00
		21.72		64.90	1.91E-04		0.00E+00	0.00E+00
		37.93		23.75	5.16E-01		-1.54E+00	2.37E-01
		131.42		20.40	1.03E+02		-3.70E+01	4.70E+01
	TH-234	63.29		3.80	1.30E+02	1.30E+02	7.31E+01	6.23E+01
	NP-237	29.37		14.00	3.10E-01	3.10E-01	-5.39E+00	1.49E-01
		86.50		12.60	7.10E+01		-4.55E+01	3.29E+01
	U-237	97.08		16.30	8.01E+01	5.61E+01	1.45E+01	3.71E+01
		101.07		26.30	5.61E+01		1.16E+01	2.60E+01
		114.00		12.30	2.61E+02		2.55E+02	1.24E+02
		208.01		22.00	1.50E+02		6.28E+01	6.87E+01
	AM-241	59.54		35.90	6.22E+00	6.22E+00	-2.35E+01	2.91E+00
	AM-243	74.67		66.00	8.09E+00	8.09E+00	1.88E+00	3.75E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

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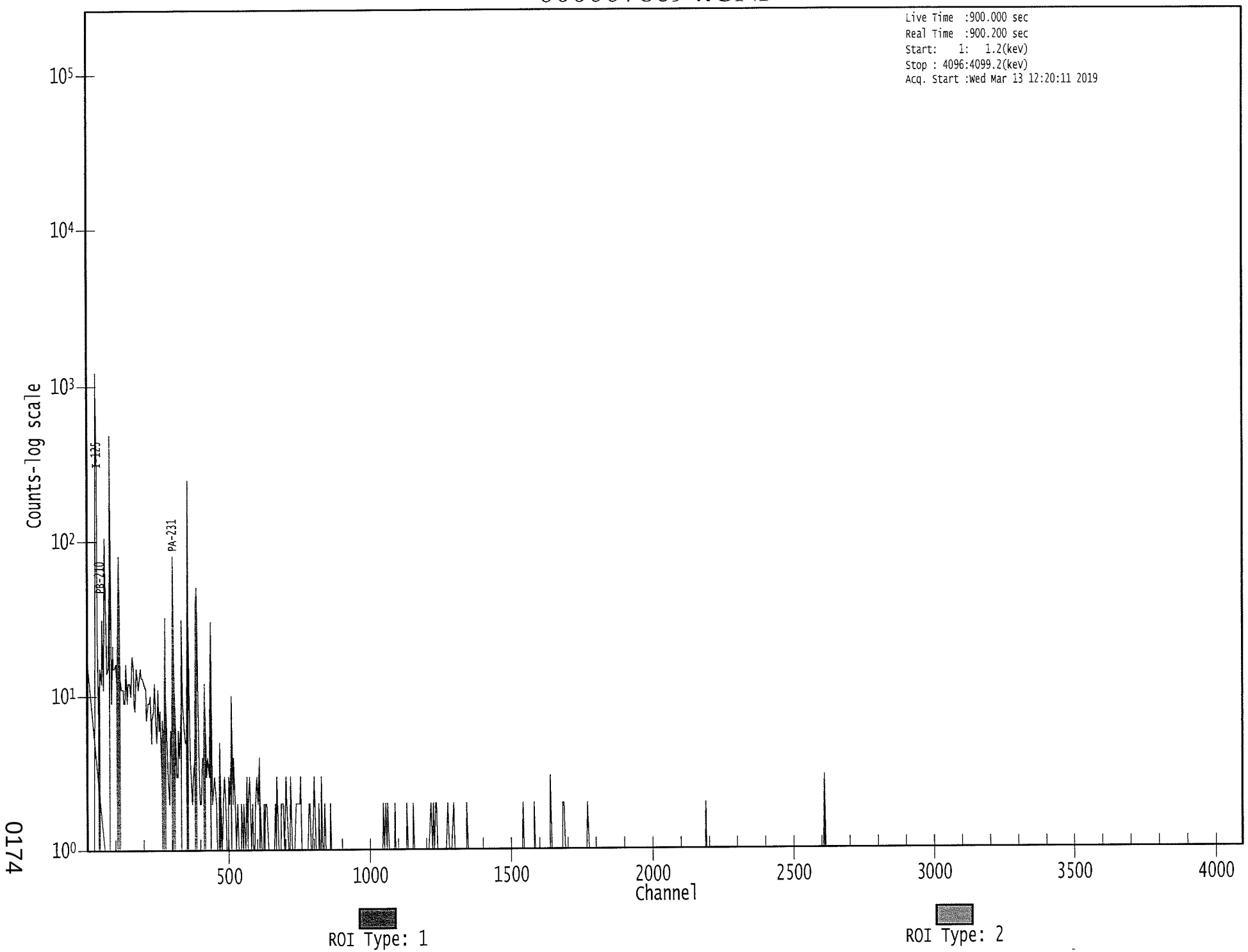

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KP 3/13/19

Apex-Gamma

Analysis Report for 1902131-08

BC 19

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-08
Sample Description	: BC 19
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 9:00:38AM
Acquisition Started	: 3/13/2019 12:20:18PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE3
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 902.3 seconds
Dead Time	: 0.26 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 7/21/2018
Efficiency Calibration Used Done On	: 7/21/2018
Efficiency Calibration Description	:
Sample Number	: 78695

