ERM

HERO LANDS

STANDARD LEVEL IV
REPORT OF ANALYSIS

WORK ORDER #20-07104-OR

August 12, 2020

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 # 20-07104

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

Date for Partial	Initials	Date	Initials	Checklist Items
		7-22-20	[signature]	Sample Log-In
		8/7/20	[signature]	Data Compilation
		8/10/20	[signature]	First Technical Data Review
		8/11/20	[signature]	Second Technical Data Review
		8/12/20	[signature]	Data Entry/Electronic Deliverable
		8/12/20	[signature]	Case Narrative
		8/12/20	[signature]	Electronic Deliverable Proof
		8/12/20	[signature]	Samples Analyzed within Holding Time Yes? ✓ No?
		8/12/20	[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] 8/12/20

Laboratory Manager — Date

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 Landfarm	Project Number: 04942255
Send Report To: David.Uptheegrove@erm.com	Sampler (Print Name): Patrick Bourdain
Address: 840 W. Sam Houston Parkway N.; Suite 600; Houston TX, 77024	Sampler (Print Name):
	Shipment Method: FedEx
	Airbill Number: 8111 8879 2033
Phone: 504-481-6470	Laboratory Receiving:
Fax:	

REC'D JUL 22 2020

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Purchase Order #: 20-07104

	Field Sample ID	Sample Date	Sample Time	Sample Matrix	Number of Containers	Analysis Requested: Ra 226/228	Comments, Special Instructions, etc.	Lab Sample ID (to be completed by lab)
4	MW-3A	7/15/20	0835	W	1	X		
5	MW-4A	7/15/20	1030			X		
6	MW-9B	7/15/20	1315			X		
7	MW-7A	7/16/20	0900			X		
8	MW-2A	7/16/20	1150			X		
9	MW-2B	7/16/20	1405			X		

Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:
[signature]	Kenneth Spencer 7-22-20 0930	7/17/20	4:45
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	
		Total # Containers Received?	
Level I ☐	Routine ☐	COC Seals Present?	
Level II ☐	24 Hour ☐	COC Seals Intact?	
Level III ☐	1 Week ☐	Received Containers Intact?	
Other ☐	Other ___	Temperature?	

EBERLINE SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #	**20-07104**
Lab Deadline	**8/5/2020**
Analysis	**Ra226 - Level 4**
Sample Matrix	**Water**

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
	04	20	NN1.1
	05	50	NN1.1
	06	10	NN1.1
	07	30	NN1.1
	08	20	NN1.1
	09	30	NN1.1

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room	[illegible]	7/28/20 0000
Relinquished by	Sample Storage	Rough Prep	(Prep)	Separations	Count Room	[illegible]	7/29/20 0430
Received by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	AY	7/29/20 0705
Relinquished by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	AY	8/3/20 1200
Received by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	KB	8/3/20 1204
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	KP	8/4/20 0437
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		

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EBERLINE SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #	**20-07104**
Lab Deadline	**8/5/2020**
Analysis	**Ra228 - Level 4**
Sample Matrix	**Water**

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
	04	20	NN1.1
	05	50	NN1.1
	06	10	NN1.1
	07	30	NN1.1
	08	20	NN1.1
	09	30	NN1.1

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room	[illegible]	7/28/20 0000
Relinquished by	Sample Storage	Rough Prep	(Prep)	Separations	Count Room	[illegible]	7/29/20 0430
Received by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	AY	7/29/20 0700
Relinquished by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	AY	8/3/20 1200
Received by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	ICB	8/3/20 1204
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	ICB	8/4/20 0437
Received by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	AY	8/7/20 0737
Relinquished by	Sample Storage	Rough Prep	Prep	(Separations)	Count Room	AY	8/7/20 1205
Received by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	ICB	8/7/20 1207
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	(Count Room)	ICB	8/7/20 1510
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		

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EBERLINE SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #	20-07104
Lab Deadline	7/22/2020
Analysis	TDS - Level 4
Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
	04	20	NN1.1
	05	50	NN1.1
	06	10	NN1.1
	07	30	NN1.1
	08	20	NN1.1
	09	30	NN1.1

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	(Rough Prep)	Prep	Separations	Count Room 1200	Ky sg	7-22-20
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MU	23JUL20 0045
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		

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EBERLINE SERVICES

Sample Receiving Report
(Volumes, pH, & CPM)

Internal Work Order
20-07104
Received By
RSPENCER

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	NN1.1		
02	BLANK	0		WA	NN1.1		
03	DUP	0		WA	NN1.1		
04	MW-3A	1		WA	NN1.1	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
05	MW-4A	1		WA	NN1.1	3.76	50
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	50
06	MW-9B	1		WA	NN1.1	3.76	10
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	10
07	MW-7A	1		WA	NN1.1	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30
08	MW-2A	1		WA	NN1.1	3.76	20
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	20
09	MW-2B	1		WA	NN1.1	3.76	30
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	7	7	3.7600	30

Received by: Kristopher Spencer Date: 7-22-20

SECTION II

SAMPLE ACKNOWLEDGEMENT

Client Name	Contract/PO	Project Type	Date Received	Required Turnaround Days	Eberline Services Work Order
ERM	0494255	Environmental	07/22/2020	21	20-07104
Project Name	**Client WO**	**Sample Disp**	**Lab Deadline**	**Internal Deadline**	**Client Deadline**
HERO LANDS	HERO LANDS	W	08/05/2020	08/11/2020	08/12/2020

Internal ID	Client ID	Sample Date	Matrix	Storage	Ra226	Ra228	TDS																						Ttl
01	LCS	07/22/20	WA	NN1.1	X	X	X																						3
02	BLANK	07/22/20	WA	NN1.1	X	X	X																						3
03	DUP	07/22/20	WA	NN1.1	X	X	X																						3
04	MW-3A	07/15/20 08:35	WA	NN1.1	X	X	X																						3
05	MW-4A	07/15/20 10:30	WA	NN1.1	X	X	X																						3
06	MW-9B	07/15/20 13:15	WA	NN1.1	X	X	X																						3
07	MW-7A	07/16/20 09:00	WA	NN1.1	X	X	X																						3
08	MW-2A	07/16/20 11:50	WA	NN1.1	X	X	X																						3
09	MW-2B	07/16/20 14:05	WA	NN1.1	X	X	X																						3
																													0
																													0
																													0
																													0
																													0
																													0
																													0
																													0
																													0
																													0
																													0
	Totals Per Analysis (non QA samples)				6	6	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

0011

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		Report Data	
	Accounts Payable		Dave Upthegrove
	ERM		ERM
	840 W Sam Houston Pkwy N Suite 600		840 W Sam Houston Pkwy N Suite 630
	Houston, TX 77024		Houston, TX 77478
Voice	281-242-5700	Voice	832-786-5006
Fax	281-520-4625	Fax	
Contact	Dave Upthegrove		
Voice	832-786-5006		
Fax			

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Eberline Services – Oak Ridge Laboratory

SAMPLE RECEIPT CHECKLIST
MP-001-2

WORK ORDER # 20 07104

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: 7-22-20

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-47501

August 12, 2020

Dave Upthegrove
ERM
840 W Sam Houston Pkwy N #600
Houston, TX 77478

CASE NARRATIVE
Work Order # 20-07104-OR

SAMPLE RECEIPT

This work order contains four water samples received 07/22/2020. Samples were analyzed for Radium-226/228 and Total Dissolved Solids.

CLIENT ID	LAB ID
MW-3A	20-07104-04
MW-4A	20-07104-05
MW-9B	20-07104-06
MW-7A	20-07104-07
MW-2A	20-07104-08
MW-2B	20-07104-09

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 mounted on micro-porous filter media. Samples were counted by alpha spectroscopy using an energy specific region of interest for Radium-226. The result was corrected for inherent self-absorption from elemental Barium. Chemical recovery was calculated using 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 a high relative percent difference; however, normalized difference is within acceptable limits for the analytical technique. 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 counted on a gas proportional counter. Chemical recovery was determined using 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 0.45µm filter media into a tared 250 ml beaker. Samples were dried on a hot plate and allowed to cool. The TDS content was determined by reweighing tared beakers.

Samples demonstrated results for Total Dissolved Solids content that ranged from 2,410.0 to 31,414.0 mg/l.

CERTIFICATION OF ACCURACY

I certify that this data report complies 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: 8/12/2020

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
ERM
840 W Sam Houston Pkwy N Suite 600
Houston, TX 77478

Work Order Details:
SDG: 20-07104
Purchase Order: 0494255
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
20-07104-01	LCS	KNOWN	07/22/20 00:00	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	1.01E+01	4.63E-01			pCi/l
20-07104-01	LCS	SPIKE	07/22/20 00:00	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	9.64E+00	1.31E+00	2.42E+00	2.96E-01	pCi/l
20-07104-02	MBL	BLANK	07/22/20 00:00	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	-1.62E-02	9.78E-02	9.79E-02	3.08E-01	pCi/l
20-07104-03	DUP	MW-2B	07/16/20 14:05	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	3.38E-02	1.93E-01	1.93E-01	4.04E-01	pCi/l
20-07104-04	TRG	MW-3A	07/15/20 08:35	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	1.47E+02	1.48E+01	3.45E+01	2.88E+00	pCi/l
20-07104-05	TRG	MW-4A	07/15/20 10:30	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	1.60E+00	4.31E-01	5.48E-01	2.58E-01	pCi/l
20-07104-06	TRG	MW-9B	07/15/20 13:15	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	5.03E-02	1.43E-01	1.44E-01	2.91E-01	pCi/l
20-07104-07	TRG	MW-7A	07/16/20 09:00	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	2.68E-01	2.68E-01	2.73E-01	3.71E-01	pCi/l
20-07104-08	TRG	MW-2A	07/16/20 11:50	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	8.55E-01	3.63E-01	4.05E-01	3.02E-01	pCi/l
20-07104-09	DO	MW-2B	07/16/20 14:05	7/22/2020	8/3/2020	20-07104	Radium-226	EPA 903.0 Modified	2.73E-01	2.32E-01	2.39E-01	2.82E-01	pCi/l
20-07104-01	LCS	KNOWN	07/22/20 00:00	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	9.11E+00	4.65E-01			pCi/l
20-07104-01	LCS	SPIKE	07/22/20 00:00	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	7.98E+00	6.89E-01	1.93E+00	7.96E-01	pCi/l
20-07104-02	MBL	BLANK	07/22/20 00:00	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	3.87E-01	3.98E-01	4.08E-01	8.10E-01	pCi/l
20-07104-03	DUP	MW-2B	07/16/20 14:05	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	5.01E-01	4.40E-01	4.55E-01	8.85E-01	pCi/l
20-07104-04	TRG	MW-3A	07/15/20 08:35	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	2.70E+01	2.09E+00	6.47E+00	2.38E+00	pCi/l
20-07104-05	TRG	MW-4A	07/15/20 10:30	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	1.87E+00	5.12E-01	6.65E-01	9.01E-01	pCi/l
20-07104-06	TRG	MW-9B	07/15/20 13:15	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	1.13E+00	5.21E-01	5.81E-01	1.00E+00	pCi/l
20-07104-07	TRG	MW-7A	07/16/20 09:00	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	1.51E+00	5.36E-01	6.36E-01	9.64E-01	pCi/l
20-07104-08	TRG	MW-2A	07/16/20 11:50	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	1.12E+00	4.27E-01	4.97E-01	7.86E-01	pCi/l
20-07104-09	DO	MW-2B	07/16/20 14:05	7/22/2020	8/7/2020	20-07104	Radium-228	EPA 904.0	3.36E-01	5.63E-01	5.68E-01	1.17E+00	pCi/l
20-07104-04	TRG	MW-3A	07/15/20 08:35	7/22/2020	7/23/2020	20-07104	TDS	SM2540C	3.14E+04				mg/l
20-07104-05	TRG	MW-4A	07/15/20 10:30	7/22/2020	7/23/2020	20-07104	TDS	SM2540C	1.02E+04				mg/l
20-07104-06	TRG	MW-9B	07/15/20 13:15	7/22/2020	7/23/2020	20-07104	TDS	SM2540C	2.41E+03				mg/l
20-07104-07	TRG	MW-7A	07/16/20 09:00	7/22/2020	7/23/2020	20-07104	TDS	SM2540C	3.02E+03				mg/l
20-07104-08	TRG	MW-2A	07/16/20 11:50	7/22/2020	7/23/2020	20-07104	TDS	SM2540C	7.32E+03				mg/l
20-07104-09	TRG	MW-2B	07/16/20 14:05	7/22/2020	7/23/2020	20-07104	TDS	SM2540C	2.55E+03				mg/l

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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

SECTION V

ANALYTICAL STANDARD

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).

Anna U. Kwan
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	9/12/2019 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 9, 2020

Verified & Approved By _____ Date: 9/12/2019

QC Approval _____ Date: 9/16/19

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	9/12/2019 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: 9-Sep-20

Verified & Approved By _____ Date: 9/12/2019 0:00

QC Approval _____ Date: 9/16/19

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: M. Mitchell 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	1/15/2020 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 15, 2021

Recertified By _____ Date: 1/15/20

QC Approval _____ Date: 1/15/20

Ba-6
(¶ 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 STANDARD SOLUTIONS
SECONDARY DILUTION RECERTIFICATION

	QCP-009-1-A	**Date**	4/23/20
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
Parent Solution Conc. 1.48E+05 **dpm/ml**

Reference Date 9/1/1993 0:00

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

Dilution Instructions:

Dilution Solvent Used 1M HCl

SECONDARY VOLUMETRIC DILUTION

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

Final Activity Concentration: 3.6950E+03 **dpm/ml**

NOTES:

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

Expiration Date: April 23, 2021

Verified & Approved By _____ Date: 4/23/20

QC Approval _____ Date: 4/23/20

SECTION VI

QUALITY CONTROL SAMPLE RESULTS SUMMARY

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
20-07104	Ra226	1	pCi	l	ERM

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		95.91%	25.12%	100.00%	4.60%	1.01E+01	4.63E-01	9.64E+00	2.42E+00	Ra-5b	4.39E+01	4.60E+00	5.08E-01

Matrix Spike

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

Replicate Sample

Analyte	*Normalized Difference*	*RPD*	*Original Result*	*Original CSU*	*Replicate Result*	*Replicate CSU*
RA-226	1.53	155.97	2.73E-01	2.39E-01	3.38E-02	1.93E-01

QC Summary

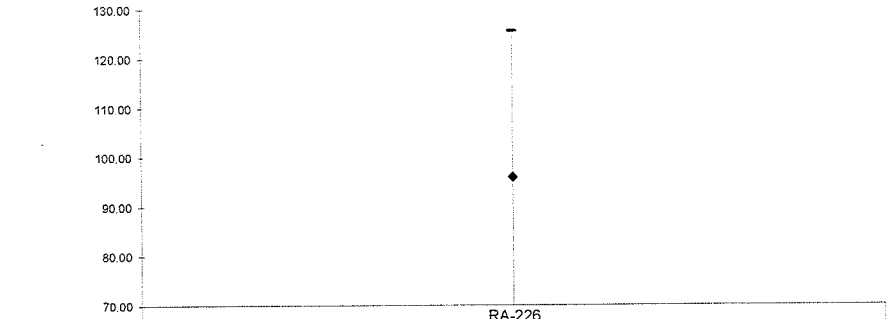
LCS Relative Bias	*LCS % R*		*MS % R*	*MS ND*	*Rep RPD*	*Rep ND*
0.96	OK				NA	OK

0027

Version

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
20-07104	Ra226	1	pCi	I	ERM

LCS % Recovery

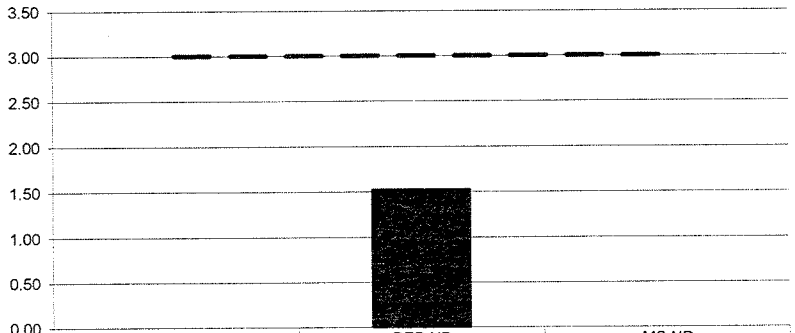


	RA-226
Lower Error	66.19
Upper Error	125.63
%R	95.91
LCL	75
Mean	100
UCL	125

Replicate Sample RPD

	RA-226
Lower Error	265.61
Upper Error	46.32
RPD	155.97
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-226	0.00	1.53	0.00
UCL	3	3	3

No Matrix Spike

0028

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
20-07104	Ra228	1	pCi	l	ERM

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		87.59%	24.23%	100.00%	5.10%	9.11E+00	4.65E-01	7.98E+00	1.93E+00	Ra-12	4.25E+01	5.10E+00	4.76E-01

Matrix Spike

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

Replicate Sample

Analyte	*Normalized Difference*	*RPD*	*Original Result*	*Original CSU*	*Replicate Result*	*Replicate CSU*
RA-228	0.44	39.37	3.36E-01	5.68E-01	5.01E-01	4.55E-01

QC Summary

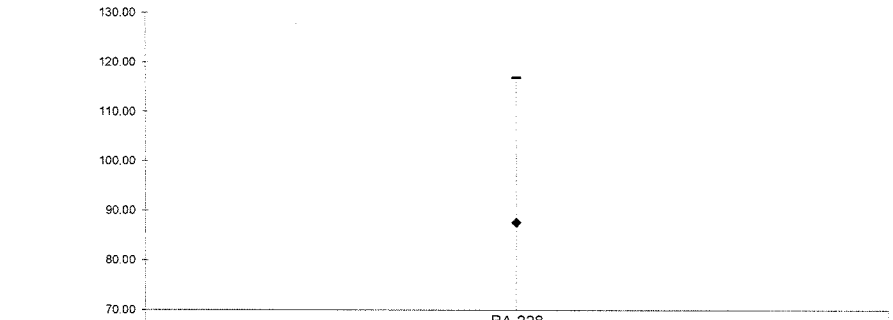
LCS Relative Bias	*LCS % R*		*MS % R*	*MS ND*	*Rep RPD*	*Rep ND*
0.88	OK				NA	OK

0029

Version

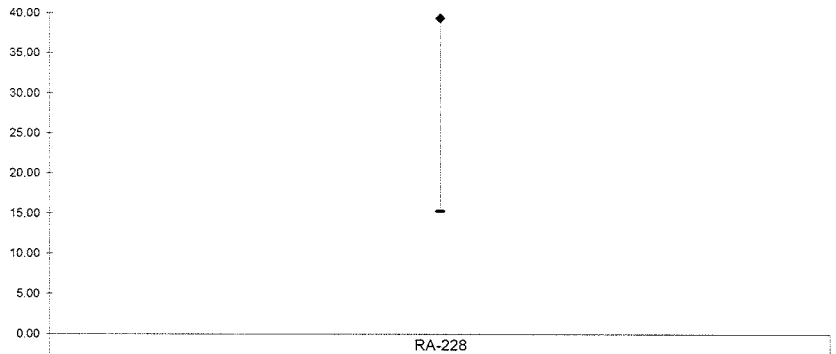
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
20-07104	Ra228	1	pCi	I	ERM

LCS % Recovery



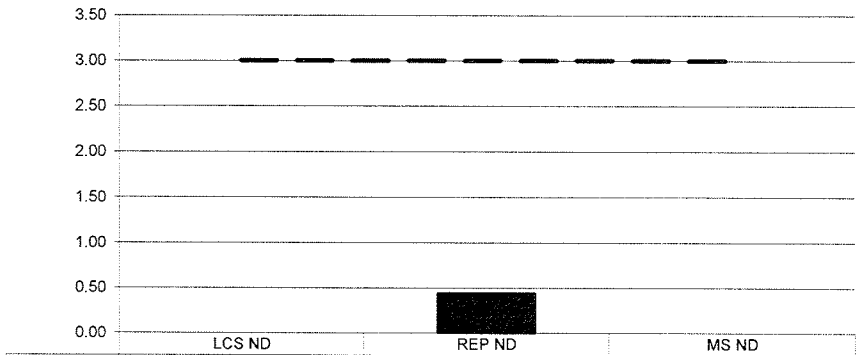
	RA-228
Lower Error	58.25
Upper Error	116.92
%R	87.59
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



	RA-228
Lower Error	63.40
Upper Error	15.34
RPD	39.37
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-228	0.00	0.44	0.00
UCL	3	3	3

No Matrix Spike

0030

SECTION VII

LABORATORY TECHNICIAN'S NOTES

RA-226 NOTES

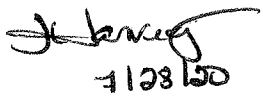
EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	20-07104
Analysis Code	Ra226
Run Number	1

#	Date	Dept	User	Notes
1	07/28/20 03:02	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS



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	20-07104
Analysis Code	Ra226
Run Number	1

#	Date	Dept	User	Notes
1	07/28/20 03:02	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	08/03/20 12:00	CHEM	AYARBER	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.

8/3/20

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
20-07104	
Analysis Code	Run
Ra226	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
022002P	Ammonium Hydroxide	Reagent Grade	JHARVEY	7/28/2020
022142D02	Ammonium Sulfate	200 mg/ml	JHARVEY	7/28/2020
022147D03	Barium Carrier	1 mg/ml	JHARVEY	7/28/2020
022385D01	Lead Carrier	166 mg/ml	JHARVEY	7/28/2020
022073P	Nitric Acid	Reagent Grade	JHARVEY	7/28/2020
021557P	Acetic Acid	Reagent Grade	AYARBER	8/3/2020
021302D05	Ammonium Sulfate	200 mg/ml	AYARBER	8/3/2020
022266S	EDTA	0.25M	AYARBER	8/3/2020

Alpha 1

Date	Sample #	Client	Load time	Count time	Analysis	Tech
7/22/20	2007055A (1-4)	Unitech	1059	2hr 50m	Np	AG
7/23/20	Daily Pulser	Lab	0358	10 min	NA	KP
7/23/20	2007083B(1-4)	UCOR	0743	2hr 50min	Am^{243}	KP
7/23/20	2007056A(4,7)	USA	1038	2hr 50min	iso-U	AG
7/24/20	Daily Pulser	Lab	0400	~~2hr 40min~~	NA	KP
7/24/20	2007082A(1-4)	MPA	0608	2hr 50min	Ra^{6}	KP
7/24/20	Cal Check	Lab	0920	2 1/2 hr	α	AG
7/24/20	System Bkgd	Lab	1458	16 hr 40 min	α	AG
7/25/20	Daily Pulser	Lab	0758	10 min	NA	KP
7/25/20	2007102A(2-5)	UCOR	0826	2hr 50min	UU	KP
7/26/20	Daily Pulser	Lab	0422	10 min	NA	KP
7/27/20	Th-8BA(1-3)	Lab	0436	1hr	Th	KP
7/27/20	Th-8BA(1-3)	Lab	1054	1hr	Th^{229}	KP
7/27/20	2007068A (1-3,5)	UCOR	1203	2hr 50min	Am^{241}	KP
7/28/20	Daily Pulser	Lab	0404	10 min	NA	KP
7/29/20	Daily Pulser	Lab	0359	10 min	NA	KP
7/29/20	2007069A(1-4)	UCOR	0755	2hr 50min	Am^{241}	KP
7/29/20	2007069A(1-4)	UCOR	1053	2hr 50 mins	Th	KB
7/30/20	Daily Pulser	Lab	0357	10 min	NA	KP
7/30/20	2007089A (1-4)	Unitech	0755	2hr 50min	Th	KP
7/30/20	2007069A(1-4)	UCOR	1100	2hr 50 min	Ra6	KB
7/30/20	2007074A (1-4)	Unitech	1359	2hr 50 min	Np	KB
7/31/20	Daily Pulser	Lab	0354	10 min	NA	KP
7/31/20	Cal Check (1-15)	Lab	0926	2hr 30min	NA	AG
7/31/20	2007133A(10-13)	URENCO	1200	2hr 50 min	UU	KB
7/31/20	System Bkgd	Lab	1455	16-40 hrs	NA	KB
8/3/20	Daily Pulser	Lab	0418	10 min	NA	KP
8/3/20	2007109A (1-4)	Unitech	0812	2hr 50min	PU	KP
8/3/20	2007070A(1-4)	Republic Serv.	1135	2hr 50min	Ra^{6}	KP
8/3/20	2007104A(4-7)	ERM	1428	2hr 50 min	Ra6	KB

Alpha 3

Date	Sample #	Client	Load time	Count time	Analysis	Tech
7/30/20	2007089A (1-4)	Unitech	1400	2hr 50 min	Am241	KB
7/30/20	2007089A (1-4)	Unitech	1400	2hr 50 min	UU	KB
7/30/20	2007089A (1-4)	Unitech	1401	2hr 50 min	Np	KB
7/31/20	Daily Pulser	Lab	0354	10 min	NA	KP
7/31/20	Cal Check (33-48)	Lab	0407	2hr 30 min	NA	KP
7/31/20	Cal Check (57-60)	Lab	0639	2hr 30 min	NA	KP
7/31/20	2007132A (1-9)	URENCO	0740	2hr 50 min	UU	KP
7/31/20	2007132A (10-13)	URENCO	0925	2hr 50 min	UU	KP
7/31/20	2007133A (1-9)	URENCO	1038	2hr 50 min	UU	KB
7/31/20	System Disgd	Lab	1455	16.40 hrs	NA	KB
8/3/20	Daily Pulser	Lab	0418	10 min	NA	KP
8/3/20	2007109A (5-10)	Unitech	0812	2hr 50 min	Pu	KP
8/3/20	2007093A (1-7)	TN Dept.	0813	2hr 50 min	UU	KP
8/3/20	2007109A (1-9)	Unitech	1112	2hr 50 min	Th	KP
8/3/20	2007128A (1-4)	PCC Structural	1113	2hr 50 min	Th	KP
8/3/20	2007128A (5)	PCC	1408	2hr 50 min	Th	KB
8/3/20	2007109A (1-9)	Unitech	1409	2hr 50 min	UU	KB
8/3/20	2007104A (1-3)	ERM	1409	2hr 50 min	Ra	KB
8/3/20	2007109A (1-9)	Unitech	1714	2hr 50 min	Np	KB
8/3/20	2007104A (8-9)	ERM	1715	2hr 50 min	Ra	KB

RA-228 NOTES

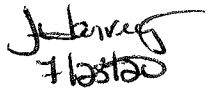
EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	20-07104
Analysis Code	Ra228
Run Number	1

#	Date	Dept	User	Notes
1	07/28/20 03:02	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS



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	20-07104
Analysis Code	Ra228
Run Number	1

#	Date	Dept	User	Notes
1	07/28/20 03:02	PREP	JHARVEY	ALIQUOTED AND FILTERED SAMPLES- ADDED SPIKE AND TRACER- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	08/07/20 12:02	CHEM	AYARBER	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.

