The results set forth herein are provided by SGS North America Inc.

e-Hardcopy 2.0
Automated Report

Technical Report for

Hydro-Environmental Technology, Inc.

8060.00 DO NOT USE Indigo-Desoto Parish, LA

SGS Job Number: LA48503X

Sampling Date: 10/08/18

Report to:

Hydro-Environmental Technology
P.O. BOX 60295
Lafayette, LA 70596
labdata@hetinc.us

ATTN: Stewart L Stover, Jr.

Total number of pages in report: **153**

Test results contained within this data package meet the requirements of the National Environmental Laboratory Accreditation Program and/or state specific certification programs as applicable.

Ron Benjamin
Lab Director

Client Service contact: Ralph Frye 337-237-4775

Certifications: LDEQ(2048), LDHH(LA150012), AR(14-045-04), AZ(AZ0805), FL(E87657), IL(200082), KY(#31), NC(487), SC(73004001), NJ(LA007), TX(T104704186-15-7), WV(257)

Sections: 1 2 3

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-1-

SGS North America Inc.

Sample Summary

Hydro-Environmental Technology, Inc.

Job No: LA48503X

8060.00 DO NOT USE Indigo-Desoto Parish, LA

Sample Number	Collected Date	Time	By	Received	Matrix Code	Type	Client Sample ID
LA48503-1	10/08/18	11:00	KC/WP	10/09/18	AQ	Water	MASON RELIEF WELL
LA48503-2	10/08/18	14:00	KC/WP	10/09/18	AQ	Water	HANSON RELIEF WELL

Subcontract Lab Data

Report of Analysis

SGS NORTH AMERICA INC.

LA48503X

STANDARD LEVEL IV
REPORT OF ANALYSIS

WORK ORDER #18-10038-OR

November 9, 2018

EBERLINE ANALYTICAL/OAK RIDGE LABORATORY
OAK RIDGE, TN

0001

TABLE OF CONTENTS

Eberline Services – Oak Ridge Laboratory

LABORATORY DATA SUPPORT CHECKLIST

MP-001-3

Eberline Services Work Order # 18-10038

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

Date for Partial	Initials	Date	Initials	Checklist Items
		10/10/18		Sample Log-In
		10-26-18		Data Compilation
		10-29-18		First Technical Data Review
		10/30/18		Second Technical Data Review
		10/31/18		Data Entry/Electronic Deliverable
		10/31/18		Case Narrative
		11/6/18		Electronic Deliverable Proof
		11/6/18		Samples Analyzed within Holding Time Yes? [X] No? [ ]
		11/6/18		QA/QC Review
				Client in Possession of Data Electronic or Hard Copy
				Invoiced by Laboratory

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

Date package approved by: _____ 11/9/18

Laboratory Manager Date

Copy No. _____

Radiochemistry Services

0003

SECTION I

CHAIN OF CUSTODY
& pH CHECK

CHAIN OF CUSTODY

REC'D OCT 10 2018

Elerline

SGS

500 Ambassador Caffery Parkway, Scott, LA 70583
Phone: 800-304-5227 Fax: 337-237-7838

FED-EX Tracking # | Bottle Order Control #

SGS Quote # | SGS Job # LA48503X

18-10038

Client / Reporting Information	Project Information	Billing Information (if different from Report to)
Company Name: SGS North America Inc.	Project Name: 8060.00 Indigo-Desoto Parish, LA	
Street Address: 500 Ambassador Caffery Parkway	Street	Company Name
City: Scott State: LA Zip: 70583	City State	Street Address
Project Contact: ralph.frye@sgs.com E-mail	Project #	City State Zip
Phone #: 800-304-5227 Fax #	Client Purchase Order #	Attention:
Sampler(s) Name(s): KC/WP Phone	Project Manager	

Requested Analysis (see TEST CODE sheet)

Matrix Codes: DW - Drinking Water; GW - Ground Water; WW - Water; SW - Surface Water; SO - Soil; SL- Sludge; SED-Sediment; OI - Oil; LIQ - Other Liquid; AIR - Air; SOL - Other Solid; WP - Wipe; FB-Field Blank; EB-Equipment Blank; RB- Rinse Blank; TB-Trip Blank