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:35:35PM

Peak Analysis From Channel : 1

Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-08

BC 19

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	30.80	17 -	41	31.16	2.25E+03	106.75	2.72E+02	2.66
m	2	34.98	17 -	41	35.34	5.67E+02	103.07	2.72E+02	2.67
	3	52.72	50 -	57	53.07	9.96E+01	44.86	2.71E+02	4.00
M	4	61.75	58 -	71	62.10	2.27E+02	50.68	2.74E+02	2.48
m	5	65.99	58 -	71	66.33	1.09E+02	48.96	3.09E+02	2.49
	6	80.91	76 -	88	81.25	9.18E+02	86.26	4.48E+02	2.76
M	7	111.69	107 -	123	112.02	2.49E+02	46.52	1.76E+02	2.82
m	8	115.59	107 -	123	115.92	7.65E+01	45.08	1.53E+02	2.83
	9	161.29	158 -	165	161.60	3.53E+01	31.18	1.35E+02	2.41
	10	261.86	257 -	267	262.13	3.78E+01	24.43	5.63E+01	5.60
	11	277.06	271 -	286	277.31	8.21E+01	39.95	1.22E+02	3.57
	12	302.80	298 -	308	303.04	1.40E+02	41.92	1.61E+02	1.84
	13	332.87	327 -	338	333.11	4.01E+01	35.94	1.34E+02	2.89
	14	355.98	349 -	361	356.20	5.16E+02	51.70	7.21E+01	2.77
M	15	383.82	379 -	404	384.04	1.15E+02	28.88	4.63E+01	2.41
m	16	386.85	379 -	404	387.07	1.56E+02	38.08	3.47E+01	2.84
M	17	414.90	411 -	423	415.10	4.14E+01	18.55	2.40E+01	3.47
m	18	418.80	411 -	423	419.00	2.13E+01	17.48	2.10E+01	2.37
	19	436.93	432 -	443	437.12	1.00E+02	20.00	0.00E+00	2.29
	20	467.99	463 -	478	468.17	1.71E+01	21.73	4.19E+01	3.80
	21	857.18	853 -	861	857.22	9.00E+00	6.00	0.00E+00	1.00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:35:35PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078529.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	30.80	2.25E+03	106.75			2.25E+03	1.07E+02
m	2	34.98	5.67E+02	103.07			5.67E+02	1.03E+02
	3	52.72	9.96E+01	44.86			9.96E+01	4.49E+01
M	4	61.75	2.27E+02	50.68	1.60E+01	3.04E+00	2.11E+02	5.08E+01
m	5	65.99	1.09E+02	48.96			1.09E+02	4.90E+01
	6	80.91	9.18E+02	86.26			9.18E+02	8.63E+01
M	7	111.69	2.49E+02	46.52			2.49E+02	4.65E+01
m	8	115.59	7.65E+01	45.08			7.65E+01	4.51E+01

Analysis Report for 1902131-08

BC 19

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	9	161.29	3.53E+01	31.18			3.53E+01	3.12E+01
	10	261.86	3.78E+01	24.43			3.78E+01	2.44E+01
	11	277.06	8.21E+01	39.95			8.21E+01	3.99E+01
	12	302.80	1.40E+02	41.92			1.40E+02	4.19E+01
	13	332.87	4.01E+01	35.94			4.01E+01	3.59E+01
	14	355.98	5.16E+02	51.70			5.16E+02	5.17E+01
M	15	383.82	1.15E+02	28.88			1.15E+02	2.89E+01
m	16	386.85	1.56E+02	38.08	0.00E+00	0.00E+00	1.56E+02	3.81E+01
M	17	414.90	4.14E+01	18.55			4.14E+01	1.85E+01
m	18	418.80	2.13E+01	17.48			2.13E+01	1.75E+01
	19	436.93	1.00E+02	20.00			1.00E+02	2.00E+01
	20	467.99	1.71E+01	21.73			1.71E+01	2.17E+01
	21	857.18	9.00E+00	6.00			9.00E+00	6.00E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-125	0.99	35.49	*	6.49	2.52E+01	4.57E+00
BA-133	1.00	30.80	*	97.60	2.89E+00	1.37E-01
		302.84	*	17.80	5.26E+02	2.48E+02
		356.01	*	60.00	4.48E+02	6.80E+01
HG-203	0.92	279.19	*	77.30	7.87E+01	4.97E+01
TH-234	0.95	63.29	*	3.80	3.28E+02	7.97E+01

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

Analysis Report for 1902131-08

BC 19

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	I-125	0.995	2.52E+01	4.57E+00	
X	I-129	0.910			
	BA-133	1.000	2.89E+00	1.37E-01	
	HG-203	0.922	7.87E+01	4.97E+01	
	TH-234	0.958	3.28E+02	7.97E+01	
X	NP-237	0.891			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-08

BC 19

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:35:35PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	3	52.72	1.10674E-01	22.52		
m	5	65.99	1.21196E-01	22.44	Sum	
	6	80.91	1.01975E+00	4.70		
M	7	111.69	2.77011E-01	9.33		
m	8	115.59	8.50215E-02	29.46	Tol.	U-237
	9	161.29	3.91963E-02	44.19		
	10	261.86	4.20370E-02	32.28		
	13	332.87	4.45898E-02	44.78	Sum	
M	15	383.82	1.27865E-01	12.55		
m	16	386.85	1.72930E-01	12.23	Sum	
M	17	414.90	4.60156E-02	22.39		
m	18	418.80	2.37187E-02	40.94	Sum	
	19	436.93	1.11111E-01	10.00		
	20	467.99	1.89620E-02	63.65		
	21	857.18	1.00000E-02	33.33		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

Nuclide Name	Energy (keV)	Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)