8/7/20

EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
20-07104	
Analysis Code	Run
Ra228	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
022002P	Ammonium Hydroxide	Reagent Grade	JHARVEY	7/28/2020
022142D02	Ammonium Sulfate	200 mg/ml	JHARVEY	7/28/2020
022147D03	Barium Carrier	1 mg/ml	JHARVEY	7/28/2020
022385D01	Lead Carrier	166 mg/ml	JHARVEY	7/28/2020
022073P	Nitric Acid	Reagent Grade	JHARVEY	7/28/2020
022277D01	Ammonium Oxalate	5%	AYARBER	8/7/2020
021951D10	Nitric Acid	1N	AYARBER	8/7/2020
021459D25	Nitric Acid	6N	AYARBER	8/7/2020
022254D02	Sodium Hydroxide	10M	AYARBER	8/7/2020
022254D01	Sodium Hydroxide	18M	AYARBER	8/7/2020
021833S	Yttrium Carrier	9 mg/ml	AYARBER	8/7/2020

Aqua LB4116

Date	Sample #	Client	Load time	Count time	Analysis	Tech
8/5/20	20071103Pb (1-4)	UCOR	1104	2 hrs	Pb^{210}	KB
8/5/20	20071129Pb (1-3,5)	UCOR	1104	2 hrs	Pb^{210}	KB
8/5/20	20071136 Pb (1-4)	UCOR	1105	2 hrs	Pb^{210}	KB
8/5/20	20090935-4 (1-3, 8-11)	TN Dept Health	1509	2 hrs	Sr^{90}/Y	KB
8/5/20	20070935R (1-3, 8-11)	TN Dept Health	1510	2 hrs	Tot Sr	KB
8/6/20	Daily Bkgd/QC	Lab	0417/0521	1hr/30min	KB	KP
8/6/20	Cross Talk	Lab	0554	5 Min	KB	KP
8/6/20	Cross Talk	Lab	0602	5 Min	KB	KP
8/7/20	Daily Bkgd/QC	Lab	0413/0534	1hr/30Min	KB	KP
8/7/20	Cross Talk	Lab	0617	5 Min	KB	KP
8/7/20	Cross Talk	Lab	0625	5 Min	KB	KP
8/7/20	20071025Y (1-5&8)	UCOR	0633	2hrs	Sr^{90}	KP
8/7/20	20071035Y (2-4&6)	UCOR	0634	2hrs	Sr^{90}	KP
8/7/20	20071035Y (1)	UCOR	0634	30min	Sr^{90}	KP
8/17/20	20071047RA (1-9)	ERM	1210	2hrs	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	20-07104
Analysis Code	TDS
Run Number	1

#	Date	Dept	User	Notes
1	07/23/20 00:43	PREP	MHIGHTOWER	Filtered sample into tared beaker, dried, re-weighed

MH 23 JUL 20

SECTION VIII

ANALYTICAL DATA (RADIUM-226)

20-07104
Ra226
Run 1

Work Order	20-07104
Analysis Code	Ra226
Run	1
Date Received	7/22/2020
Lab Deadline	8/5/2020
Client	ERM
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)	419.4
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		07/22/20 00:00	1.0000E+00
02	MBL	BLANK		07/22/20 00:00	1.0000E+00
03	DUP	MW-2B	30	07/16/20 14:05	1.0000E+00
04	TRG	MW-3A	20	07/15/20 08:35	3.3330E-01
05	TRG	MW-4A	50	07/15/20 10:30	1.0000E+00
06	TRG	MW-9B	10	07/15/20 13:15	1.0000E+00
07	TRG	MW-7A	30	07/16/20 09:00	1.0000E+00
08	TRG	MW-2A	20	07/16/20 11:50	1.0000E+00
09	DO	MW-2B	30	07/16/20 14:05	1.0000E+00

0040

* 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.

20-07104
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	2.2060	925.2	453.0	108.70		0.0196	0.0314	0.0118		108.70	3.00^	1.00
02	MBL	2.1988	922.2	469.0	112.90		0.0196	0.0313	0.0117		110.00	3.00^	1.00
03	DUP	2.1972	921.5	429.0	103.35		0.0194	0.0259	0.0065		103.35	2.34	1.00
04	TRG	2.1975	921.6	157.0	37.82		0.0196	0.0366	0.0170		37.82	3.00^	1.00
05	TRG	2.1937	920.0	416.0	100.38		0.0197	0.0251	0.0054		100.38	1.91	1.00
06	TRG	2.1864	917.0	414.0	100.23		0.0197	0.0265	0.0068		100.23	2.44	1.00
07	TRG	2.1871	917.3	315.0	76.24		0.0198	0.0276	0.0078		76.24	2.72	1.00
08	TRG	2.1875	917.4	425.0	102.84		0.0197	0.0251	0.0054		102.84	1.91	1.00
09	DO	2.1866	917.1	333.0	80.61		0.0196	0.0260	0.0064		80.61	2.31	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.

20-07104
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			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		
02	MBL			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		
03	DUP			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		
04	TRG			07/28/20 01:05	JHARVEY	08/03/20 11:13	AYARBER		
05	TRG			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		
06	TRG			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		
07	TRG			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		
08	TRG			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		
09	DO			07/28/20 01:05	JHARVEY	08/03/20 08:06	AYARBER		

* 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: 20-07104-Ra226-1

Run: 1
Analysis Code: Ra226
Eberline Services Work Order: 20-07104
Client: ERM

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	9.64E+00	1.31E+00	2.96E-01	1.01E+01	95.91	OK		OK	
02	RA-226	MBL	BLANK	pCi/l	-1.62E-02	9.78E-02	3.08E-01					OK	OK
03	RA-226	DUP	MW-2B	pCi/l	3.38E-02	1.93E-01	4.04E-01				NA	OK	
04	RA-226	TRG	MW-3A	pCi/l	1.47E+02	1.48E+01	2.88E+00					INV	
05	RA-226	TRG	MW-4A	pCi/l	1.60E+00	4.31E-01	2.58E-01					OK	
06	RA-226	TRG	MW-9B	pCi/l	5.03E-02	1.43E-01	2.91E-01					OK	
07	RA-226	TRG	MW-7A	pCi/l	2.68E-01	2.68E-01	3.71E-01					OK	
08	RA-226	TRG	MW-2A	pCi/l	8.55E-01	3.63E-01	3.02E-01					OK	
09	RA-226	DO	MW-2B	pCi/l	2.73E-01	2.32E-01	2.82E-01					OK	

Preliminary Data Report & Analytical Calculations

Work Order: 20-07104-Ra226-1

Run: 1
Analysis Code: Ra226
Eberline Services Work Order: 20-07104
Client: ERM

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	07/22/20 00:00	1.00E+00	100.00	0.00	108.70		8/3/2020 8:06	
02	RA-226	MBL	07/22/20 00:00	1.00E+00	100.00	0.00	110.00		8/3/2020 8:06	
03	RA-226	DUP	07/16/20 14:05	1.00E+00	100.00	0.00	103.35		8/3/2020 8:06	
04	RA-226	TRG	07/15/20 08:35	3.33E-01	37.82	0.00	37.82		8/3/2020 11:13	
05	RA-226	TRG	07/15/20 10:30	1.00E+00	100.00	0.00	100.38		8/3/2020 8:06	
06	RA-226	TRG	07/15/20 13:15	1.00E+00	100.00	0.00	100.23		8/3/2020 8:06	
07	RA-226	TRG	07/16/20 09:00	1.00E+00	76.24	0.00	76.24		8/3/2020 8:06	
08	RA-226	TRG	07/16/20 11:50	1.00E+00	100.00	0.00	102.84		8/3/2020 8:06	
09	RA-226	DO	07/16/20 14:05	1.00E+00	80.61	0.00	80.61		8/3/2020 8:06	

0050

Client: ERM
Eberline Services Work Order: 20-07104
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	08/03/20 14:09		A_Spec	Alpha_058	170	2.24 E+02	8.00 E-03	18.4
02	RA-226	MBL	08/03/20 14:09		A_Spec	Alpha_059	170	-3.60 E-01	8.00 E-03	17.7
03	RA-226	DUP	08/03/20 14:09		A_Spec	Alpha_060	170	9.00 E-01	3.00 E-02	16.5
04	RA-226	TRG	08/03/20 14:28		A_Spec	Alpha_004	170.02	4.29 E+02	1.50 E-02	18.4
05	RA-226	TRG	08/03/20 14:28		A_Spec	Alpha_010	170.02	5.76 E+01	2.00 E-02	18.2
06	RA-226	TRG	08/03/20 14:28		A_Spec	Alpha_011	170.02	1.45 E+00	1.50 E-02	18.6
07	RA-226	TRG	08/03/20 14:28		A_Spec	Alpha_012	170	5.30 E+00	1.00 E-02	18.7
08	RA-226	TRG	08/03/20 17:15		A_Spec	Alpha_057	170	2.43 E+01	1.60 E-02	14.4
09	RA-226	DO	08/03/20 17:15		A_Spec	Alpha_058	170	6.64 E+00	8.00 E-03	18.4

Count Room Report
Client: ERM

20-07104-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	07/22/20 00:00	1.0000	2.2060	925.1964	453.0000	108.70	3.00^	1.00
02	MBL	BLANK	07/22/20 00:00	1.0000	2.1988	922.1767	469.0000	112.90	3.00^	1.00
03	DUP	MW-2B	07/16/20 14:05	1.0000	2.1972	921.5057	429.0000	103.35	2.34	1.00
04	TRG	MW-3A	07/15/20 08:35	0.3333	2.1975	921.6315	157.0000	37.82	3.00^	1.00
05	TRG	MW-4A	07/15/20 10:30	1.0000	2.1937	920.0378	416.0000	100.38	1.91	1.00
06	TRG	MW-9B	07/15/20 13:15	1.0000	2.1864	916.9762	414.0000	100.23	2.44	1.00
07	TRG	MW-7A	07/16/20 09:00	1.0000	2.1871	917.2697	315.0000	76.24	2.72	1.00
08	TRG	MW-2A	07/16/20 11:50	1.0000	2.1875	917.4375	425.0000	102.84	1.91	1.00
09	DO	MW-2B	07/16/20 14:05	1.0000	2.1866	917.0600	333.0000	80.61	2.31	1.00

Spike and Tracer Worksheet

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
20-07104	1	Ra226	7/28/2020 0:40	JHARVEY	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	43.930	7/28/2020	0.500	0.5081				10.05	0.463	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	419.400	7/28/2020	2.2060	2.4200
02	Ba-133	Ba-6a	419.400	7/28/2020	2.1988	2.4200
03	Ba-133	Ba-6a	419.400	7/28/2020	2.1972	2.4200
04	Ba-133	Ba-6a	419.400	7/28/2020	2.1975	2.4200
05	Ba-133	Ba-6a	419.400	7/28/2020	2.1937	2.4200
06	Ba-133	Ba-6a	419.400	7/28/2020	2.1864	2.4200
07	Ba-133	Ba-6a	419.400	7/28/2020	2.1871	2.4200
08	Ba-133	Ba-6a	419.400	7/28/2020	2.1875	2.4200
09	Ba-133	Ba-6a	419.400	7/28/2020	2.1866	2.4200

Balance Printer Tapes

Tracer

LCS

Matrix Spike

0053

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 8/3/2020 10:39 AM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
20-07104	1	Ra226	liters	8/5/2020	AYARBER

Lab Fraction	ERM 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				1.00E+00	1.0000E+00	1.0000E+00				
02	BLANK	MBL				1.00E+00	1.0000E+00	1.0000E+00				
03	MW-2B	DUP				1.00E+00	1.0000E+00	1.0000E+00				
04	MW-3A	TRG				1.00E+00	3.3330E-01	3.3330E-01				
05	MW-4A	TRG				1.00E+00	1.0000E+00	1.0000E+00				
06	MW-9B	TRG				1.00E+00	1.0000E+00	1.0000E+00				
07	MW-7A	TRG				1.00E+00	1.0000E+00	1.0000E+00				
08	MW-2A	TRG				1.00E+00	1.0000E+00	1.0000E+00				
09	MW-2B	DO				1.00E+00	1.0000E+00	1.0000E+00				

Comments	

0054

Technician: Owen Lyon Date: 8/3/20

Gravimetric Worksheet

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
20-07104	**1**	**Ra226**			**AYARBER**

TRetec Fraction	ERM Client ID	Sample Type	Carrier Data	Filter Data			Gravimetric
			Carrier Added (ml)	Filter Tare (g)	Filter Final (g)	Filter Net (g)	% Recovery
01	LCS	LCS		0.0196	0.0314	**0.0118**	
02	BLANK	MBL		0.0196	0.0313	**0.0117**	
03	DUP	DUP		0.0194	0.0259	**0.0065**	
04	MW-3A	TRG		0.0196	0.0366	**0.0170**	
05	MW-4A	TRG		0.0197	0.0251	**0.0054**	
06	MW-9B	TRG		0.0197	0.0265	**0.0068**	
07	MW-7A	TRG		0.0198	0.0276	**0.0078**	
08	MW-2A	TRG		0.0197	0.0251	**0.0054**	
09	MW-2B	DO		0.0196	0.0260	**0.0064**	

0055

Technician: _____ Date: 8/3/20

Apex-Alpha™

KP 8/14/20

Sample Description: SPIKE
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 01
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_058
Chamber Serial Number: 01017326B
Detector Serial Number: 58
Env. Background: System Bkgd 282895
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: 8/3/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 2:09:06 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1844 +/- 0.0032 on 2/28/2020 11:17:23 AM
Effective Efficiency: 0.1844 +/- 0.0032

Control Certificate Name: Ra226_Ra-5b
Chem. Recov. of Control: RA-226 0.319669 +/- 0.024125
Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

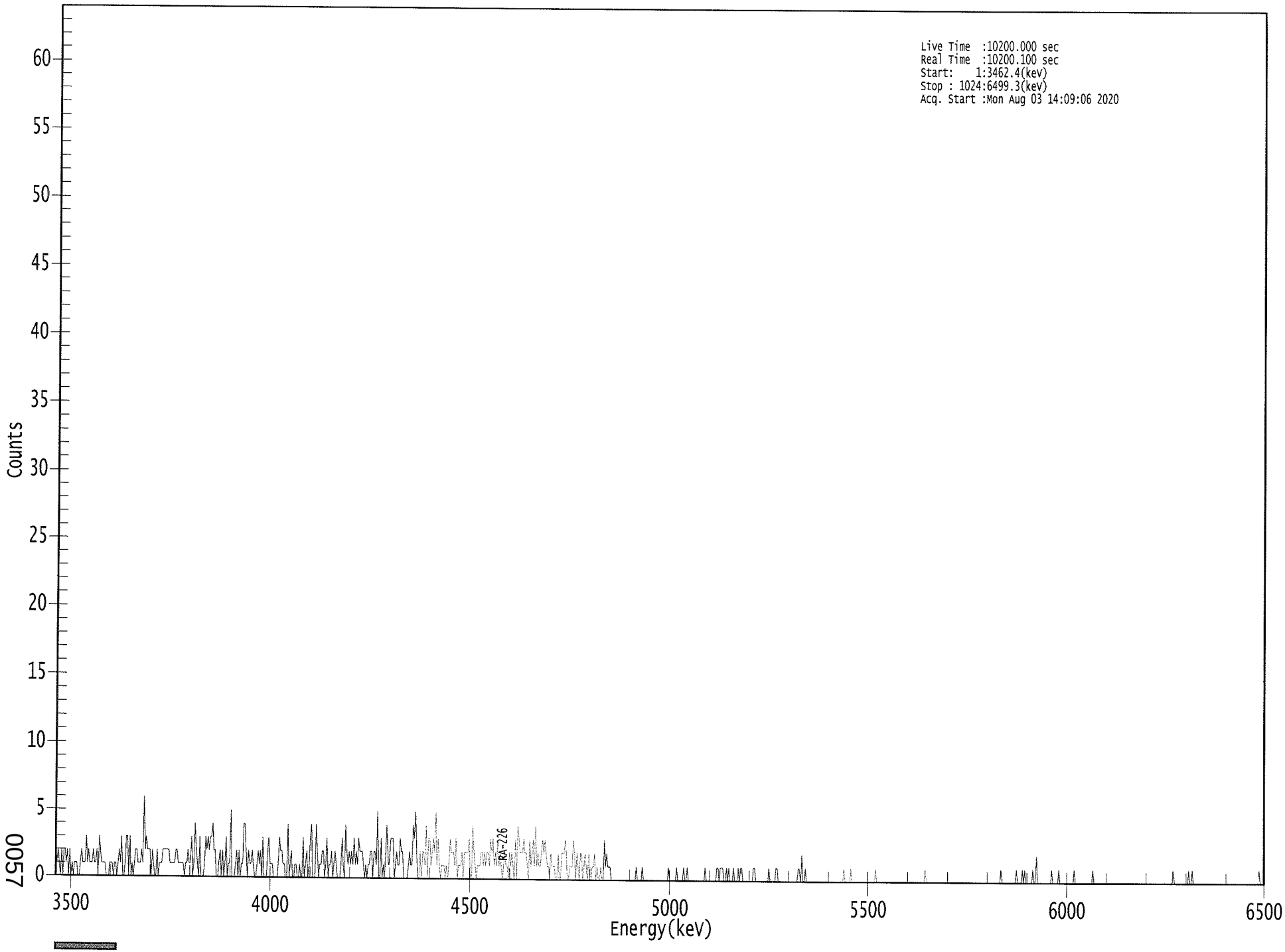
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.515	2.47	163.78	1.53	0.00E+000	3.0
RA-226	4.585	223.64	13.15	1.36	0.00E+000	4.3

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.963	5685.50*	1.12E-001 +/- 1.83E-001	3.22E-001 +/- 1.08E-002
RA-226	0.949	4785.00*	9.64E+000 +/- 1.31E+000	2.96E-001 +/- 9.90E-003

AG 8/14/20

0000277429.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:	2	1	2	1	0	2	0	2
9:	2	1	2	0	2	0	1	0
17:	1	1	1	0	0	1	2	1
25:	1	1	3	1	2	1	1	1
33:	2	1	1	2	0	3	2	1
41:	1	1	1	0	0	0	1	1
49:	1	0	1	1	0	1	2	1
57:	3	0	0	1	3	3	0	3
65:	0	1	0	1	2	2	1	1
73:	1	2	1	6	2	3	2	2
81:	2	0	2	1	0	0	2	0
89:	1	1	1	2	2	2	2	2
97:	2	1	1	1	1	1	2	2
105:	1	1	1	1	1	0	1	1
113:	2	1	1	3	0	1	4	2
121:	1	0	3	0	0	0	1	3
129:	2	3	2	3	3	4	2	2
137:	0	0	1	2	0	2	0	1
145:	3	0	1	1	5	0	0	0
153:	1	2	0	2	0	1	1	4
161:	4	2	0	2	1	1	2	1
169:	0	0	1	2	1	2	0	3
177:	0	0	0	2	3	1	1	1
185:	0	0	0	0	1	3	2	2
193:	1	1	0	0	4	0	1	2
201:	0	0	1	1	0	0	1	0
209:	0	3	0	1	2	0	1	3
217:	4	0	0	0	4	2	0	1
225:	1	2	2	0	1	3	0	1
233:	1	2	0	1	2	1	0	0
241:	0	1	3	1	0	4	2	1
249:	2	1	2	1	3	1	2	1
257:	3	2	2	2	1	0	1	0
265:	1	1	2	2	0	2	2	1
273:	5	0	0	3	0	1	0	2
281:	4	1	1	3	3	3	0	1
289:	2	1	1	3	2	2	0	0
297:	0	0	1	2	1	1	4	3
305:	5	2	0	0	2	0	2	2
313:	1	4	0	3	3	1	2	3
321:	2	5	1	3	1	0	1	1
329:	1	0	1	0	1	3	2	2
337:	2	1	3	0	1	1	1	2
345:	0	2	2	2	2	3	0	0
353:	4	2	1	0	1	1	1	2
361:	2	1	2	1	2	2	1	3

369:	2	3	1	2	1	3	1	2

Sample Title: 01

Channel								
377:	1	0	1	2	1	1	0	2
385:	1	2	1	0	3	0	4	3
393:	2	2	2	3	2	2	1	0
401:	3	1	2	3	1	4	1	2
409:	1	1	2	3	2	3	2	1
417:	1	0	2	1	1	1	0	0
425:	2	0	0	2	2	2	3	2
433:	0	0	1	1	1	3	2	0
441:	2	1	0	2	2	0	1	2
449:	1	0	2	1	0	1	1	2
457:	0	1	0	0	1	0	0	3
465:	1	2	1	1	1	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	1	0	0	0	0	1
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	1	0	0
521:	0	0	0	0	1	0	0	0
529:	0	0	1	0	0	1	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	1	0	0	0
553:	0	0	0	0	0	0	1	1
561:	0	1	1	1	0	0	1	0
569:	1	0	0	0	1	0	0	0
577:	1	0	1	1	0	0	0	0
585:	0	0	0	0	0	1	1	0
593:	0	0	0	0	0	0	0	0
601:	0	0	1	0	0	0	0	0
609:	1	1	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	1	1	0	2	0
633:	0	1	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	1	0	0	0	0	0
673:	1	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	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	1
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	1

801:	0	0	0	0	0	0	0	0

Sample Title: 01

Channel								
809:	0	0	0	0	1	0	0	0
817:	0	1	0	1	0	0	0	0
825:	0	0	1	0	0	2	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	1	0	0	0	0	0
849:	1	0	0	0	0	0	0	0
857:	0	0	0	0	0	1	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	1	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	1	0	0	0	0	0	0
953:	0	0	0	0	0	0	1	0
961:	0	1	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	1	0	0	0	0	0

KP
8/14/20

Apex-Alpha™

Sample Description: BLANK
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 02
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_059
Chamber Serial Number: 02030596A
Detector Serial Number: 59
Env. Background: System Bkgd 282896
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: 8/3/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 2:09:09 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1767 +/- 0.0030 on 2/28/2020 11:17:26 AM
Effective Efficiency: 0.1767 +/- 0.0030

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	5.531	-0.51	400.63	0.51	0.00E+000	0.0
RA-226	4.742	-0.36	604.11	1.36	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*	-2.41E-002 +/- 9.67E-002	2.48E-001 +/- 8.40E-003
RA-226	0.998	4785.00*	-1.62E-002 +/- 9.78E-002	3.08E-001 +/- 1.04E-002

AG
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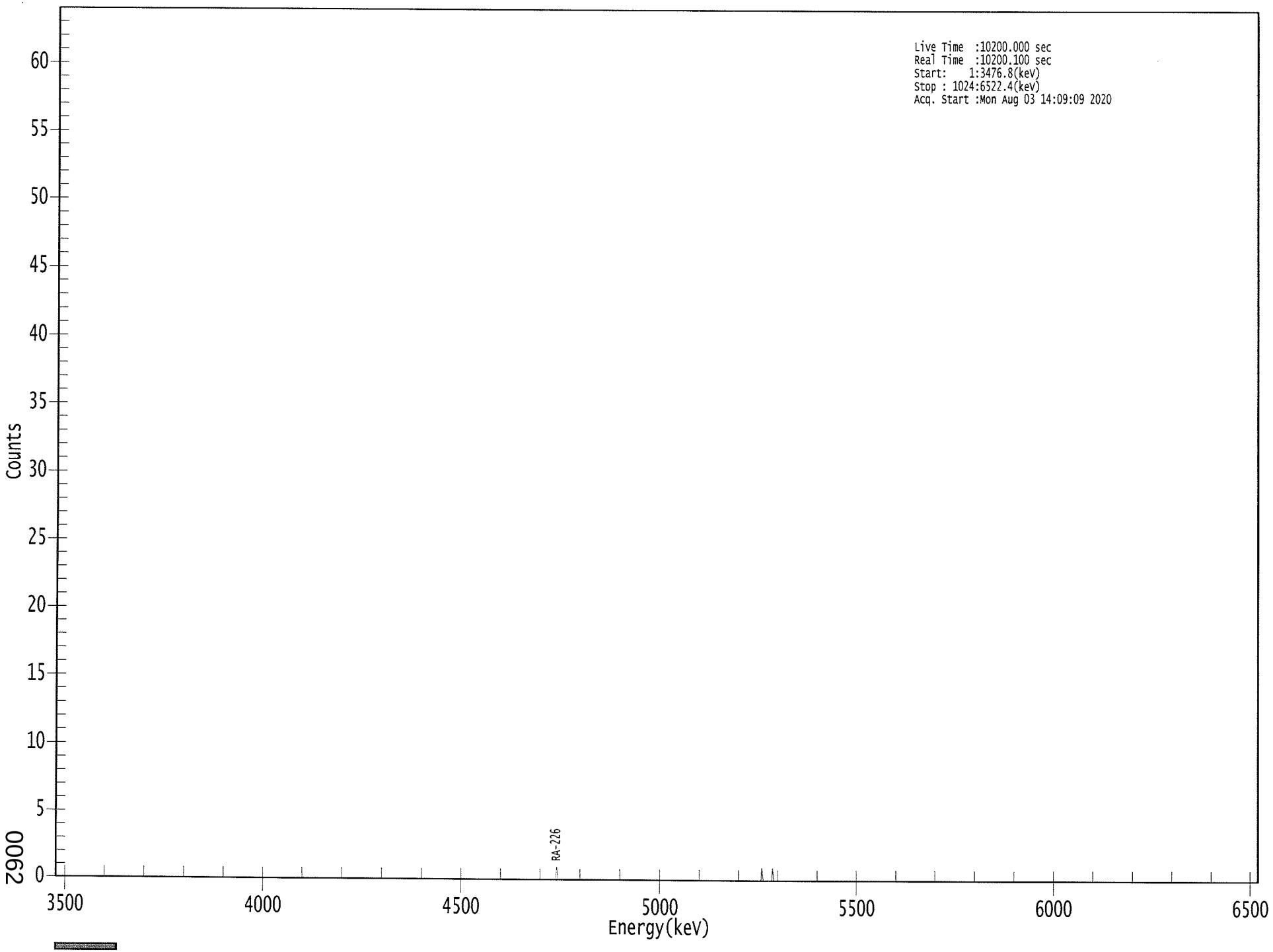
0000277430.CNF



2900

****
***** 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	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	0	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	0	0	0	0	0	0	0	0
233:	0	0	0	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	0	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	0	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	0	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	0
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	0	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 02

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	1	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:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	1
601:	0	0	0	0	0	0	0	0
609:	1	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	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	0	0	0	0	0	0	0
745:	0	0	0	0	0	0	0	0
753:	0	0	0	0	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	0	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 02

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	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™

ILD 8/14/20

Sample Description: MW-2B DUP
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 03
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_060
Chamber Serial Number: 02030596B
Detector Serial Number: 60
Env. Background: System Bkgd 282897
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.340E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 7/16/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 2:09:12 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1649 +/- 0.0029 on 2/28/2020 11:17:28 AM
Effective Efficiency: 0.1649 +/- 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	5.465	3.28	151.91	2.72	0.00E+000	3.0
RA-226	4.665	0.90	570.69	5.10	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.939	5685.50*	1.30E-001 +/- 1.98E-001	3.41E-001 +/- 1.17E-002
RA-226	0.981	4785.00*	3.38E-002 +/- 1.93E-001	4.04E-001 +/- 1.38E-002