SGS Sample #	Field ID / Point of Collection	MEOH/DI Vial #	Collection Date	Collection Time	Sampled by	Matrix	# of bottles	Number of preserved Bottles: HCl	NaOH	HNO3	H2SO4	NONE	DI Water	MEOH	ENCORE	RA-226 ,RA-228 ,TDS ,	LAB USE ONLY
1	MASON RELIEF WELL		10/8/18	11:00:00 AM	KC/WP	AQ										X	
2	HANSON RELIEF WELL		10/8/18	2:00:00 PM	KC/WP	AQ										X	

Turnaround Time (Business days)

Approved By (SGS PM): / Date:

- [ ] Std. 10 Business Days
- [ ] 5 Day RUSH
- [ ] 3 Day EMERGENCY
- [ ] 2 Day EMERGENCY
- [ ] 1 Day EMERGENCY
- [X] other Due 11/13/2018

Emergency & Rush T/A data available VIA Lablink

Data Deliverable Information

- [ ] Commercial "A" (Level 1)
- [ ] Commercial "B" (Level 2)
- [ ] FULLT1 (Level 3+4)
- [ ] REDT1 (Level 3+4)
- [ ] Commercial "C" X COMMB
- [ ] TRRP
- [ ] EDD Format
- [ ] Other

Commercial "A" = Results Only

Commercial "B" = Results + QC Summary

Comments / Special Instructions

Sample Custody must be documented below each time samples change possession, including courier delivery.

Relinquished by Sampler:	Date Time:	Received By:	Relinquished By:	Date Time:	Received By:
	10/9/18	1 10-12-18 0915	2		2
3		3	4		4
Relinquished by: 5	Date Time:	Received By: 5	Custody Seal #	Intact / Not intact	Preserved where applicable	On Ice	Cooler Temp.

0005

EBERLINE SERVICES
Oak Ridge Laboratory

Internal Chain of Custody

Work Order #	18-10038
Lab Deadline	10/30/2018
Analysis	Ra226 - Level 4
Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
Use container #3 for TDS.	04	38	W1.2
	05	40	W1.2

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	10/19/18 0900
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	10/22/18 0800
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	10/22/18 0800
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	10/23/18 1050
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	ICB	10/23/18 1050
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	ICB	10/23/18 1713
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 #	18-10038
Lab Deadline	10/30/2018
Analysis	Ra228 - Level 4
Sample Matrix	Water

Comments	Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
Use container #3 for TDS.	04	38	W1.2
	05	40	W1.2

	Location (circle one)					Initials	Date
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	10/19/18 0900
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	[illegible]	10/22/18 0800
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	10/22/18 0800
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	10/23/18 1050
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KB	10/23/18 1050
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KB	10/23/18 1713
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	10/24/18 0636
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	JB	10/26/18 1035
Received by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KB	10/26/18 1036
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	KB	10/26/18 1243
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 #	18-10038
Lab Deadline	10/15/2018
Analysis	TDS - Level 4
Sample Matrix	Water

Comments

Use container #3 for TDS.

Sample Fraction	HP 210 / 270 Detector Activity	Storage Location
04	38	W1.2
05	40	W1.2

	Location (circle one)					Initials	Date
Received by	(Sample Storage)	Rough Prep	Prep	Separations	Count Room	MN	11OCT18
Relinquished by	Sample Storage	Rough Prep	Prep	Separations	Count Room	MGL	11OCT18 0930
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
18-10038
Received By
RSPENCER

FR	ClientID	# Btls	Comments	Matrix	Storage	Rec Vol Ttl	CPM Max
01	LCS	0		WA	W1.2		
02	BLANK	0		WA	W1.2		
03	DUP	0		WA	W1.2		
04	MASON RELIEF WELL	3		WA	W1.2	2.25	38
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	<2	<2	1.0000	38
			2	<2	<2	1.0000	36
			3	7	7	0.2500	32
05	HANSON RELIEF WELL	3		WA	W1.2	2.25	40
			Container Number	pH Orig	pH Final	Volume (L)	CPM
			1	<2	<2	1.0000	35
			2	<2	<2	1.0000	37
			3	7	7	0.2500	40

VEJ
10/10/18

Received by: Randolph Spencer Date: 10-10-18

MP-001, Rev 5
Effective: 11/22/02
0009

SECTION II

SAMPLE ACKNOWLEDGEMENT

Client Name	Contract/PO	Project Type	Date Received	Required Turnaround Days	Eberline Services Work Order
SGS North America Inc.	ENV	Environmental	10/10/2018	28	18-10038
Project Name	**Client WO**	**Sample Disp**	**Lab Deadline**	**Internal Deadline**	**Client Deadline**
ENV	LA48503X	W	10/30/2018	11/06/2018	11/07/2018