Analysis Report for 1902131-08

BC 19

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	5.37E-09	5.37E-09	-2.05E-08	1.90E-09
	CO-57	122.06		85.51	2.53E+01	2.53E+01	-7.25E+00	1.18E+01
		136.48		10.60	2.78E+02		4.17E+01	1.31E+02
	NI-59	6.92		29.80	1.06E-07	1.06E-07	2.20E-09	4.81E-08
	MO-93	16.59		52.90	1.13E-03	1.13E-03	4.29E-05	5.38E-04
		18.60		10.00	1.84E-02		1.49E-02	8.85E-03
	NB-93M	16.57		9.43	6.25E-03	6.25E-03	2.38E-04	2.99E-03
	CD-109	88.03		3.72	3.12E+02	3.12E+02	-9.84E+01	1.48E+02
	SN-113	255.12		1.93	1.22E+03	3.66E+01	-2.44E+01	5.56E+02
		391.69		61.90	3.66E+01		4.28E+00	1.74E+01
	SN-119M	23.87		16.10	8.54E-02	8.54E-02	-4.04E-01	4.10E-02
		25.10		22.70	9.00E-02		-1.45E+00	4.33E-02
+	I-125	35.49	*	6.49	7.84E+00	7.84E+00	2.52E+01	3.86E+00
	I-129	29.78	*	57.00	3.88E-01	3.88E-01	4.95E+00	1.91E-01
		33.60	*	13.20	3.85E+00		1.23E+01	1.89E+00
		39.58		7.52	5.44E+00		-2.50E-01	2.61E+00
+	BA-133	30.80	*	97.60	2.26E-01	2.26E-01	2.89E+00	1.11E-01
		302.84	*	17.80	2.24E+02		5.26E+02	1.07E+02
		356.01	*	60.00	3.76E+01		4.48E+02	1.76E+01
	CE-139	165.85		80.35	3.99E+01	3.99E+01	1.26E+00	1.87E+01
	CE-144	133.54		10.80	2.46E+02	2.46E+02	1.27E+00	1.15E+02
+	HG-203	279.19	*	77.30	5.87E+01	5.87E+01	7.87E+01	2.80E+01
	PB-210	46.50		4.25	1.95E+01	1.95E+01	1.77E+00	9.25E+00
	PA-231	9.28		42.00	3.92E-06	3.92E-06	5.48E-06	1.86E-06
		10.11		20.20	2.06E-05		2.88E-05	9.78E-06
		283.67		1.60	1.29E+03		-4.68E+02	5.84E+02
		302.67		2.30	1.96E+03		4.09E+03	9.39E+02
	TH-231	25.64		14.70	1.98E-01	1.98E-01	-3.77E+00	9.59E-02
		84.21		6.40	3.25E+02		5.62E+02	1.58E+02
	PA-234M	9.89		89.00	3.69E-06	3.69E-06	5.16E-06	1.75E-06
		21.72		64.90	1.06E-02		1.05E-02	5.09E-03
		37.93		23.75	2.26E+00		4.70E+00	1.10E+00
		131.42		20.40	1.25E+02		-2.78E+00	5.88E+01
+	TH-234	63.29	*	3.80	1.79E+02	1.79E+02	3.28E+02	8.75E+01
	NP-237	29.37	*	14.00	1.58E+00	1.58E+00	2.01E+01	7.77E-01
		86.50		12.60	9.64E+01		-8.23E+00	4.60E+01
	U-237	97.08		16.30	9.37E+01	6.60E+01	-6.67E+01	4.44E+01
		101.07		26.30	6.60E+01		1.35E+01	3.13E+01
		114.00		12.30	3.32E+02		8.73E+02	1.61E+02
		208.01		22.00	1.74E+02		7.74E+01	8.17E+01
	AM-241	59.54		35.90	1.30E+01	1.30E+01	2.25E+01	6.31E+00
	AM-243	74.67		66.00	1.12E+01	1.12E+01	-1.73E+00	5.35E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

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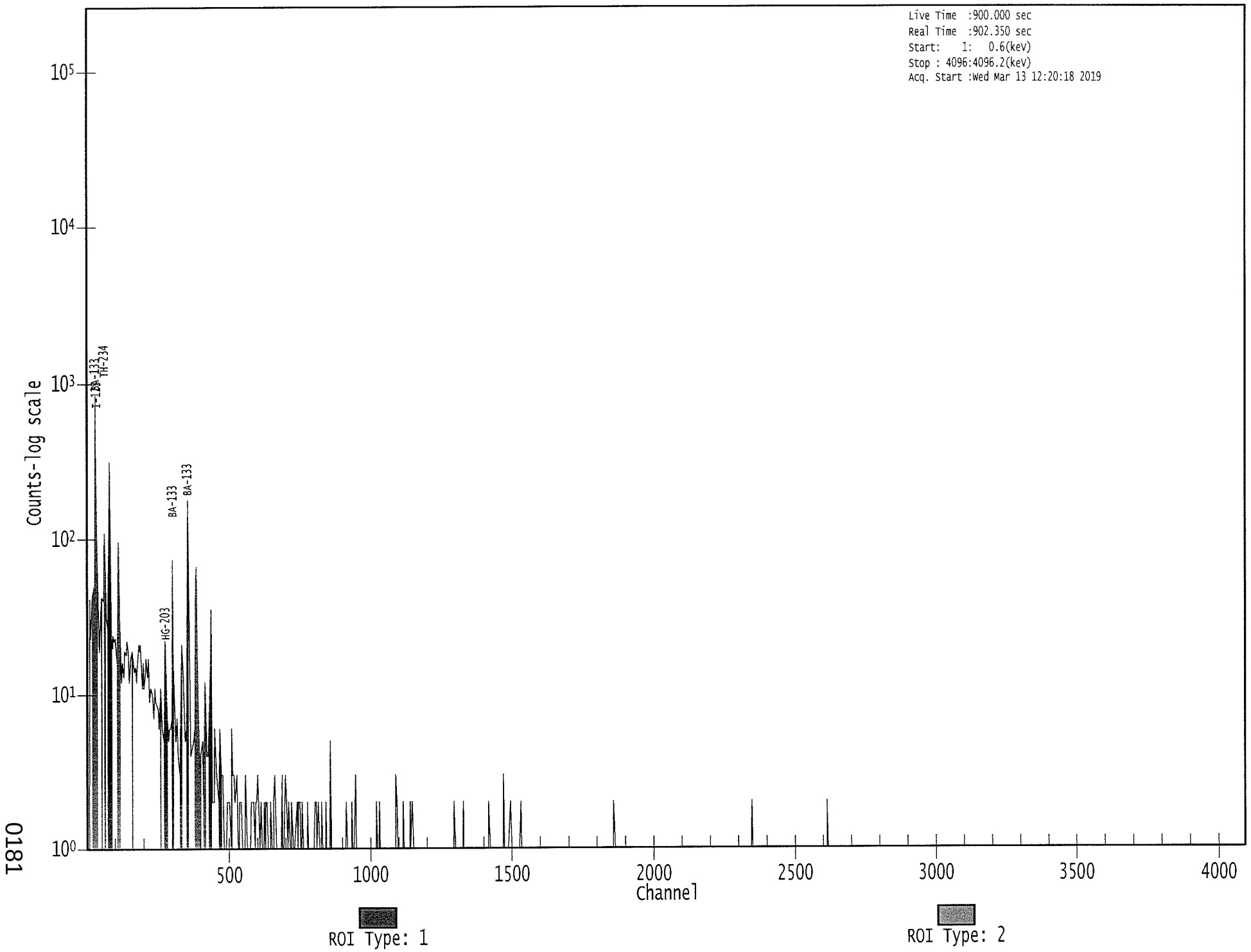

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KP 3/13/19

Apex-Gamma

Analysis Report for 1902131-09

BC 17A

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-09
Sample Description	: BC 17A
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 9:00:47AM
Acquisition Started	: 3/13/2019 12:20:28PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 906.6 seconds
Dead Time	: 0.72 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/24/2018
Efficiency Calibration Used Done On	: 11/9/2014
Efficiency Calibration Description	:
Sample Number	: 78696