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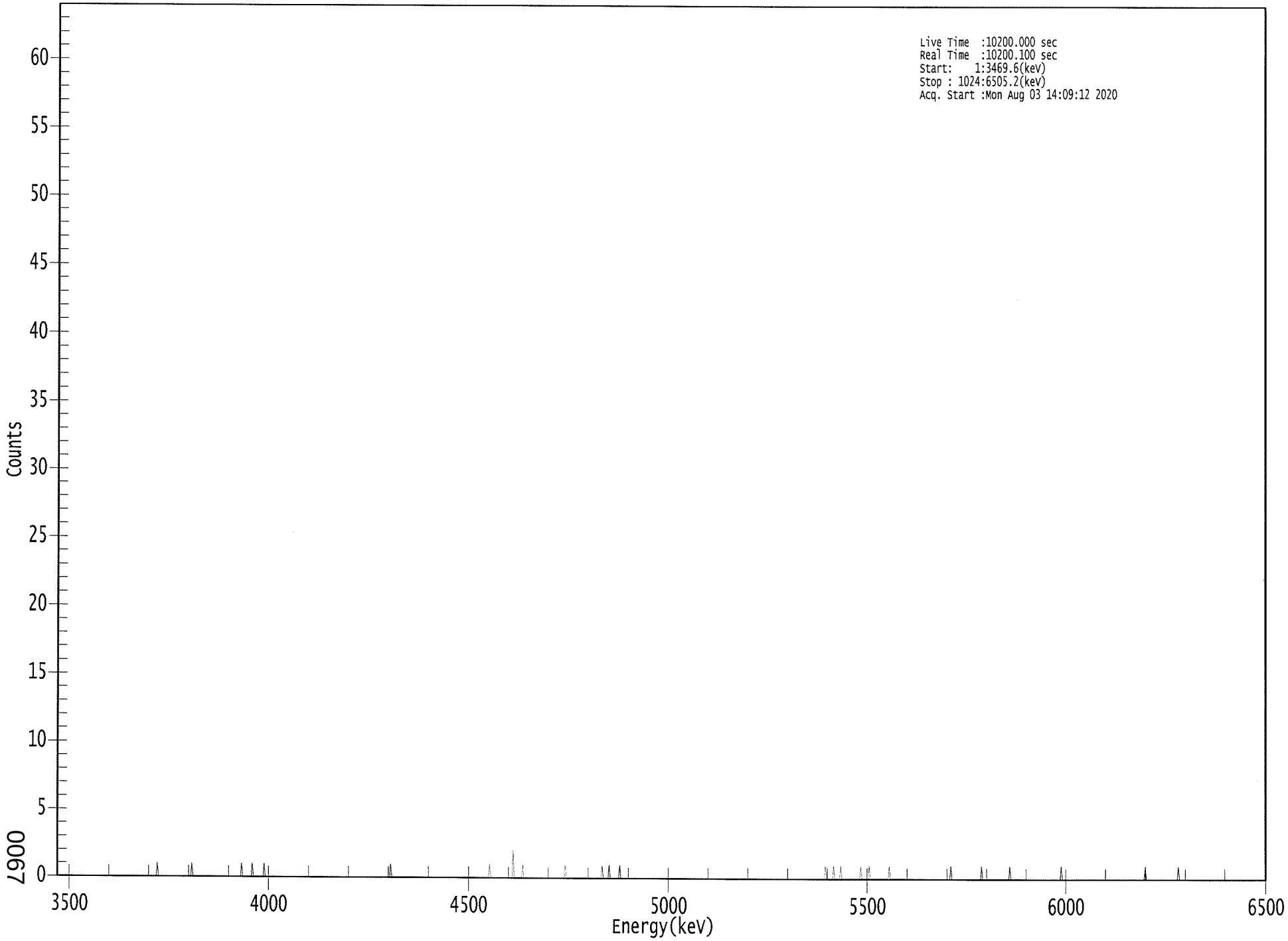
0000277431.CNF



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

Sample Title: 03

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	0	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	0
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	0
81:	0	0	0	0	0	1	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	1	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	1	0	0	0
161:	0	0	0	0	0	1	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	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	1	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	1	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 03

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	2	0	0	0	0	0	0
393:	0	1	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	1	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	1	0	0	0	0	0
473:	0	0	0	1	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	1	0	0	0	0	0	0
657:	1	0	0	0	0	0	1	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	1
681:	0	0	0	0	0	0	1	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	1
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	1	0	0	0	0
761:	0	0	0	0	0	0	0	0
769:	0	0	0	0	0	0	0	0
777:	0	0	0	0	0	1	0	0
785:	0	0	0	0	0	0	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	1	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	1	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:	1	0	0	0	0	0	0	0
929:	0	0	0	0	0	0	0	0
937:	0	0	0	0	0	0	0	0
945:	0	0	0	0	1	0	0	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

ICP
8/14/20

Apex-Alpha™

Sample Description: MW-3A
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 04
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_004
Chamber Serial Number:
Detector Serial Number: 4
Env. Background: System Bkgd 282881
Reagent Blank: <not performed>

Sample Size: 3.333E-001 +/- 0.000E+000 liter
Generic Mult. Factor: 3.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 7/15/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 2:28:44 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.3782 +/- 0.0000
Counting Efficiency: 0.1838 +/- 0.0032 on 2/28/2020 2:49:49 PM
Effective Efficiency: 0.0695 +/- 0.0012

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	5.538	34.77	35.00	3.23	0.00E+000	2.9
RA-226	4.588	429.45	9.49	2.55	0.00E+000	4.6

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.972	5685.50*	1.26E+001 +/- 4.44E+000	3.31E+000 +/- 1.11E-001
RA-226	0.950	4785.00*	1.47E+002 +/- 1.48E+001	2.88E+000 +/- 9.69E-002

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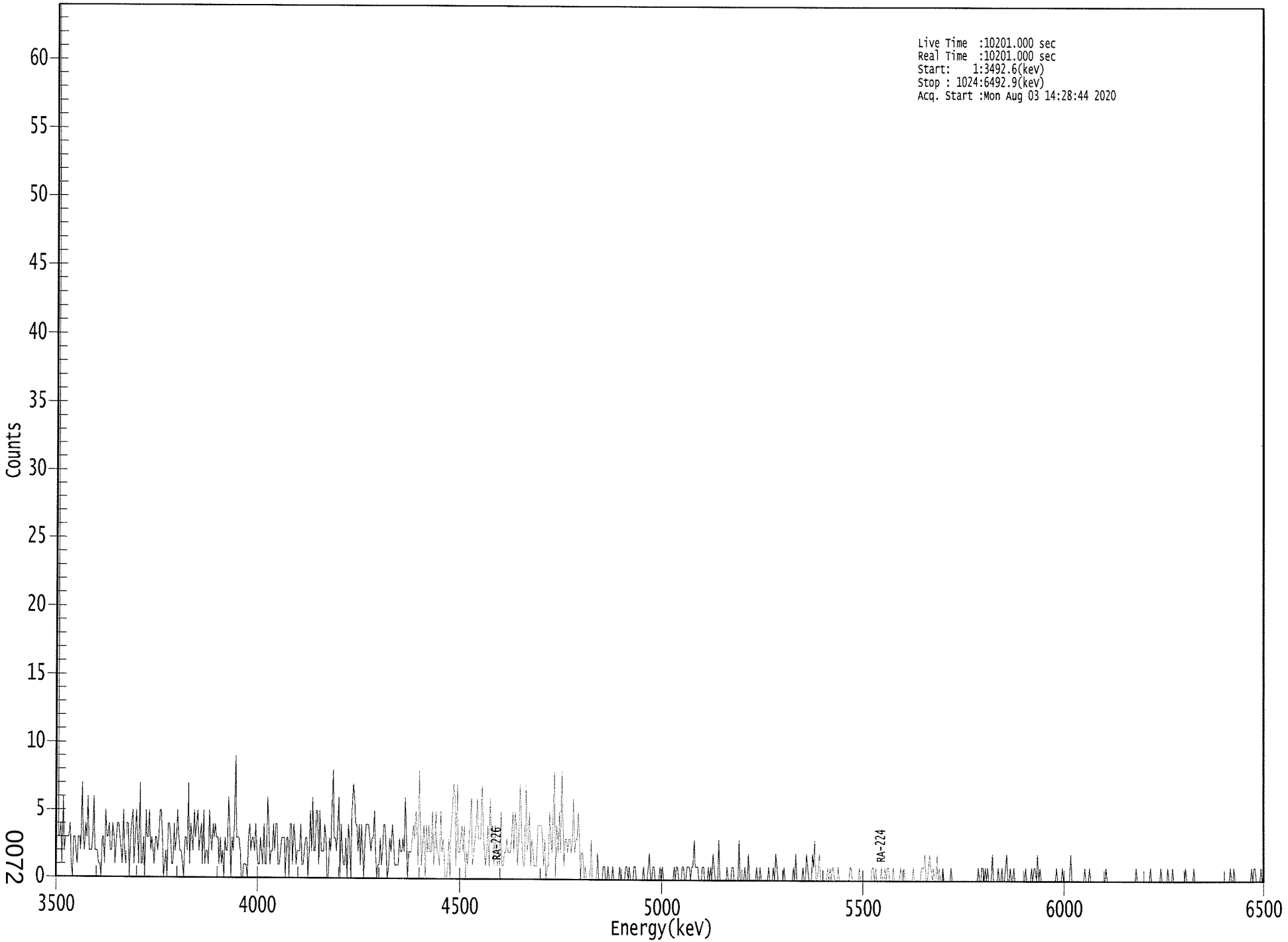
8/14/20

0000277441.CNF



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

Sample Title: 04

Elapsed Live time: 10201
Elapsed Real Time: 10201

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

369:	3	4	1	4	2	1	2	1

Sample Title: 04

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

801:	1	0	0	1	2	0	0	1

Sample Title: 04

Channel								
809:	0	0	1	0	0	0	0	0
817:	0	0	0	0	1	0	0	0
825:	0	1	0	1	1	0	2	0
833:	1	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	1	0
849:	0	0	0	1	0	0	0	0
857:	0	0	2	0	0	0	0	0
865:	0	0	0	0	0	0	1	0
873:	0	0	1	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	1	0	0	0	0	0
921:	0	0	0	0	0	0	1	0
929:	0	0	0	0	0	0	0	1
937:	0	0	0	0	0	1	0	0
945:	0	1	0	0	0	0	0	0
953:	0	0	0	0	1	0	0	0
961:	0	0	0	1	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	1	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	1	0	1	1
1017:	0	0	0	0	1	0	0	0

KD
8/4/20

Apex-Alpha™

Sample Description: MW-4A
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 05
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_010
Chamber Serial Number:
Detector Serial Number: 10
Env. Background: System Bkgd 282882
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 1.910E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 7/15/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 2:28:40 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1821 +/- 0.0031 on 2/28/2020 2:49:50 PM
Effective Efficiency: 0.1821 +/- 0.0031

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	5.557	4.94	115.82	3.06	0.00E+000	2.9
RA-226	4.601	57.60	26.70	3.40	0.00E+000	4.8

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.979	5685.50*	1.45E-001 +/- 1.68E-001	2.63E-001 +/- 8.83E-003
RA-226	0.957	4785.00*	1.60E+000 +/- 4.31E-001	2.58E-001 +/- 8.64E-003

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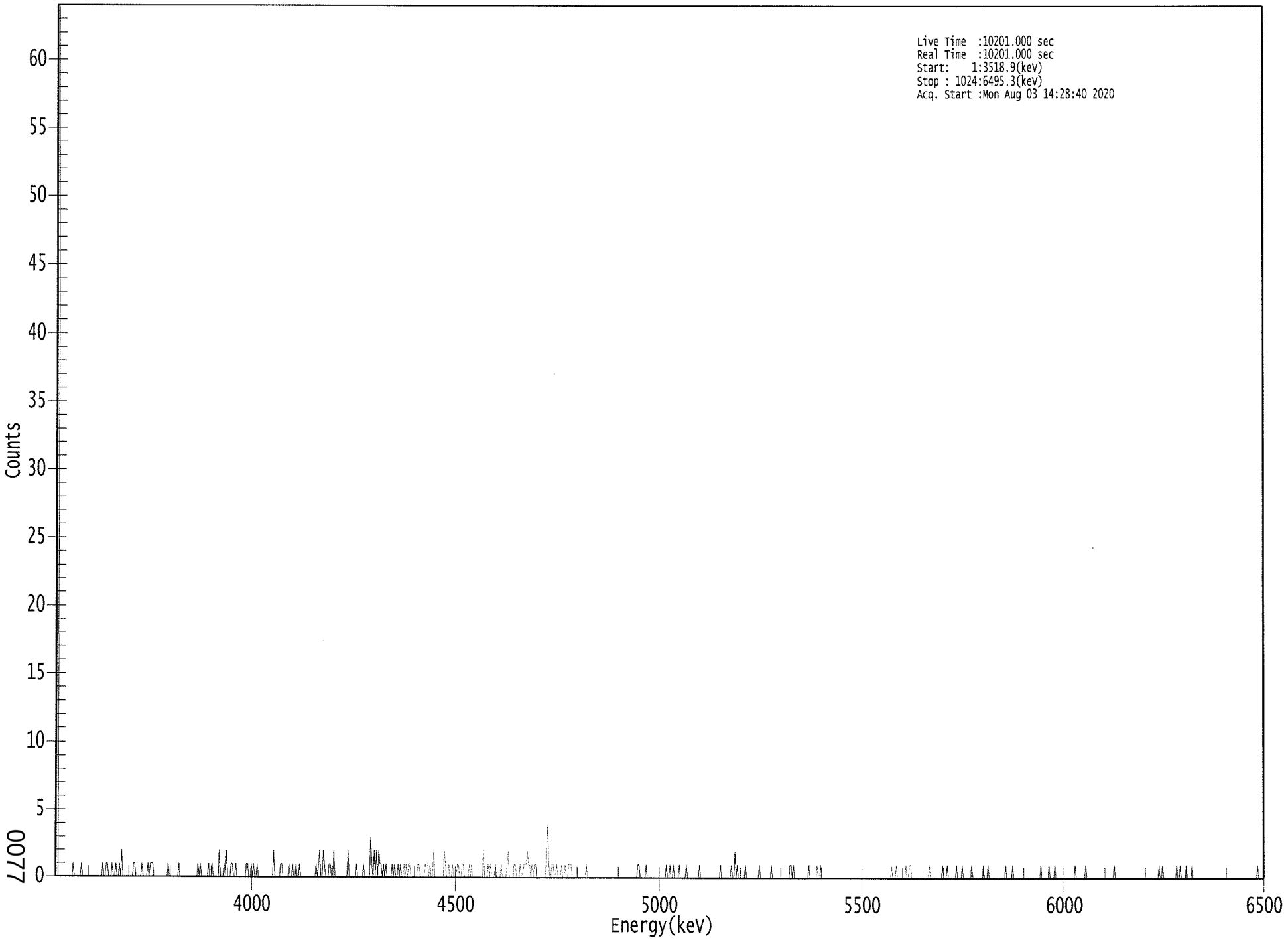
8/4/20

0000277438.CNF



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

Sample Title: 05

Elapsed Live time: 10201
Elapsed Real Time: 10201

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

369:	0	0	0	1	0	0	0	0

Sample Title: 05

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

801:	0	0	0	1	0	0	0	0

Sample Title: 05

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

Apex-Alpha™

KP
8/4/20

Sample Description: MW-9B
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 06
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_011
Chamber Serial Number:
Detector Serial Number: 11
Env. Background: System Bkgd 282883
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.440E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 7/15/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 2:28:41 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1863 +/- 0.0032 on 2/28/2020 2:49:50 PM
Effective Efficiency: 0.1863 +/- 0.0032

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

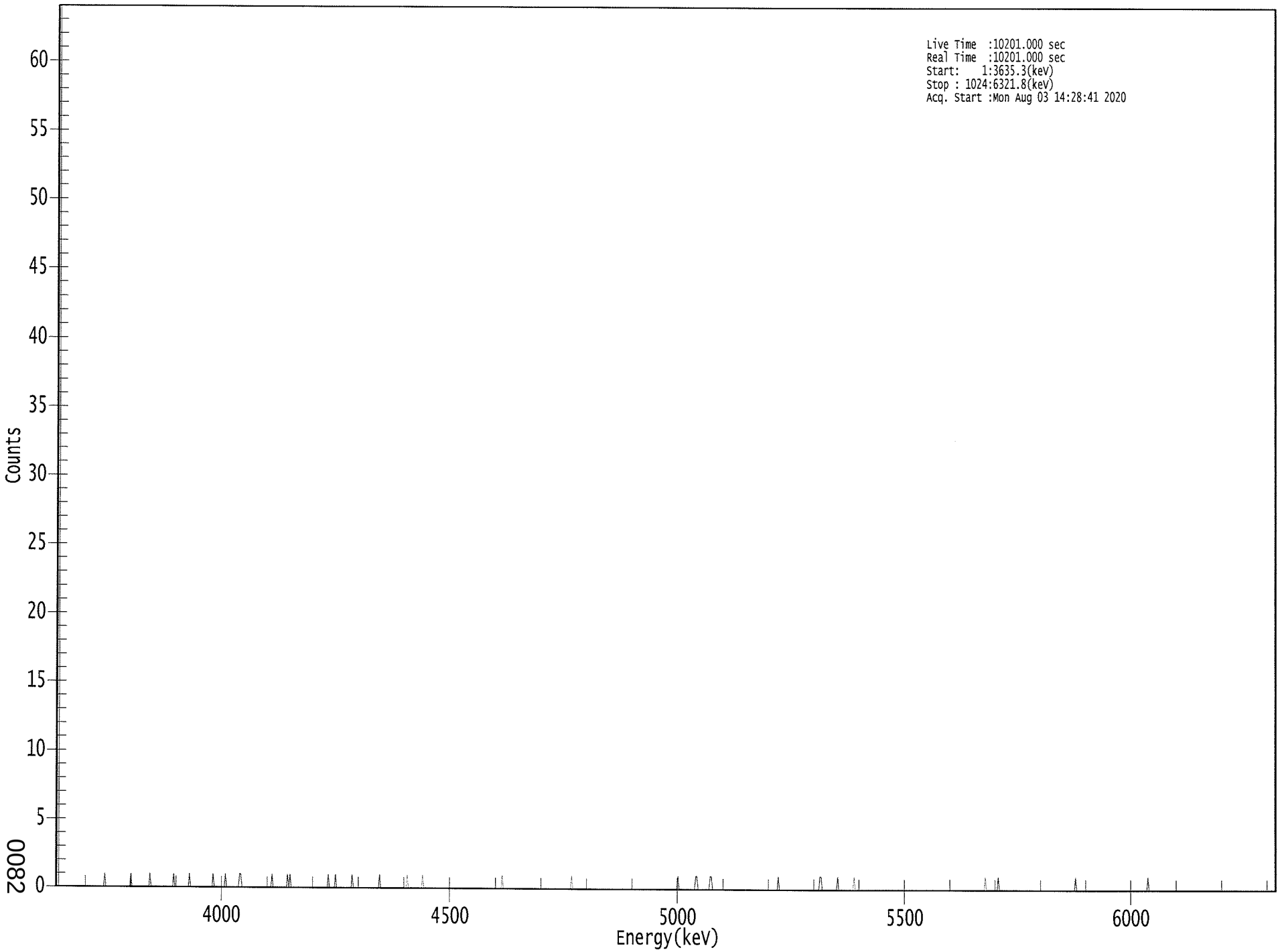
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.534	-3.27	101.99	5.27	0.00E+000	2.6
RA-226	4.558	1.45	284.67	2.55	0.00E+000	2.6

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.970	5685.50*	-1.20E-001 +/- 1.23E-001	3.99E-001 +/- 1.35E-002
RA-226	0.935	4785.00*	5.03E-002 +/- 1.43E-001	2.91E-001 +/- 9.79E-003

AG
8/4/20

0000277440.CNF



ROI Type: 1

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

Sample Title: 06

Elapsed Live time: 10201
Elapsed Real Time: 10201

Channel								
1:	10201	10201	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	0	0	0	0	0	0	0
25:	0	0	0	0	0	0	0	0
33:	0	0	0	0	0	0	0	0
41:	0	1	0	0	0	0	0	0
49:	0	0	0	0	0	0	0	0
57:	0	0	0	0	0	0	0	1
65:	0	0	0	0	0	0	0	0
73:	0	0	0	0	0	0	0	1
81:	0	0	0	0	0	0	0	0
89:	0	0	0	0	0	0	0	0
97:	0	0	0	1	0	0	0	0
105:	0	0	0	0	0	0	0	0
113:	1	0	0	0	0	0	0	0
121:	0	0	0	0	0	0	0	0
129:	0	0	0	0	1	0	0	0
137:	0	0	0	0	0	0	1	0
145:	0	0	0	0	0	0	0	0
153:	0	0	1	1	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	1	0	0
185:	0	0	0	0	0	0	0	0
193:	0	0	1	0	1	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	1	0	0	0
233:	0	0	1	0	0	0	0	0
241:	0	0	0	0	0	0	0	0
249:	1	0	0	0	0	0	0	0
257:	0	0	0	0	0	0	0	0
265:	0	0	0	0	0	0	0	1
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	1	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	1	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	1
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:	1	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	1
537:	1	0	0	0	0	0	0	0
545:	0	0	0	1	1	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	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	1
641:	1	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	1	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	1	0	0	0
673:	0	0	0	0	0	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	1	0	0	0	0	0
785:	0	0	0	0	0	1	0	0
793:	0	0	0	0	0	0	0	0

801:	0	0	0	0	0	0	0	0

Sample Title: 06

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	1	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	1	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™

KP 8/4/20

Sample Description: MW-7A
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 07
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_012
Chamber Serial Number:
Detector Serial Number: 12
Env. Background: System Bkgd 282884
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.720E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 7/16/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 2:28:43 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.7624 +/- 0.0000
Counting Efficiency: 0.1871 +/- 0.0032 on 2/28/2020 2:49:50 PM
Effective Efficiency: 0.1426 +/- 0.0024

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.485	4.28	125.10	2.72	0.00E+000	3.0
RA-226	4.574	5.30	99.84	1.70	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*	2.29E-001 +/- 2.86E-001	4.58E-001 +/- 1.54E-002
RA-226	0.944	4785.00*	2.68E-001 +/- 2.68E-001	3.71E-001 +/- 1.25E-002

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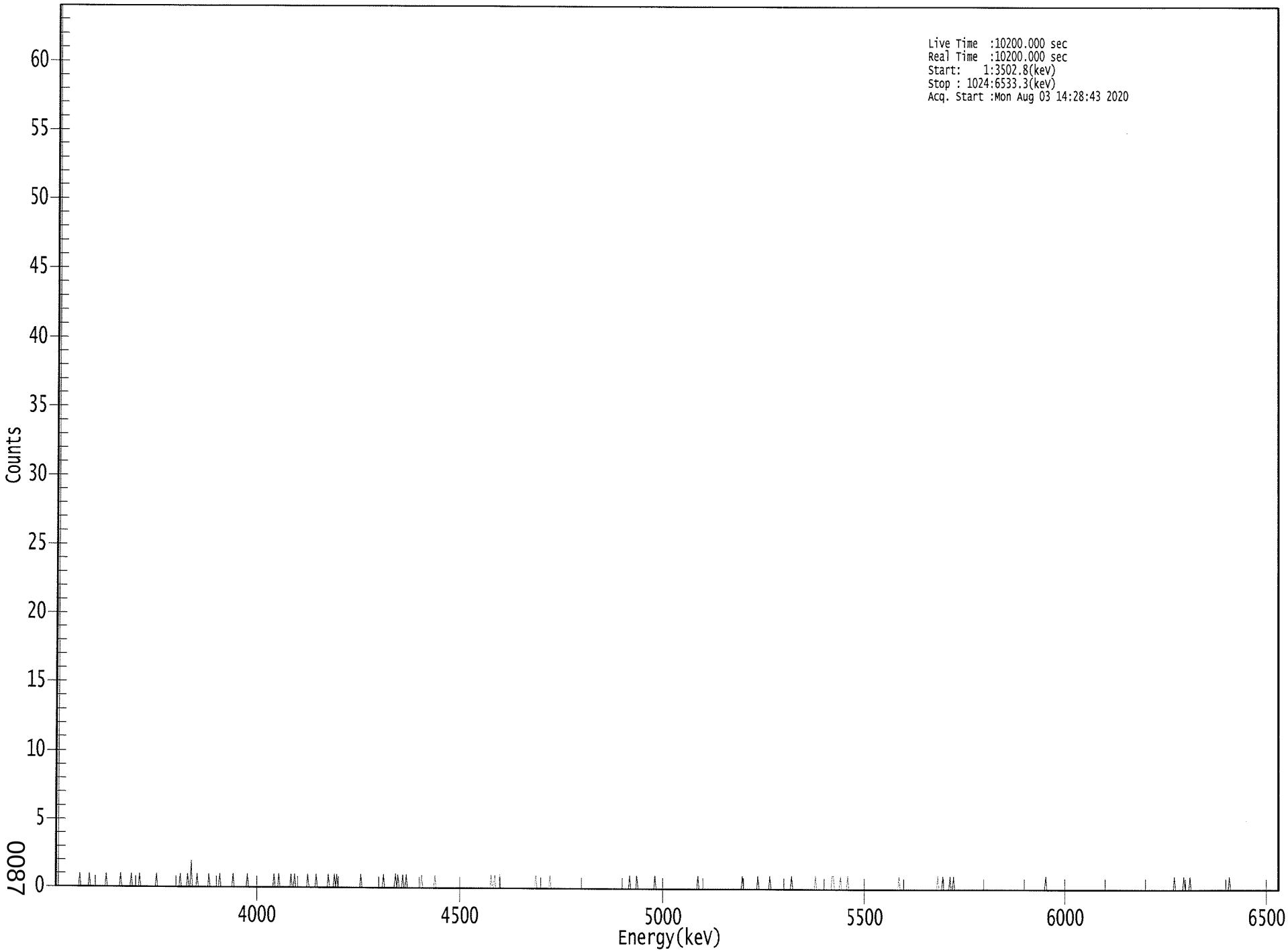
0000277439.CNF



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

Sample Title: 07

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

369:	0	0	1	0	0	0	0	0

Sample Title: 07

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	0	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	1	0	0	0	0	0	0	0
409:	0	0	0	0	1	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	1	0
481:	0	0	0	0	1	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	1	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	0	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	1
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	1	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	1	0	0	0	0	0	0
593:	0	0	0	1	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	1	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	1	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	1
649:	1	0	0	0	0	0	1	0
657:	0	0	0	0	1	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	1	0	0	0	0	0	0	0
713:	0	0	0	0	0	0	0	0
721:	0	0	0	0	0	0	0	0
729:	0	0	0	0	0	0	0	0
737:	0	1	0	0	0	1	0	0
745:	0	0	0	1	0	0	1	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: 07

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	0	0	1	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	1
937:	0	0	0	0	0	0	0	1
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	1	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