Internal ID	Client ID	Sample Date	Matrix	Storage	Ra226	Ra228	TDS																						Ttl
01	LCS	10/10/18	WA	W1.2	X	X	X																						3
02	BLANK	10/10/18	WA	W1.2	X	X	X																						3
03	DUP	10/10/18	WA	W1.2	X	X	X																						3
04	MASON RELIEF WELL	10/08/18 11:00	WA	W1.2	X	X	X																						3
05	HANSON RELIEF WELL	10/08/18 14:00	WA	W1.2	X	X	X																						3
																													0
																													0
																													0
																													0
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																													0
																													0
																													0
																													0
																													0
																													0
Totals Per Analysis (non QA samples)					2	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

EBERLINE SERVICES

Sample Log In Report

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

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

Invoice	Accounts Payable SGS North America Inc. 500 Ambassador Caffery Pkwy Scott, LA 70583 Voice 800-304-5227 Fax 337-237-7838	**Report Data**	Ralph Frye SGS North America Inc 500 Amb. Caffery Pkwy Scott, LA 70583 Voice 800-304-5227 Fax 337-237-7838
Contact	Ralph Frye Voice 800-304-5227 Fax 337-237-7838		

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Eberline Services – Oak Ridge Laboratory

SAMPLE RECEIPT CHECKLIST
MP-001-2

WORK ORDER # 18-10038

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: 10-10-18

SECTION III

CASE NARRATIVE

EBERLINE ANALYTICAL

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

2

EBS-OR-44561

November 9, 2018

Ralph Frye
SGS North America Inc.
500 Ambassador Caffery Parkway
Scott, LA 70583

CASE NARRATIVE
LA Certificate #05005
Work Order # 18-10038-OR

SAMPLE RECEIPT

This work order contains two water samples received 10/10/2018. Samples were analyzed for Radium-226/228 and Total Dissolved Solids.

CLIENT ID	LAB ID
MASON RELIEF WELL	18-10038-04
HANSON RELIEF WELL	18-10038-05

ANALYTICAL METHODS

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

ANALYTICAL RESULTS

Combined Standard Uncertainty is reported at 1-sigma value.

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

RADIUM-226

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

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

ANALYTICAL RESULTS CONTINUED

RADIUM-226 CONTINUED

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

Samples demonstrated acceptable results for all Radium-228 analyses. Chemical recovery was acceptable for all samples. The Radium-228 method blank demonstrated an acceptable result. Results for the Radium-228 duplicate demonstrated an acceptable relative percent difference and normalized difference. Results for the Radium-228 laboratory control sample demonstrated an acceptable percent recovery.

TOTAL DISSOLVED SOLIDS (TDS)

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

Laboratory fractions -04 and -05 (Client ID: MASON RELIEF WELL and HANSON RELIEF WELL) respectively demonstrated Total Dissolved Solids content of 636.0 and 594.0 mg/L.

CERTIFICATION OF ACCURACY

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

M.R. McDougall
Laboratory Manager

Date: 11/9/2018

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:
Ralph Frye
SGS North America Inc
500 Amb. Caffery Pkwy
Scott, LA 70583