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:35:48PM

Peak Analysis From Channel : 1

Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-09

BC 17A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.67	16 -	23	19.72	1.07E+02	45.83	2.77E+02	2.65
M	2	31.01	24 -	40	30.07	2.28E+03	98.88	1.36E+02	2.10
m	3	35.36	24 -	40	34.42	5.67E+02	75.80	8.06E+01	2.23
	4	52.77	47 -	55	51.85	4.78E+01	38.82	2.02E+02	1.93
M	5	62.02	57 -	71	61.10	1.94E+02	42.70	1.63E+02	2.31
m	6	66.12	57 -	71	65.21	1.10E+02	40.19	1.58E+02	2.32
m	7	70.11	57 -	71	69.19	3.54E+01	24.89	1.11E+02	2.32
	8	81.27	75 -	85	80.37	9.25E+02	75.85	2.70E+02	2.10
M	9	102.10	99 -	119	101.21	3.12E+01	19.87	6.15E+01	2.36
m	10	112.04	99 -	119	111.16	1.76E+02	35.93	9.94E+01	2.37
	11	142.86	136 -	147	142.01	6.42E+01	35.55	1.26E+02	4.18
	12	276.77	272 -	280	276.02	6.25E+01	21.30	3.10E+01	1.66
	13	303.35	298 -	309	302.63	1.13E+02	37.04	1.18E+02	2.20
	14	333.55	327 -	337	332.85	3.08E+01	28.67	9.24E+01	1.91
m	15	356.45	348 -	361	355.77	4.38E+02	42.77	2.12E+01	2.33
	16	385.65	380 -	390	384.99	1.32E+02	37.91	1.22E+02	4.89
	17	392.49	390 -	395	391.84	1.83E+01	16.19	3.14E+01	1.13
	18	437.50	432 -	442	436.89	8.50E+01	18.44	0.00E+00	1.99
	19	468.40	462 -	471	467.82	1.49E+01	14.14	2.02E+01	1.19
	20	497.52	493 -	500	496.96	6.06E+00	6.93	3.88E+00	2.59
	21	694.26	689 -	698	693.88	9.63E+00	8.54	4.75E+00	1.59
	22	777.16	773 -	779	776.86	7.00E+00	5.29	0.00E+00	2.70

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:35:48PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078530.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.67	1.07E+02	45.83			1.07E+02	4.58E+01
M	2	31.01	2.28E+03	98.88			2.28E+03	9.89E+01
m	3	35.36	5.67E+02	75.80			5.67E+02	7.58E+01
	4	52.77	4.78E+01	38.82			4.78E+01	3.88E+01
M	5	62.02	1.94E+02	42.70	1.20E+01	2.19E+00	1.82E+02	4.28E+01
m	6	66.12	1.10E+02	40.19			1.10E+02	4.02E+01
m	7	70.11	3.54E+01	24.89			3.54E+01	2.49E+01

Analysis Report for 1902131-09

BC 17A

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	8	81.27	9.25E+02	75.85			9.25E+02	7.58E+01
M	9	102.10	3.12E+01	19.87			3.12E+01	1.99E+01
m	10	112.04	1.76E+02	35.93			1.76E+02	3.59E+01
	11	142.86	6.42E+01	35.55			6.42E+01	3.56E+01
	12	276.77	6.25E+01	21.30	0.00E+00	0.00E+00	6.25E+01	2.13E+01
	13	303.35	1.13E+02	37.04			1.13E+02	3.70E+01
	14	333.55	3.08E+01	28.67			3.08E+01	2.87E+01
m	15	356.45	4.38E+02	42.77			4.38E+02	4.28E+01
	16	385.65	1.32E+02	37.91			1.32E+02	3.79E+01
	17	392.49	1.83E+01	16.19			1.83E+01	1.62E+01
	18	437.50	8.50E+01	18.44			8.50E+01	1.84E+01
	19	468.40	1.49E+01	14.14			1.49E+01	1.41E+01
	20	497.52	6.06E+00	6.93			6.06E+00	6.93E+00
	21	694.26	9.63E+00	8.54			9.63E+00	8.54E+00
	22	777.16	7.00E+00	5.29			7.00E+00	5.29E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.93	255.12		1.93		
		391.69	*	61.90	2.88E+01	2.58E+01
I-125	1.00	35.49	*	6.49	5.09E+02	6.93E+01
BA-133	0.99	30.80	*	97.60	1.03E+02	4.91E+00
		302.84	*	17.80	5.56E+02	2.50E+02
		356.01	*	60.00	6.88E+02	1.12E+02
TH-234	0.96	63.29	*	3.80	7.78E+02	1.91E+02

Analysis Report for 1902131-09

BC 17A

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.935	2.88E+01	2.58E+01	
	I-125	1.000	5.09E+02	6.93E+01	
X	I-129	0.848			
	BA-133	0.998	1.05E+02	4.90E+00	
	TH-234	0.969	7.78E+02	1.91E+02	
X	NP-237	0.562			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-09

BC 17A

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:35:48PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	20.67	1.18503E-01	21.48	Tol.	PA-234M
	4	52.77	5.31506E-02	40.58		
m	6	66.12	1.22430E-01	18.24	Sum	
m	7	70.11	3.93017E-02	35.18	Sum	
	8	81.27	1.02764E+00	4.10		
M	9	102.10	3.46696E-02	31.85	Tol.	U-237
m	10	112.04	1.95911E-01	10.19	Tol.	U-237
	11	142.86	7.12861E-02	27.71		
	12	276.77	6.94373E-02	17.04		
	14	333.55	3.42424E-02	46.52	Sum	
	16	385.65	1.46471E-01	14.38	Sum	
	18	437.50	9.44444E-02	10.85		
	19	468.40	1.65778E-02	47.39		
	20	497.52	6.73611E-03	57.14		
	21	694.26	1.06944E-02	44.38	Sum	
	22	777.16	7.77778E-03	37.80		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