KP 8/4/20

Sample Description: MW-2A
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 08
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_057
Chamber Serial Number: 01017326A
Detector Serial Number: 57
Env. Background: System Bkgd 282894
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 1.910E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 7/16/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 5:15:28 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1437 +/- 0.0025 on 2/28/2020 11:17:21 AM
Effective Efficiency: 0.1437 +/- 0.0025

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

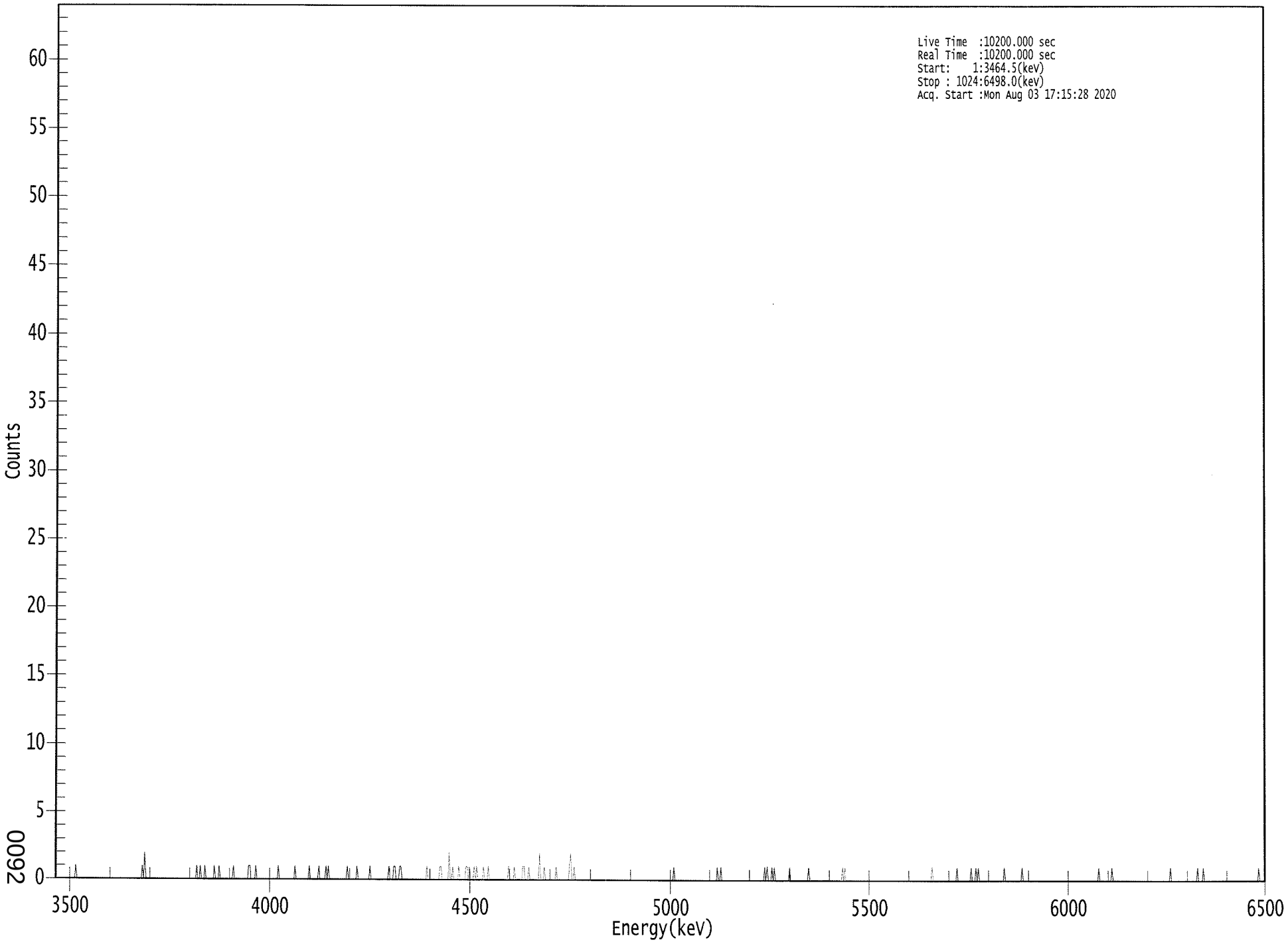
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.511	1.13	315.94	1.87	0.00E+000	3.0
RA-226	4.576	24.28	42.30	2.72	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.961	5685.50*	4.21E-002 +/- 1.33E-001	2.82E-001 +/- 9.77E-003
RA-226	0.945	4785.00*	8.55E-001 +/- 3.63E-001	3.02E-001 +/- 1.04E-002

AG 8/4/20

0000277451.CNF



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

Sample Title: 08

Elapsed Live time: 10200
Elapsed Real Time: 10200

Channel								
1:	0	0	0	0	0	0	0	0
9:	0	0	0	0	0	0	0	0
17:	0	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	1	0	2	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	1
121:	0	0	1	0	0	0	1	0
129:	0	0	0	0	0	0	1	0
137:	0	0	1	0	0	0	0	0
145:	0	0	0	0	0	0	1	0
153:	0	0	0	0	0	0	0	0
161:	0	0	0	1	1	0	0	0
169:	0	1	0	0	0	0	0	0
177:	0	0	0	0	0	0	0	0
185:	0	0	0	0	1	0	0	0
193:	0	0	0	0	0	0	0	0
201:	0	0	1	0	0	0	0	0
209:	0	0	0	0	0	0	1	0
217:	0	0	0	0	0	0	1	0
225:	0	0	0	0	1	0	1	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	1	0
257:	0	0	0	0	0	0	0	0
265:	0	1	0	0	0	0	0	0
273:	0	0	0	0	0	0	0	0
281:	0	1	0	0	0	1	1	0
289:	0	0	1	1	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	1	0	0	0	0	0	0
321:	0	0	0	0	1	1	0	0
329:	0	0	0	0	2	0	0	1
337:	0	0	0	0	1	0	0	0
345:	0	0	1	1	0	1	0	0
353:	0	1	0	1	0	0	0	0
361:	0	1	0	0	0	1	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 08

Channel								
377:	0	0	0	0	0	0	1	0
385:	0	0	0	1	0	0	0	0
393:	0	0	1	1	0	0	0	1
401:	0	0	0	0	0	0	0	0
409:	2	0	0	0	1	0	0	0
417:	0	0	0	0	0	0	1	0
425:	0	0	0	0	0	0	0	0
433:	0	1	2	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	1	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	1	0
561:	0	1	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	1	0
601:	1	0	0	0	1	0	1	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	1	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	1	0	0	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:	1	0	1	0	0	0	0	0
673:	0	0	0	0	0	0	0	0
681:	0	0	0	0	0	0	0	0
689:	0	0	0	0	0	0	0	0
697:	0	0	0	0	0	0	0	0
705:	0	0	0	0	0	0	0	0
713:	0	0	0	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	1	0	0	0
745:	0	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	0	0	0	1	0	0
777:	0	1	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	1	0	0	0	0	0	0

Sample Title: 08

Channel								
809:	0	0	0	0	0	0	0	0
817:	1	0	0	0	0	0	0	0
825:	0	0	0	0	0	0	0	0
833:	0	0	0	0	0	0	0	0
841:	0	0	0	0	0	0	0	0
849:	0	0	0	0	0	0	0	0
857:	0	0	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	0	1	0	0	0	0	0	0
889:	0	0	0	0	1	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	1	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	1	0	0
969:	0	0	1	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	1	0	0	0	0	0	0

Apex-Alpha™

KP
8/4/20

Sample Description: MW-2B
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002774
Batch Identification: 2007104A-RA
Sample Identification: 09
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_058
Chamber Serial Number: 01017326B
Detector Serial Number: 58
Env. Background: System Bkgd 282895
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 2.310E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 7/16/2020 12:10:24 PM
Acquisition Date/Time: 8/3/2020 5:15:31 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 0.8061 +/- 0.0000
Counting Efficiency: 0.1844 +/- 0.0032 on 2/28/2020 11:17:23 AM
Effective Efficiency: 0.1486 +/- 0.0025

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

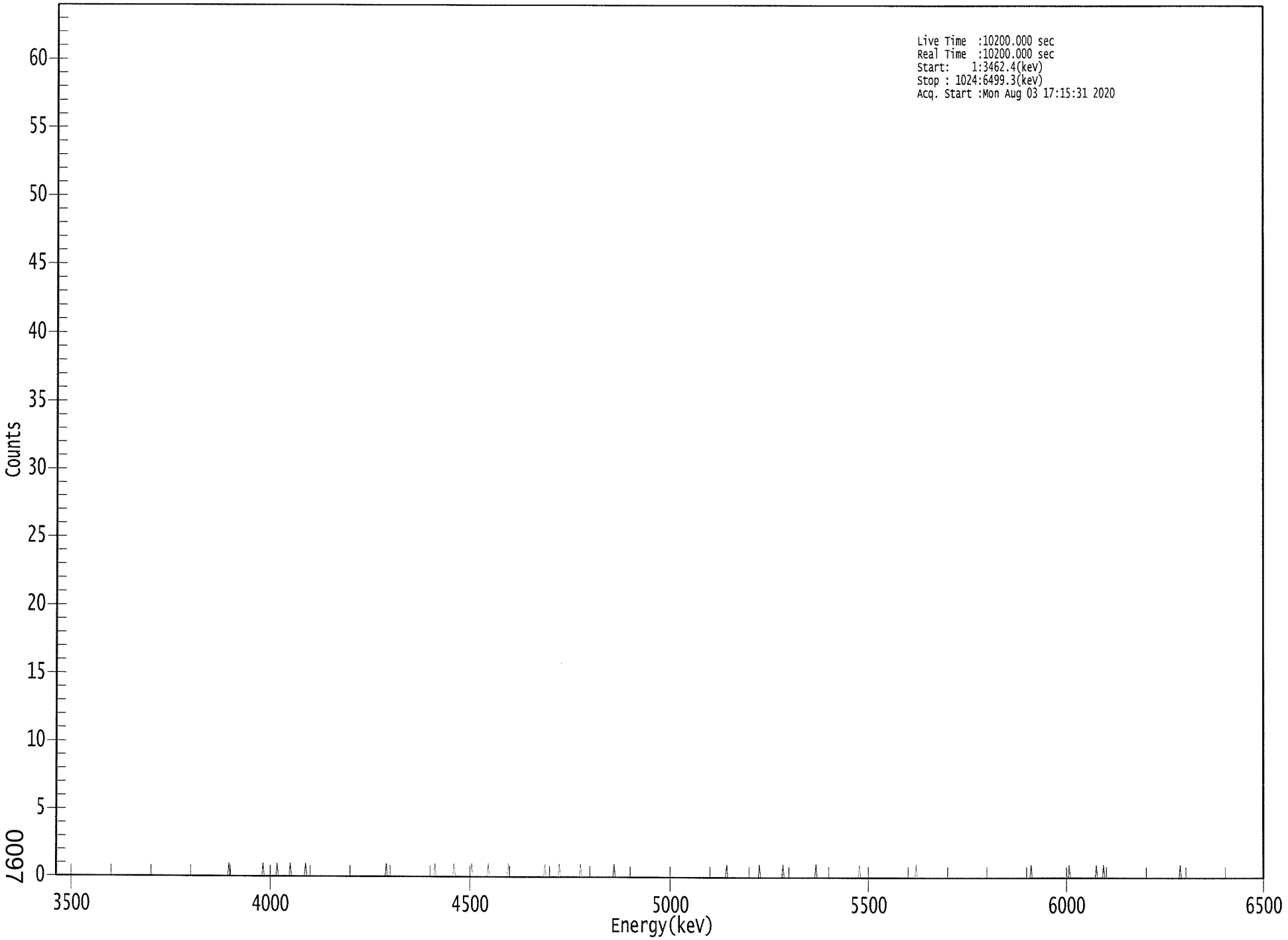
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.549	0.47	626.93	1.53	0.00E+000	3.0
RA-226	4.589	6.64	84.69	1.36	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.976	5685.50*	2.05E-002 +/- 1.28E-001	3.10E-001 +/- 1.04E-002
RA-226	0.951	4785.00*	2.73E-001 +/- 2.32E-001	2.82E-001 +/- 9.46E-003

AG
8/4/20

0000277452.CNF



ROI Type: 1

****
***** 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	0	0	0
129:	0	0	0	0	0	0	0	0
137:	0	0	0	0	0	0	0	0
145:	0	0	1	0	0	0	0	0
153:	0	0	0	0	0	0	0	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	1	0	0	0	0
193:	0	0	0	0	0	0	1	0
201:	0	0	0	0	0	0	0	0
209:	0	0	0	1	0	0	0	0
217:	0	0	0	0	0	0	0	0
225:	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	1
281:	0	0	0	0	0	0	0	0
289:	0	0	0	0	0	0	0	0
297:	0	0	0	0	0	0	0	0
305:	0	0	0	0	0	0	0	0
313:	0	0	0	0	0	0	0	0
321:	1	0	0	0	0	0	0	0
329:	0	0	0	0	0	0	0	0
337:	1	0	0	0	0	0	0	0
345:	0	0	0	0	0	0	0	1
353:	0	0	0	0	0	0	0	0
361:	0	0	0	0	0	1	0	0

369:	0	0	0	0	0	0	0	0

Sample Title: 09

Channel								
377:	0	0	0	0	0	0	1	0
385:	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	1	0	0
417:	0	0	0	0	0	0	0	0
425:	0	1	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	1	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	1
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	1	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	1	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	1	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	1	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	0	0	0	0	0	0	0
673:	0	0	0	0	0	0	0	1
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	1
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: 09

Channel								
809:	0	0	0	0	0	0	0	0
817:	0	0	0	0	0	0	0	0
825:	0	1	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	1	0	0	0	0	0	0
865:	0	0	0	0	0	0	0	0
873:	0	0	0	0	0	0	0	0
881:	1	0	0	0	0	0	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	1
953:	0	0	0	0	0	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

8/3/2020 4:39:50 AM

Apex-Alpha™

QA SUMMARY REPORT
Review Of QA Results - Pulser Check

Date : 8/3/2020
Time : 4:39:50 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_001	21f	ALL	Not Done	
Alpha_002	21f	ALL	Not Done	
Alpha_003	21f	ALL	Not Done	
Alpha_004	21f	ALL	Passed	8/3/2020 4:18:11 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	8/3/2020 4:18:12 AM
Alpha_011	21f	ALL	Passed	8/3/2020 4:18:12 AM
Alpha_012	21f	ALL	Passed	8/3/2020 4:18:13 AM
Alpha_013	21f	ALL	Not Done	
Alpha_014	21f	ALL	Not Done	
Alpha_015	21f	ALL	Not Done	
Alpha_016	21f	ALL	Not Done	
Alpha_033	Alpha Analyst100DC	ALL	Not Done	
Alpha_034	Alpha Analyst100DC	ALL	Not Done	
Alpha_035	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:15 AM
Alpha_036	Alpha Analyst100DC	ALL	Not Done	
Alpha_037	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:16 AM
Alpha_038	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:18 AM
Alpha_039	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:19 AM
Alpha_040	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:21 AM
Alpha_041	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:23 AM
Alpha_042	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:24 AM
Alpha_043	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:26 AM
Alpha_044	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:28 AM
Alpha_045	Alpha Analyst100DC	ALL	Not Done	
Alpha_046	Alpha Analyst100DC	ALL	Not Done	
Alpha_047	Alpha Analyst100DC	ALL	Not Done	
Alpha_048	Alpha Analyst100DC	ALL	Not Done	
Alpha_049	Alpha Analyst100DC	ALL	Not Done	
Alpha_050	Alpha Analyst100DC	ALL	Not Done	
Alpha_051	Alpha Analyst100DC	ALL	Not Done	
Alpha_052	Alpha Analyst100DC	ALL	Not Done	
Alpha_053	Alpha Analyst100DC	ALL	Not Done	
Alpha_054	Alpha Analyst100DC	ALL	Not Done	
Alpha_055	Alpha Analyst100DC	ALL	Not Done	
Alpha_056	Alpha Analyst100DC	ALL	Not Done	
Alpha_057	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:29 AM
Alpha_058	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:31 AM

Review of QA Results - Pulser Check

8/3/2020 4:39:50 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_059	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:33 AM
Alpha_060	Alpha Analyst100DC	ALL	Passed	8/3/2020 4:18:36 AM

APPROVED BY: KP

APPROVAL DATE: 8/3/20

****
***** 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)

20-07104
Ra228
Run 1

Work Order	20-07104
Analysis Code	Ra228
Run	1
Date Received	7/22/2020
Lab Deadline	8/5/2020
Client	ERM
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)	418.64
Carrier	Yttrium
Carrier Conc (mg/ml)	34.083

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		07/22/20 00:00	1.0000E+00
02	MBL	BLANK		07/22/20 00:00	1.0000E+00
03	DUP	MW-2B	30	07/16/20 14:05	1.0000E+00
04	TRG	MW-3A	20	07/15/20 08:35	1.0000E+00
05	TRG	MW-4A	50	07/15/20 10:30	1.0000E+00
06	TRG	MW-9B	10	07/15/20 13:15	1.0000E+00
07	TRG	MW-7A	30	07/16/20 09:00	1.0000E+00
08	TRG	MW-2A	20	07/16/20 11:50	1.0000E+00
09	DO	MW-2B	30	07/16/20 14:05	1.0000E+00

0105

* 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.

20-07104
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	2.2060	923.5	453.0	108.89	2.340	0.0855	0.1651	0.0796	99.81	108.68	1.00	1.00
02	MBL	2.1988	920.5	469.0	113.11	2.380	0.0856	0.1666	0.0810	99.86	109.84	1.00	1.00
03	DUP	2.1972	919.8	429.0	103.54	2.000	0.0868	0.1486	0.0618	90.66	93.87	1.00	1.00
04	TRG	2.1975	920.0	157.0	37.89	2.340	0.0867	0.1662	0.0795	99.68	37.77	1.00	1.00
05	TRG	2.1937	918.4	416.0	100.56	2.250	0.0867	0.1629	0.0762	99.37	99.92	1.00	1.00
06	TRG	2.1864	915.3	414.0	100.41	2.430	0.0868	0.1692	0.0824	99.49	99.90	1.00	1.00
07	TRG	2.1871	915.6	315.0	76.38	2.430	0.0869	0.1689	0.0820	99.01	75.62	1.00	1.00
08	TRG	2.1875	915.8	425.0	103.03	2.200	0.0870	0.1613	0.0743	99.09	102.09	1.00	1.00
09	DO	2.1866	915.4	333.0	80.76	2.450	0.0868	0.1698	0.0830	99.40	80.27	1.00	1.00

0106

* 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.

20-07104
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			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
02	MBL			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
03	DUP			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
04	TRG			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
05	TRG			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
06	TRG			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
07	TRG			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
08	TRG			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER
09	DO			08/07/20 09:06	AYARBER	08/03/20 08:06	AYARBER	08/07/20 10:08	AYARBER

0107

* 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: 20-07104-Ra228-1

Client: ERM
Eberline Services Work Order: 20-07104
Analysis Code: Ra228
Run: 1
0108

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	7.98E+00	6.89E-01	7.96E-01	9.11E+00	87.59	OK		OK	
02	RA-228	MBL	BLANK	pCi/l	3.87E-01	3.98E-01	8.10E-01					OK	OK
03	RA-228	DUP	MW-2B	pCi/l	5.01E-01	4.40E-01	8.85E-01				NA	OK	
04	RA-228	TRG	MW-3A	pCi/l	2.70E+01	2.09E+00	2.38E+00					INV	
05	RA-228	TRG	MW-4A	pCi/l	1.87E+00	5.12E-01	9.01E-01					OK	
06	RA-228	TRG	MW-9B	pCi/l	1.13E+00	5.21E-01	1.00E+00					OK	
07	RA-228	TRG	MW-7A	pCi/l	1.51E+00	5.36E-01	9.64E-01					OK	
08	RA-228	TRG	MW-2A	pCi/l	1.12E+00	4.27E-01	7.86E-01					OK	
09	RA-228	DO	MW-2B	pCi/l	3.36E-01	5.63E-01	1.17E+00					OK	

Work Order: 20-07104-Ra228-1

Client: ERM
Eberline Services Work Order: 20-07104
Analysis Code: Ra228
Run: 1
0109

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	07/22/20 00:00	1.00E+00	108.89	99.81	108.68	1.00	8/3/2020 8:06	8/7/2020 10:08
02	RA-228	MBL	07/22/20 00:00	1.00E+00	113.11	99.86	109.84	1.00	8/3/2020 8:06	8/7/2020 10:08
03	RA-228	DUP	07/16/20 14:05	1.00E+00	103.54	90.66	93.87	1.00	8/3/2020 8:06	8/7/2020 10:08
04	RA-228	TRG	07/15/20 08:35	1.00E+00	37.89	99.68	37.77	1.00	8/3/2020 8:06	8/7/2020 10:08
05	RA-228	TRG	07/15/20 10:30	1.00E+00	100.56	99.37	99.92	1.00	8/3/2020 8:06	8/7/2020 10:08
06	RA-228	TRG	07/15/20 13:15	1.00E+00	100.41	99.49	99.90	1.00	8/3/2020 8:06	8/7/2020 10:08
07	RA-228	TRG	07/16/20 09:00	1.00E+00	76.38	99.01	75.62	1.00	8/3/2020 8:06	8/7/2020 10:08
08	RA-228	TRG	07/16/20 11:50	1.00E+00	103.03	99.09	102.09	1.00	8/3/2020 8:06	8/7/2020 10:08
09	RA-228	DO	07/16/20 14:05	1.00E+00	80.76	99.40	80.27	1.00	8/3/2020 8:06	8/7/2020 10:08

Preliminary Data Report & Analytical Calculations

Work Order: 20-07104-Ra228-1

Client: ERM
Eberline Services Work Order: 20-07104
Analysis Code: Ra228
Run: 1
0110

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-228	LCS	08/07/20 12:09		LB4110A	A1	120	873	1.233333333	0.4803
02	RA-228	MBL	08/07/20 12:09		LB4110A	A2	120	218	1.5	0.4724
03	RA-228	DUP	08/07/20 12:09		LB4110A	A3	120	198	1.3	0.4719
04	RA-228	TRG	08/07/20 12:09		LB4110A	B1	120	1069	1.466666667	0.4626
05	RA-228	TRG	08/07/20 12:09		LB4110A	B3	120	325	1.383333333	0.449
06	RA-228	TRG	08/07/20 12:09		LB4110A	B4	120	319	1.833333333	0.4619
07	RA-228	TRG	08/07/20 12:09		LB4110A	C1	120	217	0.966666667	0.4667
08	RA-228	TRG	08/07/20 12:09		LB4110A	C2	120	235	1.133333333	0.4578
09	RA-228	DO	08/07/20 12:09		LB4110A	C3	120	222	1.65	0.4699

Count Room Report
Client: ERM

20-07104-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	07/22/20 00:00	1.0000	2.2060	923.5198	453.0000	108.89	1.00	1.00
02	MBL	BLANK	07/22/20 00:00	1.0000	2.1988	920.5056	469.0000	113.11	1.00	1.00
03	DUP	MW-2B	07/16/20 14:05	1.0000	2.1972	919.8358	429.0000	103.54	1.00	1.00
04	TRG	MW-3A	07/15/20 08:35	1.0000	2.1975	919.9614	157.0000	37.89	1.00	1.00
05	TRG	MW-4A	07/15/20 10:30	1.0000	2.1937	918.3706	416.0000	100.56	1.00	1.00
06	TRG	MW-9B	07/15/20 13:15	1.0000	2.1864	915.3145	414.0000	100.41	1.00	1.00
07	TRG	MW-7A	07/16/20 09:00	1.0000	2.1871	915.6075	315.0000	76.38	1.00	1.00
08	TRG	MW-2A	07/16/20 11:50	1.0000	2.1875	915.7750	425.0000	103.03	1.00	1.00
09	DO	MW-2B	07/16/20 14:05	1.0000	2.1866	915.3982	333.0000	80.76	1.00	1.00

Spike and Tracer Worksheet

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
20-07104	1	Ra228	8/7/2020 9:05	AYARBER		

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	42.460	8/7/2020	0.470	0.4764				9.11	0.465	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	418.640	8/7/2020	2.2060	2.4200
02	Ba-133	Ba-6a	418.640	8/7/2020	2.1988	2.4200
03	Ba-133	Ba-6a	418.640	8/7/2020	2.1972	2.4200
04	Ba-133	Ba-6a	418.640	8/7/2020	2.1975	2.4200
05	Ba-133	Ba-6a	418.640	8/7/2020	2.1937	2.4200
06	Ba-133	Ba-6a	418.640	8/7/2020	2.1864	2.4200
07	Ba-133	Ba-6a	418.640	8/7/2020	2.1871	2.4200
08	Ba-133	Ba-6a	418.640	8/7/2020	2.1875	2.4200
09	Ba-133	Ba-6a	418.640	8/7/2020	2.1866	2.4200

Balance Printer Tapes

Tracer	LCS

Matrix Spike

0112

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 7/28/2020 2:59 AM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
20-07104	1	Ra228	liters	8/5/2020	JHARVEY

Lab Fraction	ERM 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	MW-2B	DUP					1.0000E+00	1.0000E+00				
04	MW-3A	TRG					1.0000E+00	1.0000E+00				
05	MW-4A	TRG					1.0000E+00	1.0000E+00				
06	MW-9B	TRG					1.0000E+00	1.0000E+00				
07	MW-7A	TRG					1.0000E+00	1.0000E+00				
08	MW-2A	TRG					1.0000E+00	1.0000E+00				
09	MW-2B	DO					1.0000E+00	1.0000E+00				

Comments	

0113

Technician: J Harvey Date: 7/28/20

Eberline Services - Oak Ridge
Version 1.0 9/1999

Gravimetric Worksheet

Printed: 8/7/2020 12:02 PM

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
20-07104	1	Ra228	Yttrium	34.0830	AYARBER

TRetec Fraction	ERM Client ID	Sample Type	Carrier Data	Filter Data			Gravimetric
			Carrier Added (ml)	Filter Tare (g)	Filter Final (g)	Filter Net (g)	% Recovery
01	LCS	LCS	2.3400	0.0855	0.1651	0.0796	99.81
02	BLANK	MBL	2.3800	0.0856	0.1666	0.0810	99.86
03	DUP	DUP	2.0000	0.0868	0.1486	0.0618	90.66
04	MW-3A	TRG	2.3400	0.0867	0.1662	0.0795	99.68
05	MW-4A	TRG	2.2500	0.0867	0.1629	0.0762	99.37
06	MW-9B	TRG	2.4300	0.0868	0.1692	0.0824	99.49
07	MW-7A	TRG	2.4300	0.0869	0.1689	0.0820	99.01
08	MW-2A	TRG	2.2000	0.0870	0.1613	0.0743	99.09
09	MW-2B	DO	2.4500	0.0868	0.1698	0.0830	99.40

0114

Technician: _____ Date: 8/7/20

GPC Detector Report
(ALL Backgrounds)