Work Order Details:
SDG: 18-10038
Project: LA48503X
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
18-10038-01	LCS	KNOWN	10/10/18 00:00	10/10/2018	10/23/2018	18-10038	Radium-226	EPA 903.0 Modified	1.00E+01	4.60E-01			pCi/l
18-10038-01	LCS	SPIKE	10/10/18 00:00	10/10/2018	10/23/2018	18-10038	Radium-226	EPA 903.0 Modified	1.01E+01	1.40E+00	2.56E+00	2.81E-01	pCi/l
18-10038-02	MBL	BLANK	10/10/18 00:00	10/10/2018	10/23/2018	18-10038	Radium-226	EPA 903.0 Modified	1.01E-01	1.97E-01	1.98E-01	3.69E-01	pCi/l
18-10038-03	DUP	HANSON RELIEF WELL	10/08/18 14:00	10/10/2018	10/23/2018	18-10038	Radium-226	EPA 903.0 Modified	3.49E+00	7.17E-01	1.03E+00	2.60E-01	pCi/l
18-10038-04	TRG	MASON RELIEF WELL	10/08/18 11:00	10/10/2018	10/23/2018	18-10038	Radium-226	EPA 903.0 Modified	4.46E+00	7.19E-01	1.19E+00	2.42E-01	pCi/l
18-10038-05	DO	HANSON RELIEF WELL	10/08/18 14:00	10/10/2018	10/23/2018	18-10038	Radium-226	EPA 903.0 Modified	2.21E+00	4.61E-01	6.56E-01	1.80E-01	pCi/l
18-10038-01	LCS	KNOWN	10/10/18 00:00	10/10/2018	10/26/2018	18-10038	Radium-228	EPA 904.0	9.06E+00	4.62E-01			pCi/l
18-10038-01	LCS	SPIKE	10/10/18 00:00	10/10/2018	10/26/2018	18-10038	Radium-228	EPA 904.0	9.74E+00	7.57E-01	2.33E+00	8.92E-01	pCi/l
18-10038-02	MBL	BLANK	10/10/18 00:00	10/10/2018	10/26/2018	18-10038	Radium-228	EPA 904.0	2.16E-01	4.42E-01	4.45E-01	9.20E-01	pCi/l
18-10038-03	DUP	HANSON RELIEF WELL	10/08/18 14:00	10/10/2018	10/26/2018	18-10038	Radium-228	EPA 904.0	2.04E+00	5.17E-01	6.92E-01	9.03E-01	pCi/l
18-10038-04	TRG	MASON RELIEF WELL	10/08/18 11:00	10/10/2018	10/26/2018	18-10038	Radium-228	EPA 904.0	5.99E+00	6.62E-01	1.51E+00	9.16E-01	pCi/l
18-10038-05	DO	HANSON RELIEF WELL	10/08/18 14:00	10/10/2018	10/26/2018	18-10038	Radium-228	EPA 904.0	1.92E+00	5.19E-01	6.77E-01	9.15E-01	pCi/l
18-10038-04	TRG	MASON RELIEF WELL	10/08/18 11:00	10/10/2018	10/11/2018	18-10038	TDS	SM2540C	6.36E+02				mg/l
18-10038-05	TRG	HANSON RELIEF WELL	10/08/18 14:00	10/10/2018	10/11/2018	18-10038	TDS	SM2540C	5.94E+02				mg/l

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

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

SECTION V

ANALYTICAL STANDARD

Ba-6
(& 6a)

National Institute of Standards & Technology

Certificate

ORIGINAL

Standard Reference Material 4251C
Barium-133 Radioactivity Standard

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

Radiological Hazard

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

Chemical Hazard

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

Storage and Handling

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

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

Preparation

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

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

Gaithersburg, Maryland 20899
October 1994

Thomas E. Gills, Chief
Standard Reference Materials Program

*Notes and references are on pages 5 and 6.

0019

EBERLINE SERVICES

QUALITY CONTROL PROGRAM

QCP-009

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

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

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

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

Radionuclide	^{133}Barium	
Certified Activity		µCi
Certified Concentration	1.318E+01	µCi per gram

Reference Date: 9/1/1993 0:00

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

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

Dilution Instructions:

Dilution Solvent Used: 1M HCl

Dilute to a volume of 1000.00 milliliters

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

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

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

Expiration Date: April 26, 2019

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

QC Approval _____ Date: 5/8/18

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EBERLINE SERVICES

QUALITY CONTROL PROGRAM

QCP-009

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

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

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

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

Radionuclide of Interest: ^{133}Ba
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

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: April 26, 2019

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

QC Approval _____ Date: 5/8/18

0021

CERTIFICATE OF CALIBRATION
ALPHA STANDARD SOLUTION

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

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. Kuen
QUALITY CONTROL

Feb. 3, 1994
Date Signed

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

0022

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

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

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

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

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

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

Dilution Instructions: Dilution Solvent Used: 1M HNO_3

Dilute to a volume of 1000.00 milliliters

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

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

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

Expiration Date: September 10, 2019

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

QC Approval _____ Date: 9/18/18

0023

EBERLINE SERVICES

QUALITY CONTROL PROGRAM
MP 009

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

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

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

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

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

Reference Date: 2/1/1994 0:00

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

Dilution Instructions: Dilution Solvent Used: 1M HNO_3

SECONDARY VOLUMETRIC DILUTION

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

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

NOTES:

Expiration Date: 10-Sep-19

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

QC Approval _____ Date: 9/18/18

0024

ANALYTICS #411 Rec'd 2/15/06 RPrentice

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

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

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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: WM. 2-13-06

0025

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
INITIAL DILUTION
MP 009

		CURRENT DATE	2/28/2017 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	Reference Date	2/10/2006 0:00
Certified Activity	1.087E-01	µCi	
Certified Concentration		µCi per gram	

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: February 12, 2019

Recertified By _____ Date: 2/12/18

QC Approval _____ Date: 2/13/18

0026

SECTION VI

QUALITY CONTROL SAMPLE RESULTS SUMMARY

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
18-10038	Ra226	1	pCi	l	SGS North America Inc.

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-226		101.23%	25.25%	100.00%	4.60%	1.00E+01	4.60E-01	1.01E+01	2.56E+00	Ra-5b	4.40E+01	4.60E+00	5.05E-01

Matrix Spike

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

Duplicate Results

Analyte	Normalized Difference	RPD	Original Result	Original CSU	Duplicate Result	Duplicate CSU
RA-226	2.05	44.87	2.21E+00	6.56E-01	3.49E+00	1.03E+00

QC Summary

LCS Relative Bias	LCS % R		MS % R	MS ND	Rep RPD	Rep ND
1.01	OK				INV	OK

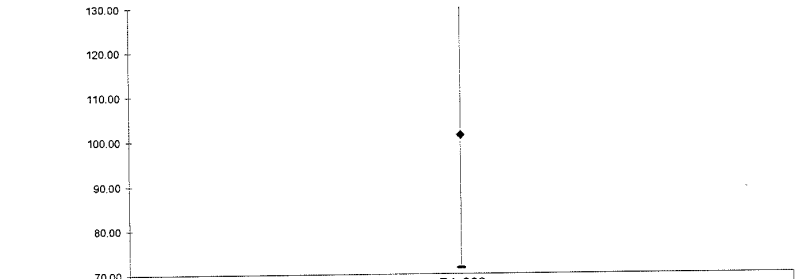
0028

Version

Eberline Analytical
Analysis Control Chart

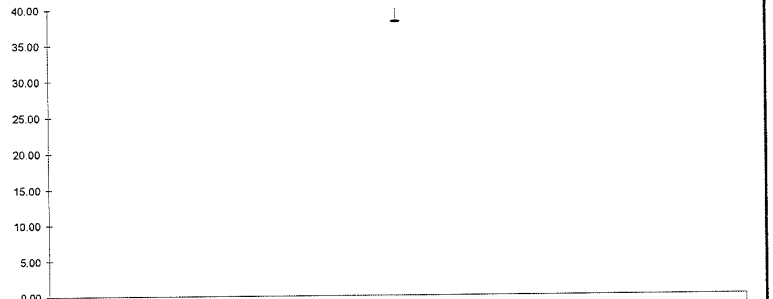
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
18-10038	Ra226	1	pCi	I	SGS North America Inc.

LCS % Recovery



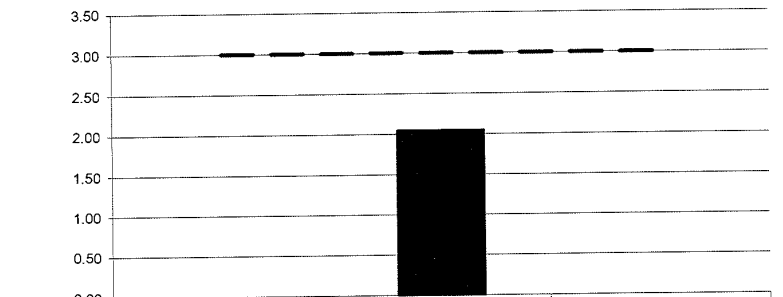
	RA-226
Lower Error	71.38
Upper Error	131.08
%R	101.23
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



	RA-226
Lower Error	51.51
Upper Error	38.24
RPD	44.87
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-226	0.00	2.05	0.00
UCL	3	3	3

No Matrix Spike

0029

Version

WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
18-10038	Ra228	1	pCi	l	SGS North America Inc.