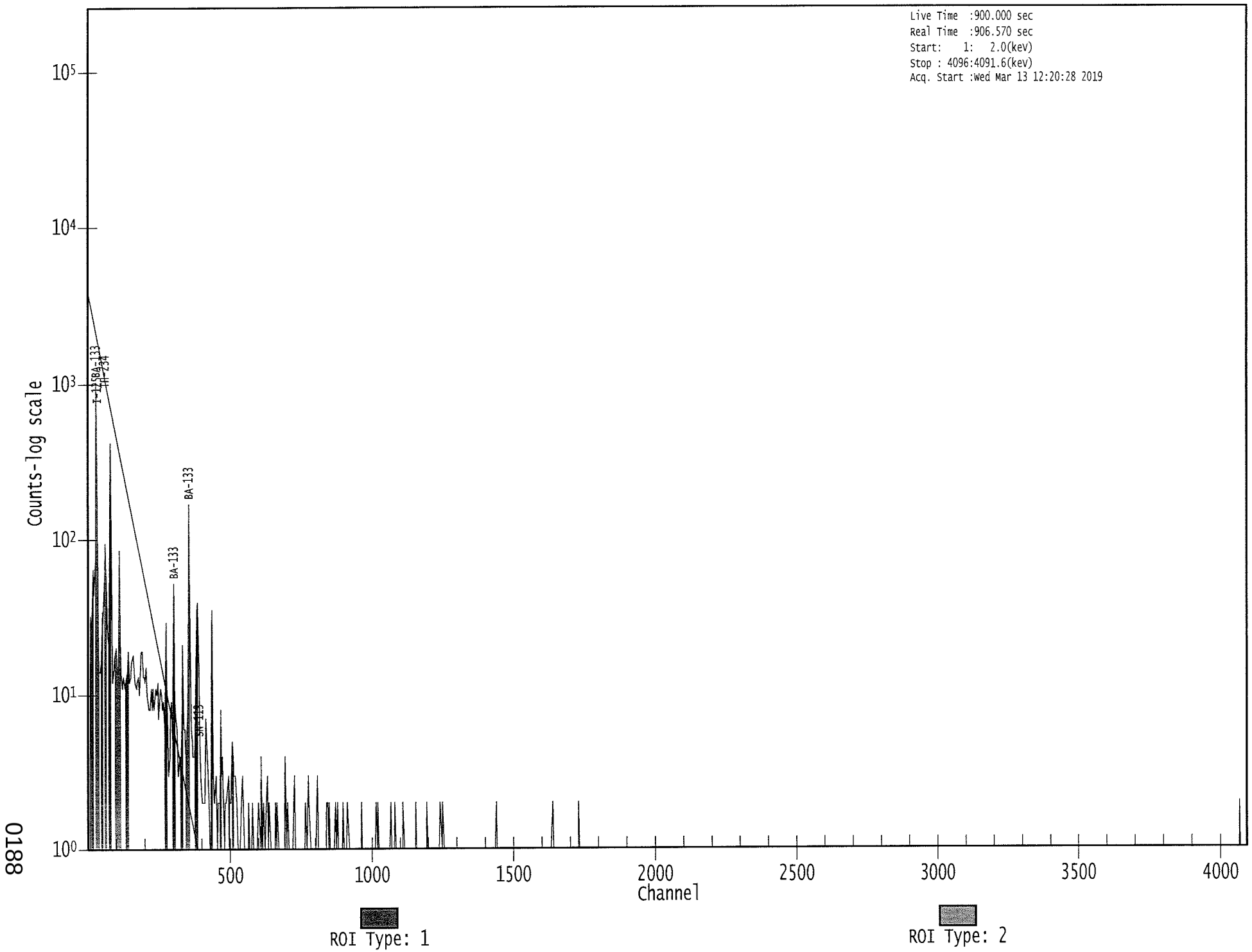
Analysis Report for 1902131-09

BC 17A

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	5.43E-03	5.43E-03	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.78E+01	1.78E+01	-2.12E+00	8.23E+00
		136.48		10.60	1.62E+02		9.31E+00	7.51E+01
	NI-59	6.92		29.80	5.77E-02	5.77E-02	-3.62E-02	2.51E-02
	MO-93	16.59		52.90	1.27E+00	1.27E+00	-1.20E-02	6.10E-01
		18.60		10.00	1.02E+01		1.75E+01	4.94E+00
	NB-93M	16.57		9.43	7.11E+00	7.11E+00	-6.70E-02	3.41E+00
	CD-109	88.03		3.72	3.18E+02	3.18E+02	-6.22E+01	1.49E+02
+	SN-113	255.12		1.93	1.31E+03	3.99E+01	-7.15E+01	6.00E+02
		391.69	*	61.90	3.99E+01		2.88E+01	1.78E+01
	SN-119M	23.87		16.10	1.02E+01	7.61E+00	-2.42E+01	4.91E+00
		25.10		22.70	7.61E+00		-1.43E+02	3.64E+00
+	I-125	35.49	*	6.49	8.50E+01	8.50E+01	5.09E+02	4.13E+01
	I-129	29.78	*	57.00	7.49E+00	7.49E+00	1.77E+02	3.64E+00
		33.60	*	13.20	4.17E+01		2.50E+02	2.03E+01
		39.58		7.52	5.07E+01		-1.28E+01	2.40E+01
+	BA-133	30.80	*	97.60	4.37E+00	4.37E+00	1.03E+02	2.13E+00
		302.84	*	17.80	2.59E+02		5.56E+02	1.23E+02
		356.01	*	60.00	5.16E+01		6.88E+02	2.37E+01
	CE-139	165.85		80.35	3.02E+01	3.02E+01	-1.12E+01	1.41E+01
	CE-144	133.54		10.80	1.63E+02	1.63E+02	4.12E+01	7.59E+01
	HG-203	279.19		77.30	4.41E+01	4.41E+01	4.38E+01	2.06E+01
	PB-210	46.50		4.25	1.06E+02	1.06E+02	2.92E+01	5.01E+01
	PA-231	9.28		42.00	2.04E-01	2.04E-01	1.27E-01	9.56E-02
		10.11		20.20	6.34E-01		6.47E-01	2.99E-01
		283.67		1.60	1.22E+03		-1.35E+02	5.37E+02
		302.67		2.30	2.20E+03		3.73E+03	1.05E+03
	TH-231	25.64		14.70	1.34E+01	1.34E+01	-4.28E+02	6.41E+00
		84.21		6.40	5.65E+02		3.01E+03	2.77E+02
	PA-234M	9.89		89.00	1.35E-01	1.35E-01	1.38E-01	6.37E-02
		21.72		64.90	2.24E+00		2.40E+00	1.08E+00
		37.93		23.75	3.09E+01		1.14E+02	1.51E+01
		131.42		20.40	8.83E+01		2.86E+01	4.11E+01
+	TH-234	63.29	*	3.80	3.95E+02	3.95E+02	7.78E+02	1.91E+02
	NP-237	29.37	*	14.00	3.05E+01	3.05E+01	7.21E+02	1.48E+01
		86.50		12.60	9.55E+01		-1.25E+01	4.49E+01
	U-237	97.08		16.30	8.45E+01	5.65E+01	3.17E+01	3.96E+01
		101.07		26.30	5.65E+01		1.51E+01	2.65E+01
		114.00		12.30	2.44E+02		5.92E+02	1.18E+02
		208.01		22.00	1.25E+02		6.40E+01	5.84E+01
	AM-241	59.54		35.90	3.40E+01	3.40E+01	6.31E+01	1.64E+01
	AM-243	74.67		66.00	1.63E+01	1.63E+01	5.00E-01	7.69E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