KP
8/7/20

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	8/7/2020	1.50E-01	P	-1.43E-02	1.39E-01	2.93E-01
LB4110A - A2	Alpha	11/2/2019	8/7/2020	1.17E-01	P	2.03E-03	1.37E-01	2.72E-01
LB4110A - A3	Alpha	11/2/2019	8/7/2020	8.33E-02	P	-2.57E-03	1.44E-01	2.90E-01
LB4110A - A4	Alpha	11/2/2019	8/7/2020	2.33E-01	P	3.27E-03	1.46E-01	2.88E-01
LB4110A - B1	Alpha	11/2/2019	8/7/2020	1.67E-01	P	-2.79E-03	1.39E-01	2.80E-01
LB4110A - B2	Alpha	11/2/2019	8/7/2020	3.17E-01	F	5.10E-02	2.05E-01	3.59E-01
LB4110A - B3	Alpha	11/2/2019	8/7/2020	1.50E-01	P	1.56E-02	1.43E-01	2.70E-01
LB4110A - B4	Alpha	11/2/2019	8/7/2020	1.00E-01	P	-1.71E-02	1.15E-01	2.47E-01
LB4110A - C1	Alpha	11/2/2019	8/7/2020	1.33E-01	P	-3.11E-02	9.01E-02	2.11E-01
LB4110A - C2	Alpha	11/2/2019	8/7/2020	1.67E-01	P	-3.85E-02	9.27E-02	2.24E-01
LB4110A - C3	Alpha	11/2/2019	8/7/2020	5.00E-02	P	-3.25E-02	7.46E-02	1.82E-01
LB4110A - C4	Alpha	11/2/2019	8/7/2020	1.33E-01	P	2.19E-02	1.89E-01	3.57E-01
LB4110A - D1	Alpha	11/2/2019	8/7/2020	3.33E-02	P	-3.30E-02	7.43E-02	1.82E-01
LB4110A - D2	Alpha	11/2/2019	8/7/2020	6.67E-02	P	-2.11E-02	9.18E-02	2.05E-01
LB4110A - D3	Alpha	11/2/2019	8/7/2020	8.33E-02	P	-1.60E-02	1.11E-01	2.38E-01
LB4110A - D4	Alpha	11/2/2019	8/7/2020	1.17E-01	P	2.18E-02	1.69E-01	3.16E-01
LB4110A - E1	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E2	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E3	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - E4	Alpha	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.93E+02	2.53E+04
LB4110A - F1	Alpha	11/2/2019	8/7/2020	1.00E-01	P	-3.45E-02	1.09E-01	2.52E-01
LB4110A - F2	Alpha	11/2/2019	8/7/2020	8.33E-02	P	-3.78E-02	8.39E-02	2.05E-01
LB4110A - F3	Alpha	11/2/2019	8/7/2020	1.17E-01	P	-2.73E-02	9.74E-02	2.22E-01
LB4110A - F4	Alpha	11/2/2019	8/7/2020	5.00E-02	P	-3.78E-02	7.48E-02	1.88E-01
LB4110A - G1	Alpha	11/2/2019	8/7/2020	5.00E-02	P	-2.93E-02	9.09E-02	2.11E-01
LB4110A - G2	Alpha	11/2/2019	8/7/2020	1.00E-01	P	-2.18E-02	8.35E-02	1.89E-01
LB4110A - G3	Alpha	11/2/2019	8/7/2020	1.83E-01	P	-1.82E-02	1.16E-01	2.51E-01
LB4110A - G4	Alpha	11/2/2019	8/7/2020	3.33E-02	P	-4.28E-02	9.54E-02	2.34E-01

GPC Detector Report
(ALL Backgrounds)

KP
8/7/20

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	8/7/2020	1.23E+00	P	-3.23E+00	1.50E+00	6.24E+00
LB4110A - A2	Beta	11/2/2019	8/7/2020	1.50E+00	P	-3.09E+00	1.81E+00	6.71E+00
LB4110A - A3	Beta	11/2/2019	8/7/2020	1.30E+00	P	-2.97E+00	1.58E+00	6.13E+00
LB4110A - A4	Beta	11/2/2019	8/7/2020	1.70E+00	P	-3.17E+00	1.61E+00	6.40E+00
LB4110A - B1	Beta	11/2/2019	8/7/2020	1.47E+00	P	1.07E+00	1.42E+00	1.77E+00
LB4110A - B2	Beta	11/2/2019	8/7/2020	1.53E+00	P	8.23E-01	1.46E+00	2.09E+00
LB4110A - B3	Beta	11/2/2019	8/7/2020	1.38E+00	P	9.29E-01	1.34E+00	1.75E+00
LB4110A - B4	Beta	11/2/2019	8/7/2020	1.83E+00	P	7.07E-01	1.50E+00	2.29E+00
LB4110A - C1	Beta	11/2/2019	8/7/2020	9.67E-01	P	7.88E-01	1.18E+00	1.56E+00
LB4110A - C2	Beta	11/2/2019	8/7/2020	1.13E+00	P	6.63E-01	1.02E+00	1.37E+00
LB4110A - C3	Beta	11/2/2019	8/7/2020	1.65E+00	P	8.22E-01	1.42E+00	2.03E+00
LB4110A - C4	Beta	11/2/2019	8/7/2020	1.28E+00	P	8.69E-01	1.31E+00	1.75E+00
LB4110A - D1	Beta	11/2/2019	8/7/2020	1.28E+00	P	6.80E-01	1.09E+00	1.49E+00
LB4110A - D2	Beta	11/2/2019	8/7/2020	1.02E+00	P	-8.57E-01	2.82E+00	6.49E+00
LB4110A - D3	Beta	11/2/2019	8/7/2020	9.17E-01	P	7.08E-01	1.14E+00	1.58E+00
LB4110A - D4	Beta	11/2/2019	8/7/2020	1.52E+00	P	1.05E+00	1.50E+00	1.94E+00
LB4110A - E1	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E2	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E3	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - E4	Beta	11/2/2017	5/19/2020	1.00E+05	F	-2.35E+04	8.94E+02	2.53E+04
LB4110A - F1	Beta	11/2/2019	8/7/2020	1.03E+00	P	8.27E-01	1.28E+00	1.73E+00
LB4110A - F2	Beta	11/2/2019	8/7/2020	7.00E-01	P	5.42E-01	9.38E-01	1.33E+00
LB4110A - F3	Beta	11/2/2019	8/7/2020	1.40E+00	P	8.27E-01	1.18E+00	1.54E+00
LB4110A - F4	Beta	11/2/2019	8/7/2020	1.80E+00	P	1.48E-01	1.28E+00	2.42E+00
LB4110A - G1	Beta	11/2/2019	8/7/2020	1.23E+00	P	7.68E-01	1.20E+00	1.64E+00
LB4110A - G2	Beta	11/2/2019	8/7/2020	1.70E+00	P	1.10E+00	1.61E+00	2.11E+00
LB4110A - G3	Beta	11/2/2019	8/7/2020	9.50E-01	P	7.24E-01	1.19E+00	1.66E+00
LB4110A - G4	Beta	11/2/2019	8/7/2020	1.38E+00	P	8.56E-01	1.27E+00	1.68E+00

GPC Detector Report
(ALL Efficiencies)

KD 8/7/20

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2019	8/7/2020	0.2338	P	0.2251	0.2336	0.2420
LB4110A - A2	Alpha	11/2/2019	8/7/2020	0.2053	P	0.1945	0.2025	0.2105
LB4110A - A3	Alpha	11/2/2019	8/7/2020	0.1994	P	0.1872	0.1969	0.2065
LB4110A - A4	Alpha	11/2/2019	8/7/2020	0.2340	P	0.2174	0.2270	0.2366
LB4110A - B1	Alpha	11/2/2019	8/7/2020	0.2127	P	0.1932	0.2086	0.2240
LB4110A - B2	Alpha	11/2/2019	8/7/2020	0.1998	P	0.1836	0.1976	0.2115
LB4110A - B3	Alpha	11/2/2019	8/7/2020	0.2364	P	0.2185	0.2340	0.2494
LB4110A - B4	Alpha	11/2/2019	8/7/2020	0.2340	P	0.2070	0.2250	0.2430
LB4110A - C1	Alpha	11/2/2019	8/7/2020	0.1992	P	0.1901	0.2009	0.2116
LB4110A - C2	Alpha	11/2/2019	8/7/2020	0.1998	P	0.1924	0.2035	0.2146
LB4110A - C3	Alpha	11/2/2019	8/7/2020	0.2204	P	0.2125	0.2296	0.2467
LB4110A - C4	Alpha	11/2/2019	8/7/2020	0.2096	P	0.1963	0.2142	0.2320
LB4110A - D1	Alpha	11/2/2019	8/7/2020	0.1893	W	0.1883	0.1994	0.2105
LB4110A - D2	Alpha	11/2/2019	8/7/2020	0.2369	P	0.2241	0.2361	0.2482
LB4110A - D3	Alpha	11/2/2019	8/7/2020	0.2389	P	0.2341	0.2437	0.2532
LB4110A - D4	Alpha	11/2/2019	8/7/2020	0.1844	P	0.1788	0.1862	0.1935
LB4110A - E1	Alpha	11/2/2017	5/19/2020	0.2075	P	0.1686	0.2257	0.2828
LB4110A - E2	Alpha	11/2/2017	5/19/2020	0.1778	P	0.1514	0.2049	0.2583
LB4110A - E3	Alpha	11/2/2017	5/19/2020	0.2234	P	0.1549	0.2076	0.2604
LB4110A - E4	Alpha	11/2/2017	5/19/2020	0.2155	P	0.1746	0.2353	0.2961
LB4110A - F1	Alpha	11/2/2019	8/7/2020	0.2151	P	0.2019	0.2133	0.2246
LB4110A - F2	Alpha	11/2/2019	8/7/2020	0.1802	P	0.1728	0.1800	0.1873
LB4110A - F3	Alpha	11/2/2019	8/7/2020	0.2271	P	0.2052	0.2213	0.2373
LB4110A - F4	Alpha	11/2/2019	8/7/2020	0.2118	P	0.2049	0.2143	0.2236
LB4110A - G1	Alpha	11/2/2019	8/7/2020	0.1859	P	0.1734	0.1870	0.2007
LB4110A - G2	Alpha	11/2/2019	8/7/2020	0.1824	P	0.1696	0.1831	0.1966
LB4110A - G3	Alpha	11/2/2019	8/7/2020	0.2116	P	0.2001	0.2152	0.2302
LB4110A - G4	Alpha	11/2/2019	8/7/2020	0.1819	P	0.1527	0.1828	0.2129

out of service

GPC Detector Report
(ALL Efficiencies)

KP
8/7/20

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2019	8/7/2020	0.5677	P	0.5420	0.5621	0.5823
LB4110A - A2	Beta	11/2/2019	8/7/2020	0.4555	W	0.4269	0.4425	0.4581
LB4110A - A3	Beta	11/2/2019	8/7/2020	0.4798	P	0.4563	0.4774	0.4986
LB4110A - A4	Beta	11/2/2019	8/7/2020	0.5609	P	0.5316	0.5515	0.5715
LB4110A - B1	Beta	11/2/2019	8/7/2020	0.5043	P	0.4499	0.4881	0.5263
LB4110A - B2	Beta	11/2/2019	8/7/2020	0.4998	P	0.4558	0.4932	0.5306
LB4110A - B3	Beta	11/2/2019	8/7/2020	0.5956	P	0.5463	0.5852	0.6241
LB4110A - B4	Beta	11/2/2019	8/7/2020	0.5897	P	0.5095	0.5555	0.6016
LB4110A - C1	Beta	11/2/2019	8/7/2020	0.4868	P	0.4582	0.4805	0.5027
LB4110A - C2	Beta	11/2/2019	8/7/2020	0.4822	P	0.4592	0.4854	0.5115
LB4110A - C3	Beta	11/2/2019	8/7/2020	0.5505	P	0.5294	0.5752	0.6210
LB4110A - C4	Beta	11/2/2019	8/7/2020	0.4974	P	0.4788	0.5201	0.5615
LB4110A - D1	Beta	11/2/2019	8/7/2020	0.5609	P	0.5520	0.5803	0.6086
LB4110A - D2	Beta	11/2/2019	8/7/2020	0.5979	P	0.5649	0.5916	0.6183
LB4110A - D3	Beta	11/2/2019	8/7/2020	0.6036	P	0.5806	0.6037	0.6267
LB4110A - D4	Beta	11/2/2019	8/7/2020	0.4859	P	0.4672	0.4837	0.5001
LB4110A - E1	Beta	11/2/2017	5/19/2020	0.5360	P	0.4167	0.5408	0.6649
LB4110A - E2	Beta	11/2/2017	5/19/2020	0.4520	P	0.3728	0.4910	0.6092
LB4110A - E3	Beta	11/2/2017	5/19/2020	0.5775	P	0.3848	0.5001	0.6154
LB4110A - E4	Beta	11/2/2017	5/19/2020	0.5466	P	0.4532	0.5887	0.7241
LB4110A - F1	Beta	11/2/2019	8/7/2020	0.5316	P	0.5147	0.5349	0.5551
LB4110A - F2	Beta	11/2/2019	8/7/2020	0.4446	P	0.4376	0.4518	0.4660
LB4110A - F3	Beta	11/2/2019	8/7/2020	0.5857	P	0.5388	0.5739	0.6090
LB4110A - F4	Beta	11/2/2019	8/7/2020	0.5523	P	0.5258	0.5480	0.5702
LB4110A - G1	Beta	11/2/2019	8/7/2020	0.4470	P	0.4148	0.4457	0.4766
LB4110A - G2	Beta	11/2/2019	8/7/2020	0.4391	P	0.4023	0.4362	0.4702
LB4110A - G3	Beta	11/2/2019	8/7/2020	0.5154	P	0.4842	0.5189	0.5535
LB4110A - G4	Beta	11/2/2019	8/7/2020	0.4379	P	0.3710	0.4399	0.5089

out of service

KB 9/7/2020

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
A1	2007104-01	30	873	120	1410	8/7/2020 12:09:30 PM
A2	2007104-02	19	218	120	1410	8/7/2020 12:09:30 PM
A3	2007104-03	23	198	120	1410	8/7/2020 12:09:30 PM
B1	2007104-04	30	1069	120	1410	8/7/2020 12:09:30 PM
B3	2007104-05	20	325	120	1410	8/7/2020 12:09:30 PM
B4	2007104-06	14	319	120	1410	8/7/2020 12:09:31 PM
C1	2007104-07	21	217	120	1410	8/7/2020 12:09:31 PM
C2	2007104-08	20	235	120	1410	8/7/2020 12:09:31 PM
C3	2007104-09	17	222	120	1410	8/7/2020 12:09:31 PM

SECTION X

BARIUM-133 ANALYTICAL TRACER DATA

106 9/13/20

Apex-Gamma

Analysis Report for 2007104-01

SPIKE

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-01
Sample Description	: SPIKE
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:27:50AM
Acquisition Started	: 8/3/2020 12:08:01PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE1
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.2 seconds
Dead Time	: 0.03 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 32 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 10/12/2019
Efficiency Calibration Used Done On	: 10/12/2019
Efficiency Calibration Description	:
Sample Number	: 100415

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:23:04PM

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 2007104-01

SPIKE

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	61.49	48 -	73	61.95	2.93E+02	46.61	1.80E+02	2.40
m	2	65.82	48 -	73	66.28	1.37E+02	43.28	1.72E+02	2.41
	3	80.78	76 -	85	81.23	8.52E+02	75.40	3.25E+02	1.72
	4	91.71	88 -	96	92.15	6.36E+01	42.30	2.31E+02	3.37
M	5	111.49	107 -	123	111.91	2.59E+02	40.60	1.33E+02	2.07
m	6	115.77	107 -	123	116.19	5.30E+01	45.12	1.72E+02	2.73
M	7	160.62	156 -	170	161.00	4.71E+01	26.87	9.67E+01	2.09
m	8	165.62	156 -	170	166.00	2.70E+01	24.70	7.35E+01	2.10
	9	205.92	201 -	212	206.27	6.21E+01	39.19	1.58E+02	6.97
	10	276.25	273 -	281	276.54	4.98E+01	30.10	1.10E+02	1.78
M	11	302.78	293 -	314	303.05	1.65E+02	29.72	4.25E+01	2.28
m	12	306.95	293 -	314	307.22	3.80E+01	24.06	3.79E+01	2.25
m	13	310.95	293 -	314	311.22	3.11E+01	19.57	3.59E+01	2.43
M	14	333.89	329 -	346	334.14	1.11E+02	23.29	2.93E+01	2.44
m	15	337.98	329 -	346	338.22	3.95E+01	20.06	4.19E+01	2.45
	16	355.90	351 -	360	356.13	5.90E+02	55.32	9.92E+01	1.78
	17	364.94	361 -	370	365.17	4.97E+01	27.80	7.47E+01	2.62
M	18	384.08	380 -	398	384.29	1.29E+02	38.12	9.59E+01	2.42
m	19	386.97	380 -	398	387.18	2.01E+02	39.36	6.06E+01	2.07
m	20	391.20	380 -	398	391.40	6.82E+01	42.25	6.36E+01	3.30
M	21	414.56	410 -	426	414.74	3.91E+01	22.72	6.42E+01	2.53
m	22	418.82	410 -	426	419.00	4.72E+01	21.52	3.63E+01	2.27
M	23	436.98	431 -	452	437.15	1.32E+02	23.41	1.79E+01	2.51
m	24	444.95	431 -	452	445.11	1.16E+01	11.14	2.83E+00	2.51
M	25	467.61	461 -	477	467.76	2.76E+01	15.49	2.03E+01	2.57
m	26	472.89	461 -	477	473.03	9.08E+00	18.63	2.41E+01	3.70
	27	580.94	578 -	583	581.00	7.00E+00	5.29	0.00E+00	2.50
	28	648.66	646 -	650	648.67	6.00E+00	4.90	0.00E+00	1.00
	29	655.06	653 -	657	655.06	5.00E+00	5.50	2.00E+00	2.72
	30	693.85	691 -	696	693.83	6.44E+00	6.40	3.13E+00	2.95
	31	963.22	960 -	965	963.00	5.00E+00	4.47	0.00E+00	1.50

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 : 8/3/2020 12:23:04PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100123.CNF

Analysis Report for 2007104-01

SPIKE

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	61.49	2.93E+02	46.61	2.39E+01	2.34E+00	2.69E+02	4.67E+01
m	2	65.82	1.37E+02	43.28			1.37E+02	4.33E+01
	3	80.78	8.52E+02	75.40			8.52E+02	7.54E+01
	4	91.71	6.36E+01	42.30	2.84E+01	1.72E+00	3.51E+01	4.23E+01
M	5	111.49	2.59E+02	40.60			2.59E+02	4.06E+01
m	6	115.77	5.30E+01	45.12			5.30E+01	4.51E+01
M	7	160.62	4.71E+01	26.87			4.71E+01	2.69E+01
m	8	165.62	2.70E+01	24.70			2.70E+01	2.47E+01
	9	205.92	6.21E+01	39.19	0.00E+00	0.00E+00	6.21E+01	3.92E+01
	10	276.25	4.98E+01	30.10			4.98E+01	3.01E+01
M	11	302.78	1.65E+02	29.72			1.65E+02	2.97E+01
m	12	306.95	3.80E+01	24.06			3.80E+01	2.41E+01
m	13	310.95	3.11E+01	19.57			3.11E+01	1.96E+01
M	14	333.89	1.11E+02	23.29			1.11E+02	2.33E+01
m	15	337.98	3.95E+01	20.06	1.11E+00	5.72E-01	3.84E+01	2.01E+01
	16	355.90	5.90E+02	55.32			5.90E+02	5.53E+01
	17	364.94	4.97E+01	27.80			4.97E+01	2.78E+01
M	18	384.08	1.29E+02	38.12			1.29E+02	3.81E+01
m	19	386.97	2.01E+02	39.36			2.01E+02	3.94E+01
m	20	391.20	6.82E+01	42.25			6.82E+01	4.22E+01
M	21	414.56	3.91E+01	22.72			3.91E+01	2.27E+01
m	22	418.82	4.72E+01	21.52			4.72E+01	2.15E+01
M	23	436.98	1.32E+02	23.41			1.32E+02	2.34E+01
m	24	444.95	1.16E+01	11.14			1.16E+01	1.11E+01
M	25	467.61	2.76E+01	15.49			2.76E+01	1.55E+01
m	26	472.89	9.08E+00	18.63			9.08E+00	1.86E+01
	27	580.94	7.00E+00	5.29	2.21E+00	1.17E+00	4.79E+00	5.42E+00
	28	648.66	6.00E+00	4.90			6.00E+00	4.90E+00
	29	655.06	5.00E+00	5.50			5.00E+00	5.50E+00
	30	693.85	6.44E+00	6.40			6.44E+00	6.40E+00
	31	963.22	5.00E+00	4.47			5.00E+00	4.47E+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

Analysis Report for 2007104-01

SPIKE

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.94	255.12		1.93		
		391.69	*	61.90	5.29E+01	3.33E+01
BA-133	0.99	81.00	*	34.06	4.36E+02	5.81E+01
		302.84	*	18.33	4.66E+02	1.55E+02
		356.01	*	62.05	4.74E+02	7.01E+01
CE-139	0.99	165.85	*	80.35	1.44E+01	1.36E+01
TH-234	0.92	63.29	*	3.80	7.26E+02	1.33E+02
AM-241	0.90	59.54	*	35.90	7.68E+01	1.40E+01

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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	0.947	5.29E+01	3.33E+01	
	BA-133	0.999	4.53E+02	4.30E+01	
	CE-139	0.999	1.44E+01	1.36E+01	
?	TH-234	0.921	7.26E+02	1.33E+02	
?	AM-241	0.907	7.68E+01	1.40E+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 2007104-01

SPIKE

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:23:04PM
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	2	65.82	1.52144E-01	15.80		
	4	91.71	3.90443E-02	60.24		
M	5	111.49	2.88045E-01	7.83		
m	6	115.77	5.88500E-02	42.60	Tol.	U-237
M	7	160.62	5.23187E-02	28.53	Sum	
	9	205.92	6.90307E-02	31.54	Tol.	U-237
	10	276.25	5.53439E-02	30.21		
m	12	306.95	4.22136E-02	31.67		
m	13	310.95	3.45667E-02	31.45		
M	14	333.89	1.23010E-01	10.52		
m	15	337.98	4.26721E-02	26.13		
	17	364.94	5.51916E-02	27.99	Sum	
M	18	384.08	1.43226E-01	14.79	Sum	
m	19	386.97	2.22815E-01	9.81		
M	21	414.56	4.34671E-02	29.03		
m	22	418.82	5.23953E-02	22.82	Sum	
M	23	436.98	1.46845E-01	8.86	Sum	
m	24	444.95	1.29155E-02	47.90		
M	25	467.61	3.06446E-02	28.09	Sum	
m	26	472.89	1.00936E-02	102.57	Sum	
	27	580.94	5.31851E-03	56.61		
	28	648.66	6.66667E-03	40.82		
	29	655.06	5.55556E-03	55.00		
	30	693.85	7.15278E-03	49.73	Sum	
	31	963.22	5.55556E-03	44.72		

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

Analysis Report for 2007104-01

SPIKE

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)
	FE-55	5.89		24.50	1.49E-04	1.49E-04	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.66E+01	1.66E+01	1.36E+00	7.78E+00
		136.48		10.60	1.60E+02		4.06E+01	7.56E+01
	NI-59	6.92		29.80	2.91E-04	2.91E-04	0.00E+00	0.00E+00
	MO-93	16.59		52.90	9.33E-03	9.33E-03	0.00E+00	0.00E+00
		18.60		10.00	7.73E-02		0.00E+00	0.00E+00
	NB-93M	16.57		9.43	5.21E-02	5.21E-02	0.00E+00	0.00E+00
	CD-109	88.03		3.72	3.06E+02	3.06E+02	-3.11E+01	1.46E+02
+	SN-113	255.12		1.93	8.31E+02	5.95E+01	-1.40E+02	3.79E+02
		391.69	*	61.90	5.95E+01		5.29E+01	2.87E+01
	SN-119M	23.87		16.10	1.20E-01	1.01E-01	0.00E+00	0.00E+00
		25.10		22.70	1.01E-01		0.00E+00	0.00E+00
	I-129	29.78		57.00	1.51E+00	1.51E+00	-1.77E+00	7.21E-01
		33.60		13.20	2.06E+01		1.00E+02	1.01E+01
		39.58		7.52	3.27E+01		-1.60E+02	1.57E+01
+	BA-133	81.00	*	34.06	4.16E+01	3.71E+01	4.36E+02	2.01E+01
		302.84	*	18.33	1.90E+02		4.66E+02	9.10E+01
		356.01	*	62.05	3.71E+01		4.74E+02	1.75E+01
+	CE-139	165.85	*	80.35	3.90E+01	3.90E+01	1.44E+01	1.88E+01
	CE-144	133.54		10.80	1.49E+02	1.49E+02	4.58E+01	7.01E+01
	HG-203	279.19		77.30	3.27E+01	3.27E+01	4.18E+01	1.54E+01
	PB-210	46.50		4.25	6.04E+01	6.04E+01	1.40E+01	2.85E+01
	TH-231	25.64		14.70	1.68E-01	1.68E-01	0.00E+00	0.00E+00
		84.21		6.40	2.77E+02		-1.68E+01	1.35E+02
	PA-234M	9.89		89.00	5.79E-04	5.79E-04	0.00E+00	0.00E+00
		21.72		64.90	2.12E-02		0.00E+00	0.00E+00
		37.93		23.75	1.52E+01		4.96E+01	7.41E+00
		131.42		20.40	7.41E+01		2.95E+00	3.47E+01
+	TH-234	63.29	*	3.80	4.30E+02	4.30E+02	7.26E+02	2.11E+02
	NP-237	29.37		14.00	5.90E+00	5.90E+00	-6.88E+00	2.81E+00
		86.50		12.60	8.51E+01		-8.91E+00	4.05E+01
	U-237	97.08		16.30	6.76E+01	4.77E+01	-1.22E+01	3.18E+01
		101.07		26.30	4.77E+01		2.83E+01	2.26E+01
		114.00		12.30	2.19E+02		5.83E+02	1.06E+02
		208.01		22.00	1.04E+02		4.57E+01	4.90E+01
+	AM-241	59.54	*	35.90	4.55E+01	4.55E+01	7.68E+01	2.24E+01
	AM-243	74.67		66.00	1.20E+01	1.20E+01	1.41E+00	5.67E+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

Analysis Report for 2007104-01

SPIKE

Apex-Gamma

Analysis Report for 2007104-02
BLANK

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-02
Sample Description	: BLANK
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:27:58AM
Acquisition Started	: 8/3/2020 12:08:08PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE2
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.2 seconds
Dead Time	: 0.03 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 29 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 6/6/2020
Efficiency Calibration Used Done On	: 9/14/2019
Efficiency Calibration Description	:
Sample Number	: 100416