Laboratory Control Sample

Analyte		LCS Measured	CSU Measured	LCS Expected	Uncert. Expected	Known	Known Error	Result	CSU	Standard ID	Standard ACT (dpm)	Standard Error	Standard Added (g)
RA-228		107.42%	23.94%	100.00%	5.10%	9.06E+00	4.62E-01	9.74E+00	2.33E+00	Ra-12	5.26E+01	5.10E+00	3.82E-01

Matrix Spike

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

Duplicate Results

Analyte	*Normalized Difference*	*RPD*	*Original Result*	*Original CSU*	*Duplicate Result*	*Duplicate CSU*
RA-228	0.23	5.83	1.92E+00	6.77E-01	2.04E+00	6.92E-01

QC Summary

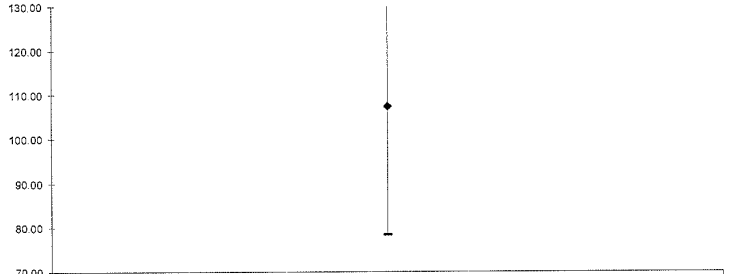
LCS Relative Bias	*LCS % R*		*MS % R*	*MS ND*	*Rep RPD*	*Rep ND*
1.07	OK				NA	OK

0030

Version

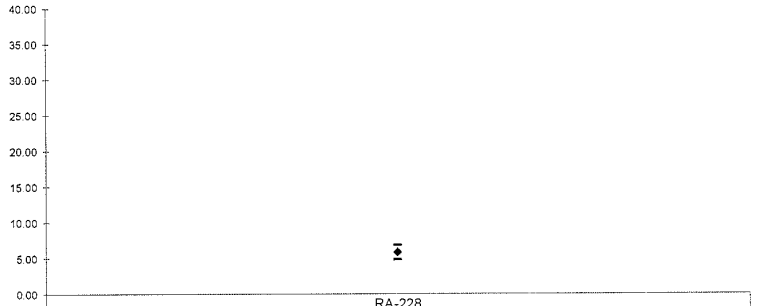
WO	Analysis	Run	Activity Units	Aliquot Units	Client Name
18-10038	Ra228	1	pCi	l	SGS North America Inc.

LCS % Recovery



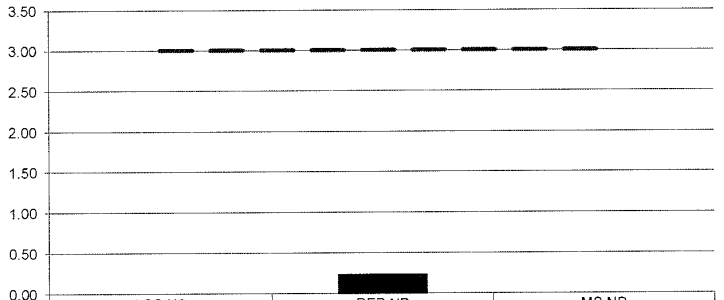
	RA-228
Lower Error	78.38
Upper Error	136.46
%R	107.42
LCL	75
Mean	100
UCL	125

Replicate Sample RPD



	RA-228
Lower Error	6.83
Upper Error	4.82
RPD	5.83
CL	35

Normalized Difference



	LCS ND	REP ND	MS ND
RA-228	0.00	0.23	0.00
UCL	3	3	3

No Matrix Spike

0031

Version

SECTION VII

LABORATORY TECHNICIAN'S NOTES

RA-226 NOTES

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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	18-10038
Analysis Code	Ra226
Run Number	1

#	Date	Dept	User	Notes
1	10/19/18 09:44	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS

J Harvey 10/19/18

0034

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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	18-10038
Analysis Code	Ra226
Run Number	1

#	Date	Dept	User	Notes
1	10/19/18 09:44	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	10/23/18 10:47	CHEM	JBAILEY	ADDED EDTA TO SAMPLES AND LET SIT. ADDED AMMONIUM SULFATE AND ACETIC ACID TO SAMPLES. FILTERED ONTO TARED FILTER PAPERS, LET DRY UNDER HEAT LAMP, REWEIGHED, AND SUBMITTED TO COUNT.