0000078696.CNF



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KP
3/13/19

Apex-Gamma

Analysis Report for 1902131-10
BC 17B

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1902131-10
Sample Description	: BC 17B
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 3/13/2019 9:00:59AM
Acquisition Started	: 3/13/2019 12:35:56PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 936.2 seconds
Dead Time	: 3.87 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/24/2018
Efficiency Calibration Used Done On	: 11/9/2014
Efficiency Calibration Description	:
Sample Number	: 78697

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 3/13/2019 12:51:35PM

Peak Analysis From Channel : 1
Peak Analysis To Channel : 4096

Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)

Analysis Report for 1902131-10

BC 17B

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
m	1	20.82	14 -	23	19.88	1.03E+02	41.06	2.18E+02	2.24
M	2	26.15	24 -	39	25.20	3.44E+01	14.56	4.99E+01	1.90
m	3	30.98	24 -	39	30.04	2.29E+03	100.06	1.36E+02	2.00
m	4	35.14	24 -	39	34.21	5.93E+02	77.43	1.38E+02	2.27
M	5	52.78	48 -	68	51.86	6.33E+01	34.05	1.56E+02	2.30
m	6	61.75	48 -	68	60.83	1.94E+02	41.76	1.61E+02	2.31
m	7	66.11	48 -	68	65.20	1.09E+02	38.93	1.66E+02	2.32
	8	81.21	74 -	86	80.31	8.47E+02	79.47	3.44E+02	2.25
M	9	108.45	105 -	113	107.57	1.87E+01	23.13	8.46E+01	3.15
m	10	111.88	105 -	113	111.00	1.51E+02	33.63	1.11E+02	1.81
	11	116.68	114 -	120	115.81	4.12E+01	32.62	1.56E+02	2.17
	12	160.95	157 -	163	160.11	3.59E+01	26.37	9.82E+01	2.17
M	13	276.97	262 -	283	276.23	4.64E+01	23.66	4.78E+01	2.51
	14	303.05	296 -	306	302.33	1.05E+02	41.42	1.64E+02	2.05
	15	320.18	311 -	326	319.47	2.81E+01	24.25	4.57E+01	6.34
M	16	333.47	327 -	342	332.77	4.42E+01	19.52	1.47E+01	3.09
m	17	338.51	327 -	342	337.82	2.78E+01	20.12	2.23E+01	3.09
	18	356.41	351 -	362	355.73	4.45E+02	49.32	7.34E+01	2.25
	19	386.46	379 -	392	385.81	1.97E+02	40.87	9.83E+01	2.31
	20	416.20	411 -	420	415.57	3.63E+01	17.92	2.54E+01	1.54
M	21	433.61	432 -	440	433.00	6.20E+00	3.74	2.00E+00	2.61
m	22	437.37	432 -	440	436.76	7.11E+01	17.09	8.00E+00	2.61
	23	511.21	506 -	516	510.67	2.50E+01	11.93	6.07E+00	1.97
	24	641.43	637 -	644	641.00	9.00E+00	6.00	0.00E+00	1.16
	25	707.98	704 -	711	707.62	9.32E+00	7.75	3.36E+00	1.88

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

BACKGROUND SUBTRACT REPORT

Peak Analysis Performed on : 3/13/2019 12:51:35PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000078530.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	1	20.82	1.03E+02	41.06			1.03E+02	4.11E+01
M	2	26.15	3.44E+01	14.56			3.44E+01	1.46E+01
m	3	30.98	2.29E+03	100.06			2.29E+03	1.00E+02
m	4	35.14	5.93E+02	77.43			5.93E+02	7.74E+01

Analysis Report for 1902131-10

BC 17B

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	5	52.78	6.33E+01	34.05			6.33E+01	3.41E+01
m	6	61.75	1.94E+02	41.76	1.20E+01	2.19E+00	1.82E+02	4.18E+01
m	7	66.11	1.09E+02	38.93			1.09E+02	3.89E+01
	8	81.21	8.47E+02	79.47			8.47E+02	7.95E+01
M	9	108.45	1.87E+01	23.13			1.87E+01	2.31E+01
m	10	111.88	1.51E+02	33.63			1.51E+02	3.36E+01
	11	116.68	4.12E+01	32.62			4.12E+01	3.26E+01
	12	160.95	3.59E+01	26.37			3.59E+01	2.64E+01
M	13	276.97	4.64E+01	23.66	0.00E+00	0.00E+00	4.64E+01	2.37E+01
	14	303.05	1.05E+02	41.42			1.05E+02	4.14E+01
	15	320.18	2.81E+01	24.25			2.81E+01	2.42E+01
M	16	333.47	4.42E+01	19.52			4.42E+01	1.95E+01
m	17	338.51	2.78E+01	20.12			2.78E+01	2.01E+01
	18	356.41	4.45E+02	49.32			4.45E+02	4.93E+01
	19	386.46	1.97E+02	40.87			1.97E+02	4.09E+01
	20	416.20	3.63E+01	17.92			3.63E+01	1.79E+01
M	21	433.61	6.20E+00	3.74			6.20E+00	3.74E+00
m	22	437.37	7.11E+01	17.09			7.11E+01	1.71E+01
	23	511.21	2.50E+01	11.93	1.24E+01	1.29E+00	1.26E+01	1.20E+01
	24	641.43	9.00E+00	6.00			9.00E+00	6.00E+00
	25	707.98	9.32E+00	7.75			9.32E+00	7.75E+00