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:23:18PM

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 2007104-02

BLANK

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.17	35 -	39	35.86	4.00E+02	58.37	2.45E+02	1.55
	2	52.54	50 -	57	53.21	6.37E+01	35.67	1.73E+02	2.25
M	3	61.53	58 -	71	62.19	2.30E+02	40.68	1.42E+02	1.70
m	4	65.68	58 -	71	66.34	8.81E+01	32.66	1.54E+02	1.71
	5	80.91	79 -	87	81.56	8.50E+02	69.72	2.04E+02	1.88
M	6	111.71	108 -	121	112.32	1.75E+02	35.56	1.27E+02	1.83
m	7	115.90	108 -	121	116.51	3.44E+01	34.44	1.40E+02	2.03
	8	185.15	182 -	189	185.68	3.85E+01	29.53	1.19E+02	1.52
	9	276.42	273 -	281	276.87	7.47E+01	25.44	5.26E+01	1.71
M	10	302.81	298 -	312	303.23	1.72E+02	28.77	3.45E+01	1.51
m	11	307.38	298 -	312	307.79	2.82E+01	16.72	3.87E+01	1.82
M	12	333.64	330 -	343	334.03	6.65E+01	20.02	2.99E+01	1.68
m	13	337.72	330 -	343	338.10	2.23E+01	14.31	1.25E+01	1.69
	14	356.12	353 -	361	356.48	5.23E+02	49.26	4.57E+01	1.95
M	15	380.66	380 -	396	381.00	7.53E+00	7.00	8.92E+00	1.57
m	16	383.99	380 -	396	384.33	1.10E+02	26.00	1.58E+01	1.91
m	17	386.88	380 -	396	387.22	1.90E+02	34.87	1.13E+01	1.91
m	18	391.34	380 -	396	391.67	3.86E+01	17.66	6.80E+00	1.92
	19	415.94	412 -	421	416.25	3.35E+01	27.07	8.71E+01	1.64
	20	437.14	434 -	442	437.42	1.02E+02	20.98	5.54E+00	1.90
	21	467.95	465 -	470	468.21	9.28E+00	11.22	1.74E+01	1.00
	22	828.96	825 -	831	828.88	8.00E+00	5.66	0.00E+00	2.10

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 : 8/3/2020 12:23:18PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100124.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.17	4.00E+02	58.37	3.92E+01	1.95E+00	3.61E+02	5.84E+01
	2	52.54	6.37E+01	35.67			6.37E+01	3.57E+01
M	3	61.53	2.30E+02	40.68	4.48E+00	1.99E+00	2.26E+02	4.07E+01
m	4	65.68	8.81E+01	32.66	4.48E+00	1.99E+00	8.36E+01	3.27E+01
	5	80.91	8.50E+02	69.72			8.50E+02	6.97E+01
M	6	111.71	1.75E+02	35.56	1.72E+00	1.78E+00	1.73E+02	3.56E+01
m	7	115.90	3.44E+01	34.44			3.44E+01	3.44E+01

Analysis Report for 2007104-02

BLANK

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	8	185.15	3.85E+01	29.53	1.07E+01	1.75E+00	2.78E+01	2.96E+01
	9	276.42	7.47E+01	25.44			7.47E+01	2.54E+01
M	10	302.81	1.72E+02	28.77			1.72E+02	2.88E+01
m	11	307.38	2.82E+01	16.72			2.82E+01	1.67E+01
M	12	333.64	6.65E+01	20.02			6.65E+01	2.00E+01
m	13	337.72	2.23E+01	14.31	1.13E-01	1.18E+00	2.21E+01	1.44E+01
	14	356.12	5.23E+02	49.26			5.23E+02	4.93E+01
M	15	380.66	7.53E+00	7.00			7.53E+00	7.00E+00
m	16	383.99	1.10E+02	26.00			1.10E+02	2.60E+01
m	17	386.88	1.90E+02	34.87			1.90E+02	3.49E+01
m	18	391.34	3.86E+01	17.66			3.86E+01	1.77E+01
	19	415.94	3.35E+01	27.07			3.35E+01	2.71E+01
	20	437.14	1.02E+02	20.98			1.02E+02	2.10E+01
	21	467.95	9.28E+00	11.22			9.28E+00	1.12E+01
	22	828.96	8.00E+00	5.66			8.00E+00	5.66E+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	2.54E+01	1.18E+01
BA-133	1.00	81.00	*	34.06	5.15E+02	6.71E+01
		302.84	*	18.33	6.11E+02	2.12E+02
		356.01	*	62.05	4.19E+02	6.10E+01
TH-234	0.92	63.29	*	3.80	4.56E+02	8.40E+01
AM-241	0.90	59.54	*	35.90	4.83E+01	8.89E+00

Analysis Report for 2007104-02

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* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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	0.962	2.54E+01	1.18E+01	
	BA-133	1.000	4.69E+02	4.42E+01	
?	TH-234	0.924	4.56E+02	8.40E+01	
?	AM-241	0.904	4.83E+01	8.89E+00	

? = 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 2007104-02

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UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:23:18PM
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	35.17	4.00587E-01	8.10	Tol.	I-129
	2	52.54	7.07407E-02	28.01		
m	4	65.68	9.29096E-02	19.56	Tol.	TH-234
M	6	111.71	1.92574E-01	10.27	Tol.	U-237
m	7	115.90	3.82638E-02	50.00	Tol.	U-237
	8	185.15	3.09067E-02	53.17		
	9	276.42	8.29978E-02	17.03		
m	11	307.38	3.13298E-02	29.65		
M	12	333.64	7.39347E-02	15.04		
m	13	337.72	2.46026E-02	32.42		
M	15	380.66	8.36203E-03	46.51		
m	16	383.99	1.22085E-01	11.83	Sum	
m	17	386.88	2.10748E-01	9.19		
	19	415.94	3.71717E-02	40.46	Sum	
	20	437.14	1.13587E-01	10.26	Sum	
	21	467.95	1.03086E-02	60.49		
	22	828.96	8.88889E-03	35.36		

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 2007104-02

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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	4.58E-09	4.58E-09	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.44E+01	2.44E+01	6.45E+00	1.13E+01
		136.48		10.60	2.38E+02		-3.37E+01	1.10E+02
	NI-59	6.92		29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
	MO-93	16.59		52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
		18.60		10.00	1.34E-03		0.00E+00	0.00E+00
	NB-93M	16.57		9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
	CD-109	88.03		3.72	2.72E+02	2.72E+02	9.53E+01	1.27E+02
+	SN-113	255.12		1.93	1.18E+03	2.06E+01	6.44E+02	5.37E+02
		391.69	*	61.90	2.06E+01		2.54E+01	9.41E+00
	SN-119M	23.87		16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
		25.10		22.70	5.92E-03		0.00E+00	0.00E+00
	I-129	29.78		57.00	6.12E-01	6.12E-01	5.75E+00	3.02E-01
		33.60		13.20	4.64E+00		9.18E+00	2.28E+00
		39.58		7.52	4.26E+00		-1.21E-01	1.97E+00
+	BA-133	81.00	*	34.06	3.97E+01	2.62E+01	5.15E+02	1.90E+01
		302.84	*	18.33	1.81E+02		6.11E+02	8.56E+01
		356.01	*	62.05	2.62E+01		4.19E+02	1.20E+01
	CE-139	165.85		80.35	3.82E+01	3.82E+01	-8.98E+00	1.77E+01
	CE-144	133.54		10.80	2.28E+02	2.28E+02	-9.10E+01	1.06E+02
	HG-203	279.19		77.30	2.39E+01	2.39E+01	-4.33E+01	1.07E+01
	PB-210	46.50		4.25	1.72E+01	1.72E+01	-6.19E+00	7.94E+00
	TH-231	25.64		14.70	1.06E-02	1.06E-02	0.00E+00	0.00E+00
		84.21		6.40	1.52E+02		-2.29E+03	7.09E+01
	PA-234M	9.89		89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
		21.72		64.90	7.08E-04		0.00E+00	0.00E+00
		37.93		23.75	1.47E+00		-1.86E-01	6.95E-01
		131.42		20.40	1.23E+02		-3.88E+00	5.71E+01
+	TH-234	63.29	*	3.80	1.92E+02	1.92E+02	4.56E+02	9.32E+01
	NP-237	29.37		14.00	2.27E+00	2.27E+00	2.14E+01	1.12E+00
		86.50		12.60	7.52E+01		-1.15E+01	3.49E+01
	U-237	97.08		16.30	7.59E+01	5.62E+01	-7.29E+01	3.51E+01
		101.07		26.30	5.62E+01		-3.83E+00	2.61E+01
		114.00		12.30	2.59E+02		-1.06E+02	1.24E+02
		208.01		22.00	1.24E+02		1.59E+01	5.65E+01
+	AM-241	59.54	*	35.90	2.03E+01	2.03E+01	4.83E+01	9.87E+00
	AM-243	74.67		66.00	9.52E+00	9.52E+00	-6.41E+00	4.44E+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

KB 8/3/20

Apex-Gamma

Analysis Report for 2007104-03
MW-2B

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-03
Sample Description	: MW-2B
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:28:08AM
Acquisition Started	: 8/3/2020 12:08:15PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE3
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 902.1 seconds
Dead Time	: 0.23 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 10 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 6/6/2020
Efficiency Calibration Used Done On	: 10/19/2019
Efficiency Calibration Description	:
Sample Number	: 100417

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:23:29PM

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 2007104-03

MW-2B

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	21.01	18 -	25	21.45	9.34E+01	44.32	2.67E+02	2.09
M	2	31.06	26 -	41	31.48	1.97E+03	93.62	1.77E+02	2.03
m	3	35.40	26 -	41	35.81	5.76E+02	60.93	1.05E+02	2.09
	4	52.79	50 -	56	53.18	7.09E+01	33.39	1.52E+02	3.13
M	5	62.25	59 -	69	62.63	2.31E+02	46.82	2.22E+02	2.23
m	6	66.27	59 -	69	66.65	1.17E+02	39.28	1.87E+02	2.03
	7	81.34	76 -	87	81.70	8.32E+02	79.67	3.77E+02	2.06
	8	101.48	99 -	104	101.82	2.50E+01	26.46	1.20E+02	2.01
M	9	112.16	106 -	121	112.49	2.42E+02	41.73	1.40E+02	2.45
m	10	116.48	106 -	121	116.80	6.81E+01	40.99	1.37E+02	2.54
	11	194.42	191 -	198	194.65	3.15E+01	30.66	1.35E+02	4.62
	12	277.35	274 -	281	277.47	3.19E+01	26.00	9.01E+01	1.45
M	13	299.70	297 -	315	299.79	1.47E+01	10.25	1.00E+01	2.26
m	14	303.42	297 -	315	303.52	1.53E+02	27.00	1.40E+01	2.26
m	15	308.23	297 -	315	308.32	3.18E+01	23.32	1.60E+01	2.74
M	16	334.15	330 -	341	334.21	5.93E+01	23.40	5.33E+01	2.28
m	17	338.15	330 -	341	338.21	1.92E+01	20.09	4.49E+01	2.28
	18	356.61	351 -	360	356.64	4.88E+02	47.63	4.56E+01	2.15
M	19	384.44	380 -	395	384.44	1.38E+02	36.93	4.20E+01	2.54
m	20	387.45	380 -	395	387.44	2.06E+02	37.39	2.50E+01	2.29
m	21	391.64	380 -	395	391.63	4.23E+01	27.13	1.17E+01	2.55
	22	417.85	411 -	428	417.80	7.92E+01	26.53	3.16E+01	4.52
M	23	433.26	432 -	440	433.20	6.69E+00	4.00	0.00E+00	2.34
m	24	437.65	432 -	440	437.58	9.94E+01	20.00	0.00E+00	2.08
M	25	468.44	462 -	476	468.33	2.04E+01	11.16	7.89E+00	2.28
m	26	473.01	462 -	476	472.90	8.66E+00	8.51	1.68E+00	2.86
	27	750.28	746 -	752	749.83	6.00E+00	4.90	0.00E+00	1.98

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 : 8/3/2020 12:23:29PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100125.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	21.01	9.34E+01	44.32	8.05E+00	2.25E+00	8.53E+01	4.44E+01
M	2	31.06	1.97E+03	93.62			1.97E+03	9.36E+01

Analysis Report for 2007104-03

MW-2B

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	3	35.40	5.76E+02	60.93			5.76E+02	6.09E+01
	4	52.79	7.09E+01	33.39			7.09E+01	3.34E+01
M	5	62.25	2.31E+02	46.82	1.41E+01	1.88E+00	2.17E+02	4.69E+01
m	6	66.27	1.17E+02	39.28			1.17E+02	3.93E+01
	7	81.34	8.32E+02	79.67			8.32E+02	7.97E+01
	8	101.48	2.50E+01	26.46			2.50E+01	2.65E+01
M	9	112.16	2.42E+02	41.73			2.42E+02	4.17E+01
m	10	116.48	6.81E+01	40.99			6.81E+01	4.10E+01
	11	194.42	3.15E+01	30.66			3.15E+01	3.07E+01
	12	277.35	3.19E+01	26.00			3.19E+01	2.60E+01
M	13	299.70	1.47E+01	10.25			1.47E+01	1.02E+01
m	14	303.42	1.53E+02	27.00			1.53E+02	2.70E+01
m	15	308.23	3.18E+01	23.32			3.18E+01	2.33E+01
M	16	334.15	5.93E+01	23.40			5.93E+01	2.34E+01
m	17	338.15	1.92E+01	20.09			1.92E+01	2.01E+01
	18	356.61	4.88E+02	47.63			4.88E+02	4.76E+01
M	19	384.44	1.38E+02	36.93			1.38E+02	3.69E+01
m	20	387.45	2.06E+02	37.39			2.06E+02	3.74E+01
m	21	391.64	4.23E+01	27.13	0.00E+00	0.00E+00	4.23E+01	2.71E+01
	22	417.85	7.92E+01	26.53			7.92E+01	2.65E+01
M	23	433.26	6.69E+00	4.00			6.69E+00	4.00E+00
m	24	437.65	9.94E+01	20.00			9.94E+01	2.00E+01
M	25	468.44	2.04E+01	11.16			2.04E+01	1.12E+01
m	26	473.01	8.66E+00	8.51			8.66E+00	8.51E+00
	27	750.28	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	0.95	255.12		1.93		
		391.69	*	61.90	3.57E+01	2.33E+01
I-129	0.86	29.78	*	57.00	2.71E+01	1.29E+00
		33.60	*	13.20	5.78E+01	6.12E+00

Analysis Report for 2007104-03

MW-2B

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-129	0.86	39.58		7.52		
BA-133	0.99	81.00	*	34.06	4.14E+02	5.68E+01
		302.84	*	18.33	5.04E+02	1.70E+02
		356.01	*	62.05	4.40E+02	6.95E+01
HG-203	0.91	279.19	*	77.30	2.56E+01	2.22E+01
TH-234	0.97	63.29	*	3.80	4.94E+02	1.10E+02

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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	0.955	3.57E+01	2.33E+01	
	I-129	0.860	2.84E+01	1.27E+00	
	BA-133	0.993	4.29E+02	4.26E+01	
	HG-203	0.917	2.56E+01	2.22E+01	
	TH-234	0.973	4.94E+02	1.10E+02	
X	NP-237	0.740			

? = 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 2007104-03
MW-2B

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:23:29PM
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	21.01	9.48115E-02	26.00	Tol.	MO-93 PA-234M
	4	52.79	7.88057E-02	23.54		
m	6	66.27	1.29543E-01	16.85	Sum	
	8	101.48	2.77778E-02	52.92	Tol.	U-237
M	9	112.16	2.69264E-01	8.61	Sum	
m	10	116.48	7.56593E-02	30.10	Sum	
	11	194.42	3.49719E-02	48.70		
M	13	299.70	1.63511E-02	34.82		
m	15	308.23	3.53201E-02	36.69	Sum	
M	16	334.15	6.59348E-02	19.72	Sum	
m	17	338.15	2.13290E-02	52.34	Sum	
M	19	384.44	1.53339E-01	13.38	Sum	
m	20	387.45	2.29264E-01	9.06	Sum	
	22	417.85	8.79766E-02	16.76	Sum	
M	23	433.26	7.43543E-03	29.89		
m	24	437.65	1.10493E-01	10.06	Sum	
M	25	468.44	2.26205E-02	27.40		
m	26	473.01	9.62289E-03	49.16	Sum	
	27	750.28	6.66667E-03	40.82	Sum	

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 2007104-03

MW-2B

	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	6.04E-06	6.04E-06	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.67E+01	1.67E+01	-2.90E+00	7.77E+00
		136.48		10.60	1.88E+02		-8.25E+01	8.86E+01
	NI-59	6.92		29.80	1.47E-04	1.47E-04	-5.29E-05	6.56E-05
	MO-93	16.59		52.90	4.20E-02	4.20E-02	5.91E-03	2.00E-02
		18.60		10.00	4.98E-01		-9.11E-03	2.39E-01
	NB-93M	16.57		9.43	2.34E-01	2.34E-01	3.29E-02	1.11E-01
	CD-109	88.03		3.72	2.66E+02	2.66E+02	-9.65E+01	1.26E+02
+	SN-113	255.12		1.93	1.11E+03	3.45E+01	2.58E+02	5.13E+02
		391.69	*	61.90	3.45E+01		3.57E+01	1.61E+01
	SN-119M	23.87		16.10	1.08E+00	9.14E-01	-7.87E-01	5.20E-01
		25.10		22.70	9.14E-01		-2.28E+01	4.38E-01
+	I-129	29.78	*	57.00	1.41E+00	1.41E+00	2.71E+01	6.87E-01
		33.60	*	13.20	1.01E+01		5.78E+01	4.91E+00
		39.58		7.52	1.76E+01		1.54E+00	8.41E+00
+	BA-133	81.00	*	34.06	4.63E+01	2.88E+01	4.14E+02	2.25E+01
		302.84	*	18.33	1.16E+02		5.04E+02	5.35E+01
		356.01	*	62.05	2.88E+01		4.40E+02	1.32E+01
	CE-139	165.85		80.35	2.87E+01	2.87E+01	-8.41E+00	1.35E+01
	CE-144	133.54		10.80	1.80E+02	1.80E+02	4.33E+01	8.50E+01
+	HG-203	279.19	*	77.30	3.30E+01	3.30E+01	2.56E+01	1.54E+01
	PB-210	46.50		4.25	3.56E+01	3.56E+01	2.20E+00	1.67E+01
	TH-231	25.64		14.70	1.55E+00	1.55E+00	-3.87E+01	7.45E-01
		84.21		6.40	3.37E+02		1.15E+03	1.65E+02
	PA-234M	9.89		89.00	1.08E-03	1.08E-03	9.88E-04	5.11E-04
		21.72		64.90	1.72E-01		2.23E-01	8.28E-02
		37.93		23.75	8.52E+00		3.01E+01	4.16E+00
		131.42		20.40	9.30E+01		2.99E+01	4.38E+01
+	TH-234	63.29	*	3.80	1.90E+02	1.90E+02	4.94E+02	9.19E+01
	NP-237	29.37	*	14.00	5.74E+00	5.74E+00	1.10E+02	2.80E+00
		86.50		12.60	8.23E+01		1.96E+01	3.90E+01
	U-237	97.08		16.30	7.26E+01	4.88E+01	-7.76E+00	3.42E+01
		101.07		26.30	4.88E+01		2.41E+00	2.30E+01
		114.00		12.30	2.40E+02		6.16E+02	1.17E+02
		208.01		22.00	1.11E+02		2.29E+01	5.18E+01
	AM-241	59.54		35.90	1.81E+01	1.81E+01	1.78E-01	8.76E+00
	AM-243	74.67		66.00	1.10E+01	1.10E+01	-3.45E+00	5.22E+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

Apex-Gamma

Analysis Report for 2007104-04
MW-3A

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-04
Sample Description	: MW-3A
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:28:19AM
Acquisition Started	: 8/3/2020 12:08:23PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.6 seconds
Dead Time	: 0.07 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 6/6/2020
Efficiency Calibration Used Done On	: 10/12/2019
Efficiency Calibration Description	:
Sample Number	: 100418

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:23:40PM

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 2007104-04

MW-3A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	30.62	24 -	40	30.63	6.74E+02	56.62	8.37E+01	2.25
m	2	34.98	24 -	40	34.99	1.97E+02	53.42	6.49E+01	2.92
	3	52.47	48 -	55	52.47	2.33E+01	26.76	1.03E+02	1.32
M	4	61.75	58 -	68	61.74	6.16E+01	27.10	8.83E+01	2.97
	5	80.75	76 -	86	80.73	2.98E+02	45.84	1.22E+02	2.20
M	6	111.52	107 -	119	111.47	5.50E+01	24.58	6.52E+01	3.34
m	7	116.85	107 -	119	116.80	1.93E+01	19.79	4.01E+01	2.39
	8	186.30	182 -	190	186.19	2.40E+01	21.80	5.80E+01	1.27
	9	240.59	235 -	244	240.43	2.14E+01	19.08	3.92E+01	2.35
	10	275.85	271 -	279	275.67	2.34E+01	15.40	2.12E+01	3.87
M	11	303.55	299 -	315	303.34	2.95E+01	15.52	1.80E+01	3.54
m	12	310.48	299 -	315	310.27	1.48E+01	16.88	2.20E+01	3.55
	13	333.34	330 -	337	333.11	1.35E+01	16.49	3.71E+01	2.98
	14	355.52	349 -	361	355.27	1.43E+02	28.16	2.60E+01	2.50
M	15	383.49	380 -	396	383.22	3.01E+01	11.18	8.18E-01	2.68
m	16	386.14	380 -	396	385.87	2.57E+01	15.11	2.70E+00	2.44
m	17	389.30	380 -	396	389.02	1.64E+01	15.11	6.68E+00	2.98
	18	428.32	424 -	431	428.01	9.09E+00	7.75	3.82E+00	5.54
	19	437.00	433 -	439	436.69	1.57E+01	10.02	6.53E+00	2.92
	20	470.53	466 -	475	470.20	1.50E+01	7.75	0.00E+00	7.00

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 : 8/3/2020 12:23:40PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100126.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	30.62	6.74E+02	56.62			6.74E+02	5.66E+01
m	2	34.98	1.97E+02	53.42			1.97E+02	5.34E+01
	3	52.47	2.33E+01	26.76			2.33E+01	2.68E+01
M	4	61.75	6.16E+01	27.10	1.14E+01	2.11E+00	5.02E+01	2.72E+01
	5	80.75	2.98E+02	45.84			2.98E+02	4.58E+01
M	6	111.52	5.50E+01	24.58			5.50E+01	2.46E+01
m	7	116.85	1.93E+01	19.79			1.93E+01	1.98E+01
	8	186.30	2.40E+01	21.80	6.68E+00	1.79E+00	1.73E+01	2.19E+01
	9	240.59	2.14E+01	19.08	2.56E+00	1.60E+00	1.88E+01	1.91E+01

Analysis Report for 2007104-04

MW-3A

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	10	275.85	2.34E+01	15.40			2.34E+01	1.54E+01
M	11	303.55	2.95E+01	15.52			2.95E+01	1.55E+01
m	12	310.48	1.48E+01	16.88			1.48E+01	1.69E+01
	13	333.34	1.35E+01	16.49			1.35E+01	1.65E+01
	14	355.52	1.43E+02	28.16			1.43E+02	2.82E+01
M	15	383.49	3.01E+01	11.18			3.01E+01	1.12E+01
m	16	386.14	2.57E+01	15.11			2.57E+01	1.51E+01
m	17	389.30	1.64E+01	15.11			1.64E+01	1.51E+01
	18	428.32	9.09E+00	7.75			9.09E+00	7.75E+00
	19	437.00	1.57E+01	10.02			1.57E+01	1.00E+01
	20	470.53	1.50E+01	7.75			1.50E+01	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-113	0.80	255.12		1.93		
		391.69	*	61.90	2.61E+01	2.45E+01
I-129	0.81	29.78	*	57.00	2.04E+02	2.58E+01
		33.60	*	13.20	2.46E+02	7.05E+01
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	1.55E+02	2.82E+01
		302.84	*	18.33	1.05E+02	6.55E+01
		356.01	*	62.05	1.94E+02	4.90E+01
TH-234	0.94	63.29	*	3.80	2.15E+02	1.18E+02
AM-241	0.88	59.54	*	35.90	2.27E+01	1.25E+01

Analysis Report for 2007104-04

MW-3A

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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	0.800	2.61E+01	2.45E+01	
	I-129	0.819	2.09E+02	2.43E+01	
	BA-133	0.994	1.57E+02	2.29E+01	
?	TH-234	0.941	2.15E+02	1.18E+02	
?	AM-241	0.883	2.27E+01	1.25E+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 2007104-04

MW-3A

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:23:40PM
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	52.47	2.58370E-02	57.54		
M	6	111.52	6.10813E-02	22.35	Sum	
m	7	116.85	2.14072E-02	51.37	Sum	
	8	186.30	1.92540E-02	63.11		
	9	240.59	2.09271E-02	50.83		
	10	275.85	2.60131E-02	32.90		
m	12	310.48	1.64413E-02	57.04		
	13	333.34	1.49479E-02	61.30	Sum	
M	15	383.49	3.34845E-02	18.55	Sum	
m	16	386.14	2.85709E-02	29.38	Sum	
	18	428.32	1.01010E-02	42.60		
	19	437.00	1.74854E-02	31.85	Sum	
	20	470.53	1.66667E-02	25.82	Sum	

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)
FE-55	5.89	24.50	9.76E+01	9.76E+01	2.03E+01	4.33E+01
CO-57	122.06	85.51	6.53E+00	6.53E+00	2.53E-01	2.90E+00
	136.48	10.60	6.33E+01		-2.86E+01	2.84E+01

Analysis Report for 2007104-04

MW-3A

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	NI-59	6.92		29.80	7.59E+01	7.59E+01	4.19E+00	3.45E+01
	MO-93	16.59		52.90	2.45E+01	2.45E+01	-1.67E+01	1.16E+01
		18.60		10.00	1.20E+02		7.28E+01	5.70E+01
	NB-93M	16.57		9.43	1.38E+02	1.38E+02	-9.38E+01	6.51E+01
	CD-109	88.03		3.72	1.68E+02	1.68E+02	-6.09E+01	7.74E+01
+	SN-113	255.12		1.93	6.70E+02	2.85E+01	1.36E+02	2.99E+02
		391.69	*	61.90	2.85E+01		2.61E+01	1.21E+01
	SN-119M	23.87		16.10	5.59E+01	3.79E+01	7.24E+00	2.63E+01
		25.10		22.70	3.79E+01		-2.97E+00	1.78E+01
+	I-129	29.78	*	57.00	2.17E+01	2.17E+01	2.04E+02	1.04E+01
		33.60	*	13.20	8.87E+01		2.46E+02	4.26E+01
		39.58		7.52	7.75E+01		-4.68E-01	3.59E+01
+	BA-133	81.00	*	34.06	2.72E+01	2.72E+01	1.55E+02	1.29E+01
		302.84	*	18.33	1.15E+02		1.05E+02	5.28E+01
		356.01	*	62.05	3.68E+01		1.94E+02	1.66E+01
	CE-139	165.85		80.35	1.23E+01	1.23E+01	9.48E-01	5.64E+00
	CE-144	133.54		10.80	6.94E+01	6.94E+01	1.32E+01	3.16E+01
	HG-203	279.19		77.30	2.11E+01	2.11E+01	4.98E-01	9.52E+00
	PB-210	46.50		4.25	1.26E+02	1.26E+02	-1.66E+01	5.81E+01
	TH-231	25.64		14.70	7.15E+01	7.15E+01	-7.58E+02	3.41E+01
		84.21		6.40	2.07E+02		4.06E+02	9.95E+01
	PA-234M	9.89		89.00	2.46E+01	1.49E+01	2.57E+01	1.16E+01
		21.72		64.90	1.49E+01		-6.49E-01	7.00E+00
		37.93		23.75	4.14E+01		5.16E+01	1.98E+01
		131.42		20.40	3.71E+01		2.01E+01	1.70E+01
+	TH-234	63.29	*	3.80	2.35E+02	2.35E+02	2.15E+02	1.12E+02
	NP-237	29.37		14.00	1.59E+02	5.31E+01	7.03E+02	7.79E+01
		86.50		12.60	5.31E+01		-5.44E-01	2.46E+01
	U-237	97.08		16.30	3.76E+01	2.69E+01	-3.10E+01	1.72E+01
		101.07		26.30	2.69E+01		8.63E+00	1.24E+01
		114.00		12.30	8.05E+01		6.99E+01	3.78E+01
		208.01		22.00	5.48E+01		1.52E+01	2.50E+01
+	AM-241	59.54	*	35.90	2.49E+01	2.49E+01	2.27E+01	1.18E+01
	AM-243	74.67		66.00	9.84E+00	9.84E+00	5.20E-01	4.57E+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