10/23/18

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EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
18-10038	
Analysis Code	Run
Ra226	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
019782P	Ammonium Hydroxide	Reagent Grade	JHARVEY	10/19/2018
020136D02	Ammonium Sulfate	200 mg/ml	JHARVEY	10/19/2018
019792D07	Barium Carrier	1 mg/ml	JHARVEY	10/19/2018
019767D02	Lead Carrier	166 mg/ml	JHARVEY	10/19/2018
020414P	Nitric Acid	Reagent Grade	JHARVEY	10/19/2018
019210P	Acetic Acid	Reagent Grade	JBAILEY	10/23/2018
019733D02	Ammonium Sulfate	200 mg/ml	JBAILEY	10/23/2018
020249S	EDTA	0.25M	JBAILEY	10/23/2018

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EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
18-10038	
Analysis Code	Run
Ra226	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
019782P	Ammonium Hydroxide	Reagent Grade	JHARVEY	10/19/2018
020136D02	Ammonium Sulfate	200 mg/ml	JHARVEY	10/19/2018
019792D07	Barium Carrier	1 mg/ml	JHARVEY	10/19/2018
019767D02	Lead Carrier	166 mg/ml	JHARVEY	10/19/2018
020414P	Nitric Acid	Reagent Grade	JHARVEY	10/19/2018
019210P	Acetic Acid	Reagent Grade	JBAILEY	10/23/2018
019733D02	Ammonium Sulfate	200 mg/ml	JBAILEY	10/23/2018
020249S	EDTA	0.25M	JBAILEY	10/23/2018

0037

Alpha 3

Date	Sample #	Client	Loadtime	Counttime	Analysis	Tech
10/22/18	1910033A(2-13)	Weston	1125	2hr50~	Th	KB
10/22/18	1810019A(1-11)	Utah Div. of Waste	1124	2hr50~	Np	KB
10/22/18	1810055A(1-13)	TBE	1115	2hr50~	Ra	KB
10/23/18	Daily Pulser	Lab	0508	10min	Na	KP
10/23/18	1810020A(3-5)	Unitech	0816	2hr50min	Pu	KP
10/23/18	1810034A(1-14)	Weston	0817	2hr50min	UU	KP
10/23/18	1810036A(1-3,5)	Unitech	0819	2hr50min	UU	KP
10/23/18	1810039A(1)	Republic Serv.	0821	2hr50min	UU	KP
10/23/18	1810020A(1-4)	Unitech	0820	2hr50min	Np	KP
10/23/18	1910036A(6)	Unitech	1116	2hr50~	Th	KB
10/23/18	1910034A(1-14)	Weston	1119	2hr50~	Th	KB
10/23/18	1810092A(1-4)	USA	1117	2hr50~	Ra	KB
10/23/18	1910039A(1-4)	Republic Serv.	1118	2hr50~	Ra	KB
10/23/18	1810038A(1-5)	Stoo N. America	1419	2hr50~	Ra	KB

RA-228 NOTES

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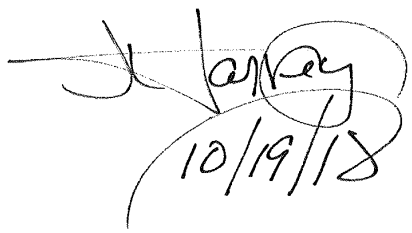
EBERLINE SERVICES

Work Order Analysis Notes

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

Internal Work Order	18-10038
Analysis Code	Ra228
Run Number	1

#	Date	Dept	User	Notes
1	10/19/18 09:45	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS



0040

2

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	18-10038
Analysis Code	Ra228
Run Number	1