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE IDENTIFICATION REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-119M	0.30	23.87		16.10		
		25.10	*	22.70	4.64E+00	1.96E+00
I-125	0.99	35.49	*	6.49	5.26E+02	6.99E+01
BA-133	0.99	30.80	*	97.60	1.04E+02	4.95E+00
		302.84	*	17.80	5.17E+02	2.59E+02
		356.01	*	60.00	6.99E+02	1.20E+02
HG-203	0.91	279.19	*	77.30	5.03E+01	2.98E+01
TH-231	0.79	25.64	*	14.70	7.16E+00	3.03E+00

Analysis Report for 1902131-10

BC 17B

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
TH-231	0.79	84.21		6.40		
TH-234	0.95	63.29	*	3.80	7.72E+02	1.85E+02

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
?	SN-119M	0.301	4.64E+00	1.96E+00	
	I-125	0.998	5.26E+02	6.99E+01	
X	I-129	0.851			
	BA-133	0.999	1.05E+02	4.94E+00	
	HG-203	0.910	5.03E+01	2.98E+01	
?	TH-231	0.792	7.16E+00	3.03E+00	
	TH-234	0.955	7.72E+02	1.85E+02	
X	NP-237	0.563			

? = nuclide is part of an undetermined solution
X = nuclide rejected by the interference analysis
@ = nuclide contains energy lines not used in Weighted Mean Activity

Errors quoted at 2.000sigma

Analysis Report for 1902131-10

BC 17B

UNIDENTIFIED PEAKS

Peak Locate Performed on : 3/13/2019 12:51:35PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
m	1	20.82	1.14911E-01	19.85		
M	5	52.78	7.02985E-02	26.91	Sum	
m	7	66.11	1.20733E-01	17.91	Sum	
	8	81.21	9.41256E-01	4.69		
M	9	108.45	2.07759E-02	61.85		
m	10	111.88	1.67365E-01	11.16		
	11	116.68	4.57750E-02	39.59		
	12	160.95	3.99020E-02	36.71		
	15	320.18	3.12636E-02	43.09		
M	16	333.47	4.91172E-02	22.08	Sum	
m	17	338.51	3.09405E-02	36.14	Sum	
	19	386.46	2.18704E-01	10.38	Sum	
	20	416.20	4.03288E-02	24.68	Sum	
M	21	433.61	6.89207E-03	30.16		
m	22	437.37	7.89834E-02	12.02		
	23	511.21	1.39918E-02	47.63		
	24	641.43	1.00000E-02	33.33		
	25	707.98	1.03535E-02	41.56		

M = First peak in a multiplet region
m = Other peak in a multiplet region
F = Fitted singlet
Errors quoted at 2.000sigma