KB 9/3/20

Apex-Gamma

Analysis Report for 2007104-05
MW-4A

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-05
Sample Description	: MW-4A
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:28:28AM
Acquisition Started	: 8/3/2020 12:23:54PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE1
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)	: 32 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 10/12/2019
Efficiency Calibration Used Done On	: 10/12/2019
Efficiency Calibration Description	:
Sample Number	: 100419

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:38:57PM

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 2007104-05

MW-4A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	52.47	49 -	57	52.93	7.27E+01	41.57	2.23E+02	3.10
M	2	61.75	58 -	75	62.21	2.21E+02	45.80	1.94E+02	2.40
m	3	65.93	58 -	75	66.38	1.23E+02	43.66	1.98E+02	2.34
	4	80.78	76 -	86	81.22	7.67E+02	72.76	2.96E+02	1.86
M	5	111.51	106 -	123	111.93	2.25E+02	42.00	1.72E+02	2.25
m	6	115.79	106 -	123	116.20	5.56E+01	37.26	1.70E+02	2.26
	7	146.17	139 -	154	146.57	6.10E+01	53.63	2.60E+02	10.29
	8	276.24	273 -	279	276.54	5.63E+01	23.07	5.55E+01	1.91
M	9	302.84	299 -	317	303.12	1.67E+02	29.22	6.39E+01	2.11
m	10	306.87	299 -	317	307.13	5.29E+01	35.78	6.66E+01	2.93
m	11	310.46	299 -	317	310.73	1.93E+01	28.22	5.66E+01	2.94
M	12	333.84	328 -	343	334.09	6.58E+01	23.30	4.43E+01	2.42
	13	355.89	350 -	361	356.12	5.48E+02	54.85	1.02E+02	1.85
	14	365.35	362 -	369	365.57	1.84E+01	20.10	5.32E+01	1.14
M	15	383.88	380 -	398	384.09	1.43E+02	36.49	5.03E+01	2.34
m	16	386.93	380 -	398	387.14	1.85E+02	36.95	3.80E+01	1.89
m	17	391.11	380 -	398	391.31	4.46E+01	34.28	4.86E+01	3.03
M	18	415.04	410 -	426	415.23	3.42E+01	18.18	3.50E+01	2.50
m	19	418.04	410 -	426	418.23	3.66E+01	20.75	3.50E+01	2.50
m	20	422.05	410 -	426	422.23	1.55E+01	18.07	3.50E+01	2.50
	21	437.00	432 -	440	437.17	9.94E+01	20.69	5.12E+00	2.10
	22	468.49	464 -	475	468.64	2.70E+01	16.00	1.99E+01	2.89
	23	483.53	480 -	486	483.67	6.50E+00	8.03	7.00E+00	2.99
	24	547.39	545 -	549	547.48	4.75E+00	5.50	2.50E+00	1.79
	25	606.04	600 -	613	606.09	1.28E+01	13.34	1.43E+01	1.40
	26	627.24	624 -	630	627.27	6.50E+00	8.03	7.00E+00	1.13

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 : 8/3/2020 12:38:57PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100123.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	52.47	7.27E+01	41.57	9.59E-01	6.15E-01	7.17E+01	4.16E+01
M	2	61.75	2.21E+02	45.80	2.39E+01	2.34E+00	1.97E+02	4.59E+01
m	3	65.93	1.23E+02	43.66			1.23E+02	4.37E+01

Analysis Report for 2007104-05

MW-4A

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	4	80.78	7.67E+02	72.76			7.67E+02	7.28E+01
M	5	111.51	2.25E+02	42.00			2.25E+02	4.20E+01
m	6	115.79	5.56E+01	37.26			5.56E+01	3.73E+01
	7	146.17	6.10E+01	53.63			6.10E+01	5.36E+01
	8	276.24	5.63E+01	23.07			5.63E+01	2.31E+01
M	9	302.84	1.67E+02	29.22			1.67E+02	2.92E+01
m	10	306.87	5.29E+01	35.78			5.29E+01	3.58E+01
m	11	310.46	1.93E+01	28.22			1.93E+01	2.82E+01
M	12	333.84	6.58E+01	23.30			6.58E+01	2.33E+01
	13	355.89	5.48E+02	54.85			5.48E+02	5.48E+01
	14	365.35	1.84E+01	20.10			1.84E+01	2.01E+01
M	15	383.88	1.43E+02	36.49			1.43E+02	3.65E+01
m	16	386.93	1.85E+02	36.95			1.85E+02	3.69E+01
m	17	391.11	4.46E+01	34.28			4.46E+01	3.43E+01
M	18	415.04	3.42E+01	18.18			3.42E+01	1.82E+01
m	19	418.04	3.66E+01	20.75			3.66E+01	2.07E+01
m	20	422.05	1.55E+01	18.07			1.55E+01	1.81E+01
	21	437.00	9.94E+01	20.69			9.94E+01	2.07E+01
	22	468.49	2.70E+01	16.00			2.70E+01	1.60E+01
	23	483.53	6.50E+00	8.03			6.50E+00	8.03E+00
	24	547.39	4.75E+00	5.50			4.75E+00	5.50E+00
	25	606.04	1.28E+01	13.34			1.28E+01	1.33E+01
	26	627.24	6.50E+00	8.03			6.50E+00	8.03E+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	3.46E+01	2.69E+01
BA-133	0.99	81.00	*	34.06	3.93E+02	5.39E+01
		302.84	*	18.33	4.71E+02	1.56E+02
		356.01	*	62.05	4.40E+02	6.69E+01
TH-234	0.94	63.29	*	3.80	5.35E+02	1.29E+02

Analysis Report for 2007104-05
MW-4A

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
AM-241	0.88	59.54	*	35.90	5.67E+01	1.36E+01

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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	0.945	3.46E+01	2.69E+01	
	BA-133	0.999	4.16E+02	4.05E+01	
?	TH-234	0.941	5.35E+02	1.29E+02	
?	AM-241	0.883	5.67E+01	1.36E+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 2007104-05
MW-4A

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:38:57PM
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	52.47	7.97013E-02	28.98		
m	3	65.93	1.37082E-01	17.69		
M	5	111.51	2.49651E-01	9.35	Tol.	U-237
m	6	115.79	6.18244E-02	33.48	Tol.	U-237
	7	146.17	6.77662E-02	43.97		
	8	276.24	6.25132E-02	20.50		
m	10	306.87	5.88203E-02	33.80		
m	11	310.46	2.14949E-02	72.94		
M	12	333.84	7.31307E-02	17.70		
	14	365.35	2.04198E-02	54.68	Sum	
M	15	383.88	1.58393E-01	12.80	Sum	
m	16	386.93	2.05696E-01	9.98		
M	18	415.04	3.80126E-02	26.57		
m	19	418.04	4.07040E-02	28.32	Sum	
m	20	422.05	1.72053E-02	58.35		
	21	437.00	1.10490E-01	10.41	Sum	
	22	468.49	3.00300E-02	29.60		
	23	483.53	7.22222E-03	61.78		
	24	547.39	5.27778E-03	57.89		
	25	606.04	1.42778E-02	51.91	Sum	
	26	627.24	7.22222E-03	61.78		

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 2007104-05

MW-4A

	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	1.49E-04	1.49E-04	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.68E+01	1.68E+01	-9.35E-02	7.87E+00
		136.48		10.60	1.52E+02		4.62E+01	7.13E+01
	NI-59	6.92		29.80	2.91E-04	2.91E-04	0.00E+00	0.00E+00
	MO-93	16.59		52.90	9.33E-03	9.33E-03	0.00E+00	0.00E+00
		18.60		10.00	7.73E-02		0.00E+00	0.00E+00
	NB-93M	16.57		9.43	5.21E-02	5.21E-02	0.00E+00	0.00E+00
	CD-109	88.03		3.72	2.85E+02	2.85E+02	-1.91E+02	1.35E+02
+	SN-113	255.12		1.93	8.41E+02	4.76E+01	1.16E+02	3.84E+02
		391.69	*	61.90	4.76E+01		3.46E+01	2.27E+01
	SN-119M	23.87		16.10	1.20E-01	1.01E-01	0.00E+00	0.00E+00
		25.10		22.70	1.01E-01		0.00E+00	0.00E+00
	I-129	29.78		57.00	1.52E+00	1.52E+00	-1.54E+00	7.26E-01
		33.60		13.20	1.99E+01		8.83E+01	9.75E+00
		39.58		7.52	3.26E+01		-1.23E+02	1.57E+01
+	BA-133	81.00	*	34.06	4.11E+01	3.99E+01	3.93E+02	1.99E+01
		302.84	*	18.33	2.02E+02		4.71E+02	9.72E+01
		356.01	*	62.05	3.99E+01		4.40E+02	1.89E+01
	CE-139	165.85		80.35	2.27E+01	2.27E+01	-5.54E+00	1.06E+01
	CE-144	133.54		10.80	1.47E+02	1.47E+02	5.07E+01	6.89E+01
	HG-203	279.19		77.30	2.95E+01	2.95E+01	-5.29E+00	1.38E+01
	PB-210	46.50		4.25	6.01E+01	6.01E+01	1.00E+01	2.84E+01
	TH-231	25.64		14.70	1.68E-01	1.68E-01	0.00E+00	0.00E+00
		84.21		6.40	2.62E+02		-3.72E+01	1.27E+02
	PA-234M	9.89		89.00	5.79E-04	5.79E-04	0.00E+00	0.00E+00
		21.72		64.90	2.12E-02		0.00E+00	0.00E+00
		37.93		23.75	1.50E+01		5.37E+01	7.32E+00
		131.42		20.40	7.36E+01		-5.46E+00	3.45E+01
+	TH-234	63.29	*	3.80	3.24E+02	3.24E+02	5.35E+02	1.58E+02
	NP-237	29.37		14.00	5.94E+00	5.94E+00	-6.01E+00	2.83E+00
		86.50		12.60	8.55E+01		-2.74E+01	4.06E+01
	U-237	97.08		16.30	6.92E+01	4.50E+01	-5.63E+01	3.26E+01
		101.07		26.30	4.50E+01		2.84E+00	2.12E+01
		114.00		12.30	2.10E+02		5.04E+02	1.02E+02
		208.01		22.00	1.01E+02		2.83E+01	4.73E+01
+	AM-241	59.54	*	35.90	3.43E+01	3.43E+01	5.67E+01	1.68E+01
	AM-243	74.67		66.00	1.14E+01	1.14E+01	-6.50E+01	5.41E+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

KB 9/3/20

Apex-Gamma

Analysis Report for 2007104-06
MW-9B

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-06
Sample Description	: MW-9B
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:28:39AM
Acquisition Started	: 8/3/2020 12:24:00PM
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)	: 29 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 6/6/2020
Efficiency Calibration Used Done On	: 9/14/2019
Efficiency Calibration Description	:
Sample Number	: 100420

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:39:11PM

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 2007104-06

MW-9B

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.12	35 -	39	35.81	3.59E+02	58.12	2.67E+02	2.65
	2	52.25	50 -	56	52.92	3.66E+01	31.67	1.59E+02	2.57
M	3	61.64	59 -	69	62.30	1.86E+02	33.47	8.35E+01	1.81
m	4	65.97	59 -	69	66.63	1.02E+02	31.02	1.06E+02	1.88
M	5	77.47	77 -	87	78.12	1.77E+01	13.53	4.58E+01	1.31
m	6	80.89	77 -	87	81.54	7.00E+02	56.43	1.07E+02	1.68
M	7	111.44	107 -	119	112.05	1.34E+02	31.58	9.00E+01	1.67
m	8	116.16	107 -	119	116.77	1.97E+01	22.83	8.62E+01	1.68
	9	160.79	158 -	166	161.35	4.12E+01	33.29	1.48E+02	5.62
	10	241.72	235 -	251	242.19	4.63E+01	38.88	1.21E+02	9.99
	11	276.36	273 -	280	276.81	5.99E+01	23.49	5.22E+01	1.38
M	12	302.74	299 -	316	303.15	1.36E+02	24.97	1.78E+01	1.67
m	13	307.09	299 -	316	307.50	1.92E+01	14.11	1.90E+01	2.00
m	14	312.09	299 -	316	312.50	8.48E+00	11.96	1.84E+01	2.01
M	15	333.84	330 -	342	334.23	5.51E+01	21.22	2.92E+01	2.19
m	16	337.91	330 -	342	338.29	1.78E+01	18.71	3.84E+01	2.25
	17	355.99	351 -	361	356.35	4.93E+02	46.68	2.76E+01	1.86
M	18	383.97	381 -	389	384.31	7.71E+01	31.62	4.13E+01	2.34
m	19	387.02	381 -	389	387.35	1.51E+02	28.84	3.38E+01	1.40
	20	417.19	412 -	425	417.50	4.71E+01	24.56	3.58E+01	6.02
	21	429.85	427 -	434	430.14	1.53E+01	10.58	9.30E+00	5.41
	22	437.13	434 -	440	437.41	7.17E+01	20.04	2.07E+01	1.95
	23	467.84	465 -	470	468.09	1.50E+01	9.49	6.00E+00	1.53
m	24	513.81	507 -	517	514.02	5.48E+00	10.30	9.42E+00	2.04
	25	523.07	520 -	527	523.27	1.10E+01	6.63	0.00E+00	2.00
	26	785.88	782 -	789	785.83	8.00E+00	8.94	8.00E+00	1.50

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 : 8/3/2020 12:39:11PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100124.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.12	3.59E+02	58.12	3.92E+01	1.95E+00	3.20E+02	5.82E+01
	2	52.25	3.66E+01	31.67			3.66E+01	3.17E+01
M	3	61.64	1.86E+02	33.47	4.48E+00	1.99E+00	1.82E+02	3.35E+01

Analysis Report for 2007104-06

MW-9B

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	4	65.97	1.02E+02	31.02			1.02E+02	3.10E+01
M	5	77.47	1.77E+01	13.53			1.77E+01	1.35E+01
m	6	80.89	7.00E+02	56.43			7.00E+02	5.64E+01
M	7	111.44	1.34E+02	31.58	1.72E+00	1.78E+00	1.33E+02	3.16E+01
m	8	116.16	1.97E+01	22.83			1.97E+01	2.28E+01
	9	160.79	4.12E+01	33.29			4.12E+01	3.33E+01
	10	241.72	4.63E+01	38.88			4.63E+01	3.89E+01
	11	276.36	5.99E+01	23.49			5.99E+01	2.35E+01
M	12	302.74	1.36E+02	24.97			1.36E+02	2.50E+01
m	13	307.09	1.92E+01	14.11			1.92E+01	1.41E+01
m	14	312.09	8.48E+00	11.96			8.48E+00	1.20E+01
M	15	333.84	5.51E+01	21.22			5.51E+01	2.12E+01
m	16	337.91	1.78E+01	18.71	1.13E-01	1.18E+00	1.77E+01	1.88E+01
	17	355.99	4.93E+02	46.68			4.93E+02	4.67E+01
M	18	383.97	7.71E+01	31.62			7.71E+01	3.16E+01
m	19	387.02	1.51E+02	28.84			1.51E+02	2.88E+01
	20	417.19	4.71E+01	24.56			4.71E+01	2.46E+01
	21	429.85	1.53E+01	10.58			1.53E+01	1.06E+01
	22	437.13	7.17E+01	20.04			7.17E+01	2.00E+01
	23	467.84	1.50E+01	9.49			1.50E+01	9.49E+00
m	24	513.81	5.48E+00	10.30			5.48E+00	1.03E+01
	25	523.07	1.10E+01	6.63			1.10E+01	6.63E+00
	26	785.88	8.00E+00	8.94			8.00E+00	8.94E+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
BA-133	1.00	81.00	*	34.06	4.24E+02	5.48E+01
		302.84	*	18.33	4.84E+02	1.72E+02
		356.01	*	62.05	3.95E+02	5.77E+01
TH-234	0.93	63.29	*	3.80	3.69E+02	6.97E+01
AM-241	0.89	59.54	*	35.90	3.91E+01	7.37E+00

Analysis Report for 2007104-06

MW-9B

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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
	BA-133	1.000	4.14E+02	3.87E+01	
?	TH-234	0.933	3.69E+02	6.97E+01	
?	AM-241	0.893	3.91E+01	7.37E+00	

? = 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 2007104-06

MW-9B

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:39:11PM
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	35.12	3.55819E-01	9.08	Tol.	I-129
	2	52.25	4.06992E-02	43.23		
m	4	65.97	1.13308E-01	15.21		
M	5	77.47	1.96297E-02	38.29		
M	7	111.44	1.47522E-01	11.91		
m	8	116.16	2.18979E-02	57.91	Tol.	U-237
	9	160.79	4.57729E-02	40.40	Sum	
	10	241.72	5.14694E-02	41.97		
	11	276.36	6.65633E-02	19.61		
m	13	307.09	2.13657E-02	36.68		
m	14	312.09	9.42012E-03	70.52		
M	15	333.84	6.12554E-02	19.24		
m	16	337.91	1.97011E-02	52.88		
M	18	383.97	8.56566E-02	20.51	Sum	
m	19	387.02	1.67436E-01	9.57		
	20	417.19	5.23590E-02	26.06	Sum	
	21	429.85	1.70556E-02	34.47		
	22	437.13	7.96206E-02	13.98	Sum	
	23	467.84	1.66667E-02	31.62		
m	24	513.81	6.08673E-03	93.97		
	25	523.07	1.22222E-02	30.15		
	26	785.88	8.88889E-03	55.90		

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

Analysis Report for 2007104-06

MW-9B

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)
	FE-55	5.89		24.50	4.58E-09	4.58E-09	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.38E+01	2.38E+01	4.90E+00	1.10E+01
		136.48		10.60	2.13E+02		2.23E+01	9.81E+01
	NI-59	6.92		29.80	2.55E-08	2.55E-08	0.00E+00	0.00E+00
	MO-93	16.59		52.90	9.74E-05	9.74E-05	0.00E+00	0.00E+00
		18.60		10.00	1.34E-03		0.00E+00	0.00E+00
	NB-93M	16.57		9.43	5.41E-04	5.41E-04	0.00E+00	0.00E+00
	CD-109	88.03		3.72	2.66E+02	2.66E+02	5.10E+01	1.23E+02
	SN-113	255.12		1.93	1.08E+03	2.06E+01	1.98E+02	4.84E+02
		391.69		61.90	2.06E+01		-7.44E+00	9.41E+00
	SN-119M	23.87		16.10	5.80E-03	5.80E-03	0.00E+00	0.00E+00
		25.10		22.70	5.92E-03		0.00E+00	0.00E+00
	I-129	29.78		57.00	5.77E-01	5.77E-01	5.14E+00	2.85E-01
		33.60		13.20	4.36E+00		5.04E+00	2.14E+00
		39.58		7.52	4.45E+00		1.36E+00	2.06E+00
+	BA-133	81.00	*	34.06	4.04E+01	2.11E+01	4.24E+02	1.94E+01
		302.84	*	18.33	1.53E+02		4.84E+02	7.18E+01
		356.01	*	62.05	2.11E+01		3.95E+02	9.47E+00
	CE-139	165.85		80.35	3.82E+01	3.82E+01	1.01E+00	1.77E+01
	CE-144	133.54		10.80	2.11E+02	2.11E+02	-2.49E+01	9.75E+01
	HG-203	279.19		77.30	2.30E+01	2.30E+01	-2.01E+00	1.02E+01
	PB-210	46.50		4.25	1.69E+01	1.69E+01	-3.93E+00	7.77E+00
	TH-231	25.64		14.70	1.06E-02	1.06E-02	0.00E+00	0.00E+00
		84.21		6.40	1.48E+02		-1.73E+03	6.89E+01
	PA-234M	9.89		89.00	4.30E-07	4.30E-07	0.00E+00	0.00E+00
		21.72		64.90	7.08E-04		0.00E+00	0.00E+00
		37.93		23.75	1.52E+00		1.33E-01	7.19E-01
		131.42		20.40	1.08E+02		-2.66E+01	4.99E+01
+	TH-234	63.29	*	3.80	1.22E+02	1.22E+02	3.69E+02	5.84E+01
	NP-237	29.37		14.00	2.14E+00	2.14E+00	1.91E+01	1.06E+00
		86.50		12.60	7.27E+01		-1.02E+01	3.36E+01
	U-237	97.08		16.30	7.67E+01	5.84E+01	1.97E+01	3.55E+01
		101.07		26.30	5.84E+01		2.09E+01	2.72E+01
		114.00		12.30	2.13E+02		-2.67E+02	1.01E+02
		208.01		22.00	1.40E+02		2.97E+01	6.44E+01
+	AM-241	59.54	*	35.90	1.29E+01	1.29E+01	3.91E+01	6.18E+00
	AM-243	74.67		66.00	9.24E+00	9.24E+00	-2.60E+00	4.29E+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

Analysis Report for 2007104-06

MW-9B

Apex-Gamma

Analysis Report for 2007104-07
MW-7A

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-07
Sample Description	: MW-7A
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:28:48AM
Acquisition Started	: 8/3/2020 12:24:07PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE3
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 902.1 seconds
Dead Time	: 0.23 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 10 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 6/6/2020
Efficiency Calibration Used Done On	: 10/19/2019
Efficiency Calibration Description	:
Sample Number	: 100421

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:39:22PM

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 2007104-07

MW-7A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	21.03	18 -	24	21.46	7.08E+01	40.37	2.44E+02	2.12
M	2	31.09	26 -	40	31.51	1.64E+03	86.61	1.61E+02	1.97
m	3	35.35	26 -	40	35.76	3.70E+02	53.23	1.13E+02	2.14
	4	53.82	51 -	58	54.22	7.20E+01	34.93	1.54E+02	2.18
M	5	62.25	59 -	70	62.63	1.76E+02	40.87	1.42E+02	2.23
m	6	66.01	59 -	70	66.39	1.12E+02	41.51	1.64E+02	2.19
M	7	76.63	76 -	88	77.00	1.61E+01	12.17	4.36E+01	1.86
m	8	81.36	76 -	88	81.73	6.21E+02	55.03	1.06E+02	2.00
	9	93.20	89 -	98	93.55	6.17E+01	34.51	1.35E+02	4.39
	10	112.38	107 -	118	112.70	2.00E+02	52.12	2.38E+02	2.11
	11	135.03	133 -	138	135.32	1.72E+01	21.19	7.76E+01	2.51
	12	240.56	238 -	244	240.74	2.14E+01	18.75	4.71E+01	3.91
	13	254.30	250 -	258	254.45	2.10E+01	23.49	7.20E+01	2.13
	14	276.34	271 -	281	276.47	4.65E+01	29.77	9.29E+01	1.95
	15	303.19	298 -	307	303.28	8.48E+01	33.69	1.10E+02	2.47
M	16	333.98	329 -	345	334.04	4.32E+01	18.38	3.00E+01	2.28
m	17	338.62	329 -	345	338.67	2.98E+01	18.49	2.48E+01	2.34
	18	356.68	351 -	363	356.72	3.69E+02	46.29	7.95E+01	2.25
	19	386.08	381 -	390	386.07	2.26E+02	37.28	6.88E+01	4.42
M	20	413.83	409 -	425	413.79	1.24E+01	13.90	1.98E+01	2.33
m	21	418.04	409 -	425	418.00	1.98E+01	15.91	1.46E+01	2.12
m	22	422.26	409 -	425	422.21	1.11E+01	13.46	1.47E+01	2.34
	23	437.92	432 -	444	437.85	7.86E+01	21.79	1.67E+01	2.45
	24	469.12	464 -	474	469.01	1.40E+01	13.37	1.60E+01	3.02
	25	510.91	507 -	514	510.75	2.32E+01	10.77	3.68E+00	5.43
	26	602.02	599 -	604	601.75	8.00E+00	5.66	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 : 8/3/2020 12:39:22PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100125.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	21.03	7.08E+01	40.37	8.05E+00	2.25E+00	6.28E+01	4.04E+01
M	2	31.09	1.64E+03	86.61			1.64E+03	8.66E+01
m	3	35.35	3.70E+02	53.23			3.70E+02	5.32E+01

Analysis Report for 2007104-07

MW-7A

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	4	53.82	7.20E+01	34.93			7.20E+01	3.49E+01
M	5	62.25	1.76E+02	40.87	1.41E+01	1.88E+00	1.62E+02	4.09E+01
m	6	66.01	1.12E+02	41.51	1.41E+01	1.88E+00	9.75E+01	4.15E+01
M	7	76.63	1.61E+01	12.17			1.61E+01	1.22E+01
m	8	81.36	6.21E+02	55.03			6.21E+02	5.50E+01
	9	93.20	6.17E+01	34.51	1.89E+01	1.88E+00	4.29E+01	3.46E+01
	10	112.38	2.00E+02	52.12			2.00E+02	5.21E+01
	11	135.03	1.72E+01	21.19			1.72E+01	2.12E+01
	12	240.56	2.14E+01	18.75	3.96E+00	1.44E+00	1.75E+01	1.88E+01
	13	254.30	2.10E+01	23.49			2.10E+01	2.35E+01
	14	276.34	4.65E+01	29.77			4.65E+01	2.98E+01
	15	303.19	8.48E+01	33.69			8.48E+01	3.37E+01
M	16	333.98	4.32E+01	18.38			4.32E+01	1.84E+01
m	17	338.62	2.98E+01	18.49			2.98E+01	1.85E+01
	18	356.68	3.69E+02	46.29			3.69E+02	4.63E+01
	19	386.08	2.26E+02	37.28			2.26E+02	3.73E+01
M	20	413.83	1.24E+01	13.90			1.24E+01	1.39E+01
m	21	418.04	1.98E+01	15.91			1.98E+01	1.59E+01
m	22	422.26	1.11E+01	13.46			1.11E+01	1.35E+01
	23	437.92	7.86E+01	21.79			7.86E+01	2.18E+01
	24	469.12	1.40E+01	13.37			1.40E+01	1.34E+01
	25	510.91	2.32E+01	10.77	1.38E+01	1.29E+00	9.33E+00	1.08E+01
	26	602.02	8.00E+00	5.66			8.00E+00	5.66E+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-129	0.86	29.78	*	57.00	2.27E+01	1.20E+00
		33.60	*	13.20	3.69E+01	5.31E+00
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	3.09E+02	4.09E+01
		302.84	*	18.33	2.80E+02	1.37E+02
		356.01	*	62.05	3.33E+02	5.87E+01