NUCLIDE MDA REPORT

Nuclide Library Used : \\OR-GAMMA1\ApexRoot\Countroom\Library\WSRC.NLB

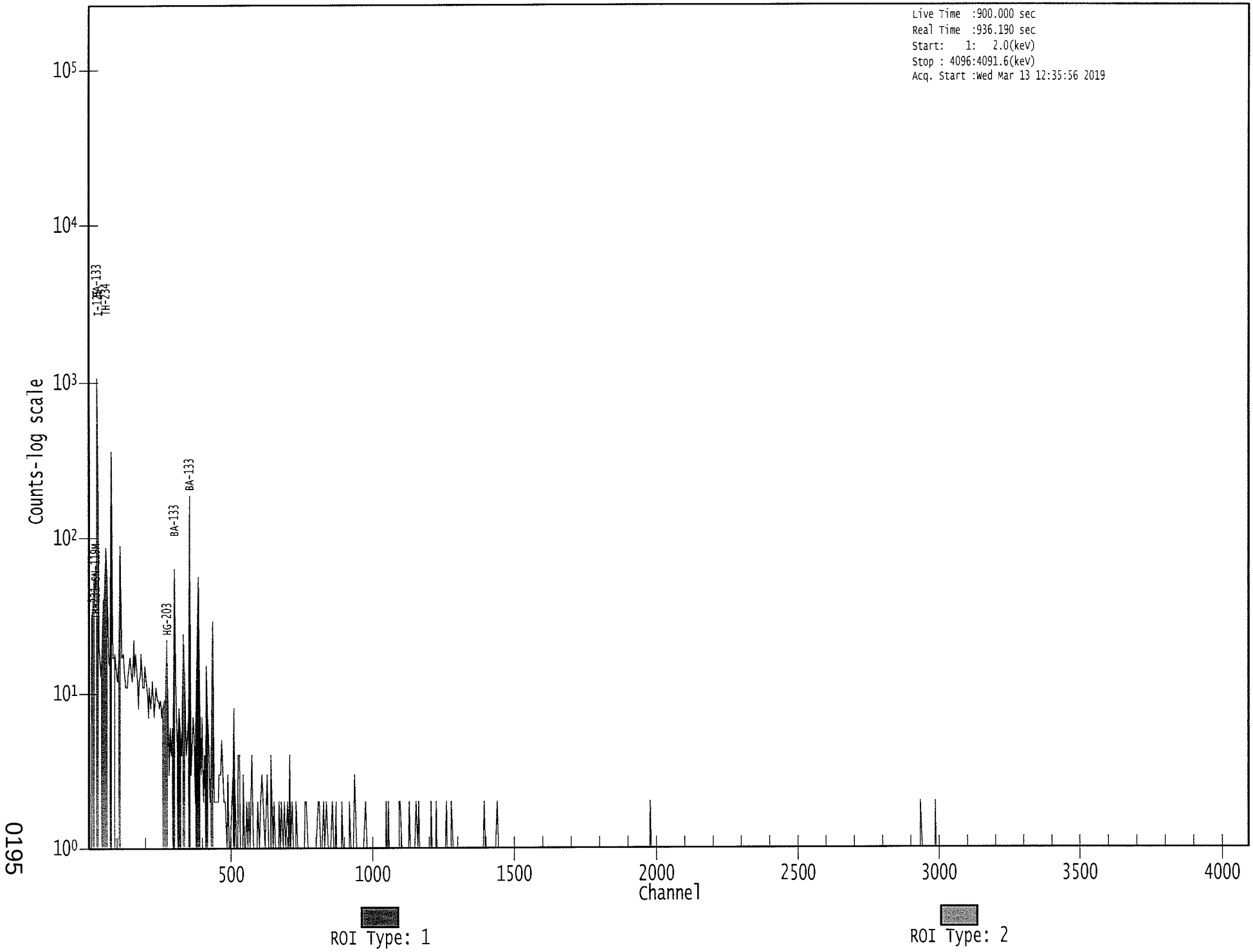
Analysis Report for 1902131-10

BC 17B

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	5.43E-03	5.43E-03	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.13E+01	2.13E+01	5.97E+00	9.98E+00
		136.48		10.60	1.82E+02		-1.74E+01	8.50E+01
	NI-59	6.92		29.80	4.85E-02	4.85E-02	-3.90E-02	2.05E-02
	MO-93	16.59		52.90	1.27E+00	1.27E+00	-1.83E+00	6.08E-01
		18.60		10.00	1.01E+01		1.61E+01	4.87E+00
	NB-93M	16.57		9.43	7.09E+00	7.09E+00	-1.03E+01	3.40E+00
	CD-109	88.03		3.72	3.41E+02	3.41E+02	-1.07E+02	1.60E+02
	SN-113	255.12		1.93	1.18E+03	7.82E+01	8.33E+01	5.35E+02
		391.69		61.90	7.82E+01		-1.61E+01	3.70E+01
+	SN-119M	23.87		16.10	1.00E+01	1.00E+01	-2.68E+01	4.79E+00
		25.10	*	22.70	1.23E+01		4.64E+00	5.98E+00
+	I-125	35.49	*	6.49	8.36E+01	8.36E+01	5.26E+02	4.06E+01
	I-129	29.78	*	57.00	7.31E+00	7.31E+00	1.77E+02	3.55E+00
		33.60	*	13.20	4.10E+01		2.58E+02	1.99E+01
		39.58		7.52	5.30E+01		-2.61E+00	2.52E+01
+	BA-133	30.80	*	97.60	4.27E+00	4.27E+00	1.04E+02	2.07E+00
		302.84	*	17.80	3.05E+02		5.17E+02	1.46E+02
		356.01	*	60.00	7.01E+01		6.99E+02	3.29E+01
	CE-139	165.85		80.35	3.02E+01	3.02E+01	8.99E+00	1.41E+01
	CE-144	133.54		10.80	1.67E+02	1.67E+02	3.27E+01	7.79E+01
+	HG-203	279.19	*	77.30	8.09E+01	8.09E+01	5.03E+01	3.90E+01
	PB-210	46.50		4.25	1.08E+02	1.08E+02	1.06E+01	5.07E+01
	PA-231	9.28		42.00	1.86E-01	1.86E-01	7.70E-02	8.64E-02
		10.11		20.20	5.99E-01		4.87E-01	2.82E-01
		283.67		1.60	1.16E+03		2.41E+01	5.08E+02
		302.67		2.30	2.39E+03		4.30E+03	1.14E+03
+	TH-231	25.64	*	14.70	1.90E+01	1.90E+01	7.16E+00	9.24E+00
		84.21		6.40	5.38E+02		2.50E+03	2.64E+02
	PA-234M	9.89		89.00	1.27E-01	1.27E-01	1.04E-01	5.99E-02
		21.72		64.90	2.13E+00		1.90E+00	1.02E+00
		37.93		23.75	3.26E+01		1.21E+02	1.59E+01
		131.42		20.40	8.23E+01		-3.46E+01	3.81E+01
+	TH-234	63.29	*	3.80	5.27E+02	5.27E+02	7.72E+02	2.58E+02
	NP-237	29.37	*	14.00	2.97E+01	2.97E+01	7.23E+02	1.44E+01
		86.50		12.60	1.04E+02		8.25E+00	4.93E+01
	U-237	97.08		16.30	8.71E+01	5.38E+01	-2.22E+01	4.09E+01
		101.07		26.30	5.38E+01		1.72E+01	2.52E+01
		114.00		12.30	2.53E+02		5.53E+02	1.22E+02
		208.01		22.00	1.16E+02		-3.68E+00	5.35E+01
	AM-241	59.54		35.90	3.42E+01	3.42E+01	6.83E+01	1.65E+01
	AM-243	74.67		66.00	1.59E+01	1.59E+01	1.52E+00	7.49E+00

\+ = Nuclide identified during the nuclide identification
* = Energy line found in the spectrum
\> = MDA value not calculated
@ = Half-life too short to be able to perform the decay correction

0000078697.CNF



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SECTION XI

ANALYTICAL DATA (TOTAL DISSOLVED SOLIDS)

TDS / TSS Worksheet

Work Order	Run	Analysis Code	Technician
19-02131	1	TDS	MHIGHTOWER

TRetec	Michael Pisani & Associates, Inc.		Filter Data			TDS/TSS	Maximum Aliq
Fraction	Client ID	Aliquot ml	Filter Tare (g)	Filter Final (g)	Filter Net (g)	(mg/L)	(mL)
04	BC 29A	100.0000	117.5243	117.7056	0.1813	1813.0000	55.16
05	BC 29B	100.0000	116.0289	117.5544	1.5255	15255.0000	6.56
06	BC 20	100.0000	116.8911	116.9905	0.0994	994.0000	100.60
07	BC 18	100.0000	126.8609	127.2243	0.3634	3634.0000	27.52
08	BC 19	100.0000	121.6592	121.7938	0.1346	1346.0000	74.29
09	BC 17A	100.0000	101.7226	101.9062	0.1836	1836.0000	54.47
10	BC 17B	100.0000	122.4219	122.9516	0.5297	5297.0000	18.88

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Technician: MH Date: 2/25/19

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 2/22/2019 3:09 PM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
19-02131	1	TDS	liters	3/6/2019	JPACHELLA

Lab Fraction	Michael Pisani & Associates, Inc. Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	DUP	DUP					1.0000E-01	1.0000E-01				
04	BC 29A	TRG					1.0000E-01	1.0000E-01				
05	BC 29B	TRG					1.0000E-01	1.0000E-01				
06	BC 20	TRG					1.0000E-01	1.0000E-01				
07	BC 18	TRG					1.0000E-01	1.0000E-01				
08	BC 19	TRG					1.0000E-01	1.0000E-01				
09	BC 17A	TRG					1.0000E-01	1.0000E-01				
10	BC 17B	TRG					1.0000E-01	1.0000E-01				

Comments	

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Technician: J Pachella Date: 2/22/19