Analysis Report for 2007104-07
MW-7A

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
CE-144	0.94	133.54	*	10.80	6.58E+01	8.24E+01
TH-234	0.97	63.29	*	3.80	3.69E+02	9.50E+01
AM-243	0.90	74.67	*	66.00	3.60E+00	2.74E+00

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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-129	0.860	2.34E+01	1.17E+00	
	BA-133	0.992	3.15E+02	3.26E+01	
	CE-144	0.945	6.58E+01	8.24E+01	
	TH-234	0.973	3.69E+02	9.50E+01	
X	NP-237	0.739			
	AM-243	0.906	3.60E+00	2.74E+00	

? = 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 2007104-07
MW-7A

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:39:22PM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	21.03	6.97791E-02	32.19	Tol.	MO-93 PA-234M
	4	53.82	7.99851E-02	24.26		
m	6	66.01	1.08279E-01	21.32	Sum	
	9	93.20	4.76347E-02	40.31	Sum	
	10	112.38	2.22149E-01	13.03	Sum	
	12	240.56	1.94220E-02	53.79		
	13	254.30	2.33333E-02	55.94		
	14	276.34	5.17085E-02	31.98		
M	16	333.98	4.80029E-02	21.28	Sum	
m	17	338.62	3.31460E-02	31.00	Sum	
	19	386.08	2.50684E-01	8.26	Sum	
M	20	413.83	1.38064E-02	55.94		
m	21	418.04	2.19934E-02	40.18	Sum	
m	22	422.26	1.22886E-02	60.86		
	23	437.92	8.73755E-02	13.85	Sum	
	24	469.12	1.55808E-02	47.67		
	25	510.91	1.03658E-02	58.14		
	26	602.02	8.88889E-03	35.36		

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 2007104-07

MW-7A

	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	6.04E-06	6.04E-06	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.48E+01	1.48E+01	-1.18E+01	6.85E+00
		136.48		10.60	1.65E+02		-8.31E+00	7.74E+01
	NI-59	6.92		29.80	1.50E-04	1.50E-04	1.47E-05	6.70E-05
	MO-93	16.59		52.90	4.25E-02	4.25E-02	6.65E-03	2.02E-02
		18.60		10.00	4.86E-01		4.29E-04	2.33E-01
	NB-93M	16.57		9.43	2.37E-01	2.37E-01	3.71E-02	1.13E-01
	CD-109	88.03		3.72	2.16E+02	2.16E+02	-9.77E+02	1.01E+02
	SN-113	255.12		1.93	1.12E+03	2.92E+01	5.31E+02	5.19E+02
		391.69		61.90	2.92E+01		6.76E+00	1.35E+01
	SN-119M	23.87		16.10	1.02E+00	8.36E-01	-2.46E-01	4.91E-01
		25.10		22.70	8.36E-01		-2.04E+01	4.00E-01
+	I-129	29.78	*	57.00	1.34E+00	1.34E+00	2.27E+01	6.53E-01
		33.60	*	13.20	9.56E+00		3.69E+01	4.64E+00
		39.58		7.52	1.53E+01		-1.52E+00	7.30E+00
+	BA-133	81.00	*	34.06	3.54E+01	3.54E+01	3.09E+02	1.70E+01
		302.84	*	18.33	1.62E+02		2.80E+02	7.65E+01
		356.01	*	62.05	4.07E+01		3.33E+02	1.91E+01
	CE-139	165.85		80.35	2.66E+01	2.66E+01	-1.78E+01	1.24E+01
+	CE-144	133.54	*	10.80	1.33E+02	1.33E+02	6.58E+01	6.13E+01
	HG-203	279.19		77.30	3.31E+01	3.31E+01	3.02E+01	1.54E+01
	PB-210	46.50		4.25	4.11E+01	4.11E+01	1.79E+01	1.94E+01
	TH-231	25.64		14.70	1.42E+00	1.42E+00	-3.47E+01	6.79E-01
		84.21		6.40	2.89E+02		9.22E+02	1.41E+02
	PA-234M	9.89		89.00	9.93E-04	9.93E-04	6.96E-04	4.67E-04
		21.72		64.90	1.66E-01		2.03E-01	7.98E-02
		37.93		23.75	6.98E+00		1.53E+01	3.39E+00
		131.42		20.40	7.39E+01		-1.06E+01	3.43E+01
+	TH-234	63.29	*	3.80	1.69E+02	1.69E+02	3.69E+02	8.14E+01
	NP-237	29.37	*	14.00	5.47E+00	5.47E+00	9.23E+01	2.66E+00
		86.50		12.60	6.32E+01		-7.23E+02	2.95E+01
	U-237	97.08		16.30	6.93E+01	4.31E+01	4.58E+00	3.26E+01
		101.07		26.30	4.31E+01		1.22E+01	2.01E+01
		114.00		12.30	2.08E+02		4.97E+02	1.00E+02
		208.01		22.00	1.05E+02		-5.63E+00	4.86E+01
	AM-241	59.54		35.90	1.60E+01	1.60E+01	1.84E+01	7.72E+00
+	AM-243	74.67	*	66.00	1.54E+01	1.54E+01	3.60E+00	7.38E+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

KB 8/3/20

Apex-Gamma

Analysis Report for 2007104-08
MW-2A

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-08
Sample Description	: MW-2A
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:28:57AM
Acquisition Started	: 8/3/2020 12:24:15PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.8 seconds
Dead Time	: 0.08 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 7 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 6/6/2020
Efficiency Calibration Used Done On	: 10/12/2019
Efficiency Calibration Description	:
Sample Number	: 100422

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:39:33PM

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 2007104-08

MW-2A

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	30.58	26 -	38	30.60	1.86E+03	93.78	2.31E+02	2.35
m	2	34.86	26 -	38	34.87	4.53E+02	83.06	1.66E+02	2.29
M	3	53.00	46 -	72	52.99	5.37E+01	46.35	2.30E+02	3.93
m	4	61.58	46 -	72	61.57	2.26E+02	44.27	1.56E+02	2.51
m	5	65.74	46 -	72	65.72	8.89E+01	39.52	1.38E+02	2.36
m	6	70.04	46 -	72	70.02	2.41E+01	27.33	1.20E+02	3.97
	7	80.65	74 -	86	80.63	7.70E+02	74.24	2.86E+02	2.22
	8	92.18	88 -	96	92.14	5.04E+01	30.89	1.13E+02	3.20
M	9	111.58	106 -	118	111.53	1.77E+02	41.18	1.63E+02	2.76
m	10	115.84	106 -	118	115.78	2.71E+01	28.77	1.10E+02	1.99
	11	276.23	270 -	281	276.05	6.40E+01	32.68	9.99E+01	2.01
	12	285.77	283 -	288	285.58	1.02E+01	13.30	2.75E+01	2.62
M	13	302.71	298 -	310	302.51	1.15E+02	29.32	6.44E+01	2.93
m	14	306.72	298 -	310	306.51	2.25E+01	29.25	5.73E+01	2.93
	15	335.06	326 -	343	334.83	6.65E+01	36.81	9.90E+01	3.06
	16	356.04	350 -	360	355.80	3.74E+02	40.76	2.25E+01	2.40
M	17	385.77	380 -	395	385.50	1.49E+02	31.11	2.55E+01	3.97
m	18	390.64	380 -	395	390.37	4.31E+01	25.53	4.89E+00	3.87
M	19	413.54	409 -	424	413.25	1.91E+01	13.86	1.60E+01	2.73
m	20	418.06	409 -	424	417.76	2.06E+01	17.00	1.80E+01	3.00
	21	437.33	433 -	441	437.03	6.40E+01	18.46	1.19E+01	2.19
	22	452.20	449 -	454	451.88	5.50E+00	7.07	5.00E+00	1.45

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 : 8/3/2020 12:39:33PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100126.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	30.58	1.86E+03	93.78			1.86E+03	9.38E+01
m	2	34.86	4.53E+02	83.06			4.53E+02	8.31E+01
M	3	53.00	5.37E+01	46.35			5.37E+01	4.63E+01
m	4	61.58	2.26E+02	44.27	1.14E+01	2.11E+00	2.15E+02	4.43E+01
m	5	65.74	8.89E+01	39.52	1.14E+01	2.11E+00	7.75E+01	3.96E+01
m	6	70.04	2.41E+01	27.33			2.41E+01	2.73E+01
	7	80.65	7.70E+02	74.24			7.70E+02	7.42E+01

Analysis Report for 2007104-08

MW-2A

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	8	92.18	5.04E+01	30.89	1.68E+01	3.44E+00	3.37E+01	3.11E+01
M	9	111.58	1.77E+02	41.18			1.77E+02	4.12E+01
m	10	115.84	2.71E+01	28.77			2.71E+01	2.88E+01
	11	276.23	6.40E+01	32.68			6.40E+01	3.27E+01
	12	285.77	1.02E+01	13.30			1.02E+01	1.33E+01
M	13	302.71	1.15E+02	29.32			1.15E+02	2.93E+01
m	14	306.72	2.25E+01	29.25			2.25E+01	2.92E+01
	15	335.06	6.65E+01	36.81			6.65E+01	3.68E+01
	16	356.04	3.74E+02	40.76			3.74E+02	4.08E+01
M	17	385.77	1.49E+02	31.11			1.49E+02	3.11E+01
m	18	390.64	4.31E+01	25.53			4.31E+01	2.55E+01
M	19	413.54	1.91E+01	13.86			1.91E+01	1.39E+01
m	20	418.06	2.06E+01	17.00			2.06E+01	1.70E+01
	21	437.33	6.40E+01	18.46			6.40E+01	1.85E+01
	22	452.20	5.50E+00	7.07			5.50E+00	7.07E+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	0.90	255.12		1.93		
		391.69	*	61.90	6.89E+01	4.27E+01
I-129	0.82	29.78	*	57.00	5.62E+02	6.06E+01
		33.60	*	13.20	5.67E+02	1.16E+02
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	4.00E+02	5.49E+01
		302.84	*	18.33	4.07E+02	1.71E+02
		356.01	*	62.05	5.08E+02	9.67E+01
TH-234	0.92	63.29	*	3.80	9.17E+02	2.06E+02
AM-241	0.89	59.54	*	35.90	9.71E+01	2.19E+01

Analysis Report for 2007104-08

MW-2A

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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	0.906	6.89E+01	4.27E+01	
	I-129	0.821	5.64E+02	5.37E+01	
	BA-133	0.999	4.25E+02	4.60E+01	
?	TH-234	0.928	9.17E+02	2.06E+02	
?	AM-241	0.899	9.71E+01	2.19E+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 2007104-08
MW-2A

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:39:33PM
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	3	53.00	5.96141E-02	43.19		
m	5	65.74	8.60803E-02	25.54	Sum	
m	6	70.04	2.67448E-02	56.77	Sum	
	8	92.18	3.74347E-02	46.13	Sum	
M	9	111.58	1.96931E-01	11.62	Sum	
m	10	115.84	3.00747E-02	53.15	Sum	
	11	276.23	7.11452E-02	25.52		
	12	285.77	1.13657E-02	65.03		
m	14	306.72	2.49448E-02	65.14		
	15	335.06	7.38985E-02	27.67	Sum	
M	17	385.77	1.65129E-01	10.47	Sum	
M	19	413.54	2.11701E-02	36.36		
m	20	418.06	2.28863E-02	41.27	Sum	
	21	437.33	7.11587E-02	14.41	Sum	
	22	452.20	6.11111E-03	64.28	Sum	

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 2007104-08

MW-2A

	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	9.55E+01	9.55E+01	-1.93E+01	4.23E+01
	CO-57	122.06		85.51	1.06E+01	1.06E+01	-2.89E+00	4.95E+00
		136.48		10.60	9.53E+01		1.16E+01	4.45E+01
	NI-59	6.92		29.80	7.99E+01	7.99E+01	-2.59E+01	3.65E+01
	MO-93	16.59		52.90	3.13E+01	3.13E+01	-1.56E+01	1.50E+01
		18.60		10.00	1.60E+02		2.01E+02	7.70E+01
	NB-93M	16.57		9.43	1.76E+02	1.76E+02	-8.75E+01	8.43E+01
	CD-109	88.03		3.72	2.12E+02	2.12E+02	-3.90E+02	9.92E+01
+	SN-113	255.12		1.93	8.53E+02	4.72E+01	-1.61E+02	3.91E+02
		391.69	*	61.90	4.72E+01		6.89E+01	2.14E+01
	SN-119M	23.87		16.10	7.36E+01	5.24E+01	-2.39E+01	3.52E+01
		25.10		22.70	5.24E+01		-2.84E+01	2.51E+01
+	I-129	29.78	*	57.00	2.84E+01	2.84E+01	5.62E+02	1.38E+01
		33.60	*	13.20	1.15E+02		5.67E+02	5.59E+01
		39.58		7.52	1.08E+02		-3.17E+00	5.10E+01
+	BA-133	81.00	*	34.06	4.36E+01	3.25E+01	4.00E+02	2.11E+01
		302.84	*	18.33	1.66E+02		4.07E+02	7.83E+01
		356.01	*	62.05	3.25E+01		5.08E+02	1.44E+01
	CE-139	165.85		80.35	1.48E+01	1.48E+01	-1.88E+00	6.90E+00
	CE-144	133.54		10.80	8.71E+01	8.71E+01	-5.40E+00	4.05E+01
	HG-203	279.19		77.30	3.43E+01	3.43E+01	2.66E+01	1.61E+01
	PB-210	46.50		4.25	1.64E+02	1.64E+02	7.98E-01	7.70E+01
	TH-231	25.64		14.70	1.16E+02	1.16E+02	-1.86E+01	5.64E+01
		84.21		6.40	3.12E+02		1.03E+03	1.52E+02
	PA-234M	9.89		89.00	2.77E+01	2.19E+01	3.83E+01	1.32E+01
		21.72		64.90	2.19E+01		2.07E+01	1.05E+01
		37.93		23.75	6.40E+01		1.13E+00	3.11E+01
		131.42		20.40	4.44E+01		-2.53E+01	2.06E+01
+	TH-234	63.29	*	3.80	6.19E+02	6.19E+02	9.17E+02	3.04E+02
	NP-237	29.37		14.00	2.60E+02	7.08E+01	1.97E+03	1.28E+02
		86.50		12.60	7.08E+01		-6.66E+02	3.34E+01
	U-237	97.08		16.30	4.74E+01	3.36E+01	-7.59E+00	2.21E+01
		101.07		26.30	3.36E+01		1.46E+01	1.57E+01
		114.00		12.30	1.34E+02		2.50E+02	6.46E+01
		208.01		22.00	8.13E+01		5.75E+00	3.82E+01
+	AM-241	59.54	*	35.90	6.55E+01	6.55E+01	9.71E+01	3.22E+01
	AM-243	74.67		66.00	1.29E+01	1.29E+01	-1.28E+02	6.11E+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

KP 9/3/20

Apex-Gamma

Analysis Report for 2007104-09
MW-2B

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 2007104-09
Sample Description	: MW-2B
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 8/3/2020 8:29:12AM
Acquisition Started	: 8/3/2020 12:39:45PM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE3
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 902.0 seconds
Dead Time	: 0.23 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 10 - 4096
Identification Energy Tolerance	: 2.500 keV
Energy Calibration Used Done On	: 6/6/2020
Efficiency Calibration Used Done On	: 10/19/2019
Efficiency Calibration Description	:
Sample Number	: 100423

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 8/3/2020 12:54:49PM

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 2007104-09

MW-2B

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	21.17	19 -	25	21.60	4.79E+01	38.58	2.38E+02	2.62
M	2	31.02	26 -	44	31.44	1.76E+03	88.74	1.79E+02	2.08
m	3	35.30	26 -	44	35.72	3.80E+02	53.54	1.15E+02	2.08
M	4	62.19	59 -	72	62.58	1.96E+02	40.97	1.52E+02	2.46
m	5	66.05	59 -	72	66.43	1.14E+02	40.92	1.41E+02	2.43
	6	81.37	77 -	87	81.73	6.87E+02	66.03	2.17E+02	1.90
M	7	108.07	106 -	128	108.40	1.87E+01	21.37	8.50E+01	2.30
m	8	112.32	106 -	128	112.64	1.89E+02	37.69	1.19E+02	2.18
	9	163.48	159 -	170	163.74	4.27E+01	41.90	1.99E+02	4.57
M	10	181.96	181 -	188	182.20	1.29E+01	10.30	2.73E+01	2.16
	11	276.81	273 -	282	276.94	4.20E+01	26.98	8.00E+01	2.05
	12	303.41	298 -	309	303.50	1.11E+02	37.52	1.21E+02	2.17
	13	333.82	331 -	338	333.88	2.50E+01	22.72	7.20E+01	1.80
	14	356.72	351 -	362	356.75	3.51E+02	43.41	6.00E+01	2.10
M	15	384.96	380 -	397	384.96	1.10E+02	29.20	2.00E+01	3.10
m	16	387.75	380 -	397	387.74	1.09E+02	29.34	9.20E+00	2.21
m	17	391.65	380 -	397	391.64	2.85E+01	24.90	3.43E+00	2.80
M	18	415.14	412 -	425	415.10	1.84E+01	10.14	9.28E+00	3.08
m	19	418.79	412 -	425	418.75	2.16E+01	17.63	1.58E+01	3.68
	20	437.70	434 -	442	437.63	6.89E+01	19.10	1.43E+01	2.20
	21	468.54	465 -	472	468.43	1.46E+01	10.39	8.74E+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 : 8/3/2020 12:54:49PM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000100125.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	21.17	4.79E+01	38.58	8.05E+00	2.25E+00	3.99E+01	3.86E+01
M	2	31.02	1.76E+03	88.74			1.76E+03	8.87E+01
m	3	35.30	3.80E+02	53.54			3.80E+02	5.35E+01
M	4	62.19	1.96E+02	40.97	1.41E+01	1.88E+00	1.82E+02	4.10E+01
m	5	66.05	1.14E+02	40.92	1.41E+01	1.88E+00	1.00E+02	4.10E+01
	6	81.37	6.87E+02	66.03			6.87E+02	6.60E+01
M	7	108.07	1.87E+01	21.37			1.87E+01	2.14E+01
m	8	112.32	1.89E+02	37.69			1.89E+02	3.77E+01

Analysis Report for 2007104-09

MW-2B

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	9	163.48	4.27E+01	41.90	7.10E-01	1.16E+00	4.20E+01	4.19E+01
M	10	181.96	1.29E+01	10.30			1.29E+01	1.03E+01
	11	276.81	4.20E+01	26.98			4.20E+01	2.70E+01
	12	303.41	1.11E+02	37.52			1.11E+02	3.75E+01
	13	333.82	2.50E+01	22.72			2.50E+01	2.27E+01
	14	356.72	3.51E+02	43.41			3.51E+02	4.34E+01
M	15	384.96	1.10E+02	29.20			1.10E+02	2.92E+01
m	16	387.75	1.09E+02	29.34			1.09E+02	2.93E+01
m	17	391.65	2.85E+01	24.90	0.00E+00	0.00E+00	2.85E+01	2.49E+01
M	18	415.14	1.84E+01	10.14			1.84E+01	1.01E+01
m	19	418.79	2.16E+01	17.63			2.16E+01	1.76E+01
	20	437.70	6.89E+01	19.10			6.89E+01	1.91E+01
	21	468.54	1.46E+01	10.39			1.46E+01	1.04E+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	0.95	255.12		1.93		
		391.69	*	61.90	2.41E+01	2.12E+01
I-129	0.86	29.78	*	57.00	2.41E+01	1.22E+00
		33.60	*	13.20	3.77E+01	5.32E+00
		39.58		7.52		
BA-133	0.99	81.00	*	34.06	3.42E+02	4.70E+01
		302.84	*	18.33	3.67E+02	1.63E+02
		356.01	*	62.05	3.16E+02	5.54E+01
CE-139	0.86	165.85	*	80.35	2.65E+01	2.75E+01
HG-203	0.86	279.19	*	77.30	3.36E+01	2.39E+01
TH-234	0.97	63.29	*	3.80	4.13E+02	9.54E+01

Analysis Report for 2007104-09

MW-2B

* = Energy line found in the spectrum.
\- = Manually added nuclide.
? = Manually edited nuclide.
@ = Energy line not used for Weighted Mean Activity
Energy Tolerance : 2.500 keV
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	0.955	2.41E+01	2.12E+01	
	I-129	0.864	2.47E+01	1.19E+00	
	BA-133	0.991	3.33E+02	3.50E+01	
	CE-139	0.866	2.65E+01	2.75E+01	
	HG-203	0.865	3.36E+01	2.39E+01	
	TH-234	0.970	4.13E+02	9.54E+01	
X	NP-237	0.742			

? = 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 2007104-09
MW-2B

UNIDENTIFIED PEAKS

Peak Locate Performed on : 8/3/2020 12:54:49PM
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	21.17	4.43207E-02	48.45	Tol.	PA-234M
m	5	66.05	1.11401E-01	20.43	Sum	
M	7	108.07	2.08077E-02	57.05		
m	8	112.32	2.10293E-01	9.96	Sum	
M	10	181.96	1.43402E-02	39.89		
	13	333.82	2.77505E-02	45.48	Sum	
M	15	384.96	1.21811E-01	13.32	Sum	
m	16	387.75	1.21106E-01	13.46	Sum	
M	18	415.14	2.04646E-02	27.52		
m	19	418.79	2.39712E-02	40.85	Sum	
	20	437.70	7.65058E-02	13.87	Sum	
	21	468.54	1.62573E-02	35.51	Sum	

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)
FE-55	5.89	24.50	6.04E-06	6.04E-06	0.00E+00	0.00E+00
CO-57	122.06	85.51	1.70E+01	1.70E+01	-3.84E+00	7.96E+00
	136.48	10.60	1.39E+02		-1.66E+01	6.43E+01
NI-59	6.92	29.80	1.80E-04	1.80E-04	7.05E-05	8.20E-05

Analysis Report for 2007104-09

MW-2B

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	MO-93	16.59		52.90	4.20E-02	4.20E-02	2.30E-03	2.00E-02
		18.60		10.00	4.57E-01		5.35E-02	2.18E-01
	NB-93M	16.57		9.43	2.34E-01	2.34E-01	1.28E-02	1.11E-01
	CD-109	88.03		3.72	2.41E+02	2.41E+02	-1.16E+02	1.13E+02
+	SN-113	255.12		1.93	9.07E+02	2.43E+01	-6.11E+01	4.10E+02
		391.69	*	61.90	2.43E+01		2.41E+01	1.10E+01
	SN-119M	23.87		16.10	9.47E-01	9.02E-01	-1.39E+00	4.53E-01
		25.10		22.70	9.02E-01		-1.96E+01	4.33E-01
+	I-129	29.78	*	57.00	1.66E+00	1.66E+00	2.41E+01	8.14E-01
		33.60	*	13.20	1.19E+01		3.77E+01	5.83E+00
		39.58		7.52	1.50E+01		-4.68E+01	7.14E+00
+	BA-133	81.00	*	34.06	3.42E+01	3.42E+01	3.42E+02	1.64E+01
		302.84	*	18.33	1.77E+02		3.67E+02	8.41E+01
		356.01	*	62.05	3.49E+01		3.16E+02	1.62E+01
+	CE-139	165.85	*	80.35	4.31E+01	4.31E+01	2.65E+01	2.07E+01
	CE-144	133.54		10.80	1.38E+02	1.38E+02	-2.23E+01	6.38E+01
+	HG-203	279.19	*	77.30	3.33E+01	3.33E+01	3.36E+01	1.56E+01
	PB-210	46.50		4.25	3.89E+01	3.89E+01	1.31E+01	1.83E+01
	TH-231	25.64		14.70	1.53E+00	1.53E+00	-3.33E+01	7.35E-01
		84.21		6.40	3.09E+02		1.03E+03	1.50E+02
	PA-234M	9.89		89.00	1.07E-03	1.07E-03	1.25E-03	5.06E-04
		21.72		64.90	1.53E-01		1.23E-01	7.31E-02
		37.93		23.75	7.08E+00		1.65E+01	3.44E+00
		131.42		20.40	7.57E+01		3.60E+01	3.52E+01
+	TH-234	63.29	*	3.80	1.90E+02	1.90E+02	4.13E+02	9.19E+01
	NP-237	29.37	*	14.00	6.78E+00	6.78E+00	9.80E+01	3.31E+00
		86.50		12.60	6.90E+01		-1.45E+01	3.24E+01
	U-237	97.08		16.30	6.45E+01	4.42E+01	-5.41E+01	3.02E+01
		101.07		26.30	4.42E+01		6.86E+00	2.07E+01
		114.00		12.30	2.12E+02		4.72E+02	1.02E+02
		208.01		22.00	1.09E+02		4.38E+00	5.07E+01
	AM-241	59.54		35.90	1.62E+01	1.62E+01	1.18E+00	7.83E+00
	AM-243	74.67		66.00	9.15E+00	9.15E+00	-6.26E-01	4.29E+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

SECTION XI

ANALYTICAL DATA (TOTAL DISSOLVED SOLIDS)

TDS / TSS Worksheet

Work Order	Run	Analysis Code	Technician
20-07104	1	TDS	MHIGHTOWER

TRetec Fraction	ERM Client ID	Filter Data: Aliquot ml	Filter Data: Filter Tare (g)	Filter Data: Filter Final (g)	Filter Data: Filter Net (g)	TDS/TSS (mg/L)	Maximum Aliq (mL)
04	MW-3A	100.0000	103.8163	106.9577	3.1414	31414.0000	3.18
05	MW-4A	100.0000	104.5198	105.5365	1.0167	10167.0000	9.84
06	MW-9B	100.0000	116.8382	117.0792	0.2410	2410.0000	41.49
07	MW-7A	100.0000	100.1115	100.4138	0.3023	3023.0000	33.08
08	MW-2A	100.0000	102.5874	103.3196	0.7322	7322.0000	13.66
09	MW-2B	100.0000	119.7156	119.9710	0.2554	2554.0000	39.15

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Technician: MH Date: 7/23/20

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

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Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
20-07104	1	TDS	liters	8/5/2020	KSALLINGS

Lab Fraction	ERM 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	MW-3A	DUP					1.0000E-01	1.0000E-01				
04	MW-3A	DO					1.0000E-01	1.0000E-01				
05	MW-4A	TRG					1.0000E-01	1.0000E-01				
06	MW-9B	TRG					1.0000E-01	1.0000E-01				
07	MW-7A	TRG					1.0000E-01	1.0000E-01				
08	MW-2A	TRG					1.0000E-01	1.0000E-01				
09	MW-2B	TRG					1.0000E-01	1.0000E-01				

Comments	

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Technician: Kenny Sas Date: 7/22/20