#	Date	Dept	User	Notes
1	10/19/18 09:45	PREP	JHARVEY	ALIQUOTED AND ADDED SPIKES AND TRACERS- PH'D SAMPLES- PRECIPITATED WITH BA AND PB CARRIERS AND AMMONIUM SULFATE- DECANTED SAMPLES AND CENTRIFUGED- SUBMITTED RADIUM PRECIP TO SEPARATIONS
2	10/26/18 10:20	CHEM	JBAILEY	ADDED FILTER PAPERS FROM COUNT ROOM TO LABELED C-TUBES, FILLED WITH EDTA SOLUTION AND LET SIT OVERNIGHT. REMOVED FILTER FROM EDTA-ADDED 2MLS YTTRIUM 9MG/ML CARRIER ADDED 18N NAOH TO SAMPLES AND RECORDED T1. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 6N HNO3, DI WATER, AND 10N NAOH. HOT BATHED FOR 15 MIN, CENTRIFUGED AND DISCARDED SUPERNANT. ADDED 1N HNO3, DI WATER, AND AMMONIUM OXALATE. FILTERED ONTO TARED FILTER PAPERS. LET DRY UNDER HEAT LAMP, REWEIGHED AND SUBMITTED TO COUNT.

10/26/18

0041

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EBERLINE SERVICES

Reagents Used in an Analysis

Internal Work Order	
18-10038	
Analysis Code	Run
Ra228	1

Reagent ID	Reagent Name	Reagent Concentration	Analyst ID	Date Recorded
019782P	Ammonium Hydroxide	Reagent Grade	JHARVEY	10/19/2018
020136D02	Ammonium Sulfate	200 mg/ml	JHARVEY	10/19/2018
019792D07	Barium Carrier	1 mg/ml	JHARVEY	10/19/2018
019767D02	Lead Carrier	166 mg/ml	JHARVEY	10/19/2018
020414P	Nitric Acid	Reagent Grade	JHARVEY	10/19/2018
018297D01	Ammonium Oxalate	5%	JBAILEY	10/26/2018
018971D06	Nitric Acid	1N	JBAILEY	10/26/2018
019673D02	Nitric Acid	6N	JBAILEY	10/26/2018
018699D10	Sodium Hydroxide	10M	JBAILEY	10/26/2018
019344D01	Sodium Hydroxide	18M	JBAILEY	10/26/2018
019519S	Yttrium Carrier	9 mg/ml	JBAILEY	10/26/2018

0042

Aqua LB4110

Date	Sample #	Client	Load time	Count time	Analysis	Tech
10/24/18	Daily Blgd/QC	Lab	0506/0609	1hr/30min	αβ	KP
10/24/18	Cross Talk	Lab	0655	5 min	αβ	KP
10/24/18	Cross Talk	Lab	0703	5 min	αβ	KP
10/24/18	181009-4AB (7E-10E)	Auxier	0714	2hrs	αβ	KP
10/24/18	181007-7PB (1-4)	UCOR	0916	2hrs	Pb	KP
10/24/18	181007-8PB (1-3,5)	UCOR	0917	2hrs	Pb	KP
10/24/18	181009-4AB (11D-13A)	Auxier	0919	2hrs	αβ	KP
10/24/18	181009-4AB (14D-17D)	Auxier	1122	2hr	αβ	KB
10/24/18	181003-7CL (1-3,5)	UCOR	1326	30min	Cl 36	KP
10/25/18	Daily Blgd/QC	Lab	0524/0613	1hr/30min	αβ	KP
10/25/18	Cross Talk	Lab	0647	5min	αβ	KP
10/25/18	Cross Talk	Lab	0655	5min	αβ	KP
10/25/18	KPA U-12 recnts (1-5)	Lab	1111	15mins	αβ	KB
10/25/18	181005-5RA (1-13)	TBE	1405	2hr	Rad	KB
10/26/18	Daily Blgd/QC	Lab	0524/0628	1hr/30min	αβ	KP
10/26/18	Cross Talk	Lab	0702	5min	αβ	KP
10/26/18	Cross Talk	Lab	0710	5min	αβ	KP
10/26/18	181000-4AB (2-7)	New York PPE	0721	2hrs	αβ	KP
10/26/18	181009-2AB (1)	USA	0722	30min	αβ	KP
10/26/18	181009-2AB (2-5)	USA	0722	2hrs	αβ	KP
10/26/18	181000-4AB (1)	New York PPE	0757	30min	αβ	KP
10/26/18	181002-05r (1)	Unitech	0835	30min	Tot Sr	KP
10/26/18	181003-9RA (1-4)	Republic Serv.	1042	2hr	Rad	KB
				1hr		KB corrected
10/26/18	181003-8RA (1-5)	SGS N. America	1042	2hrs	Rad	KB

TDS NOTES

2

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	18-10038
Analysis Code	TDS
Run Number	1

#	Date	Dept	User	Notes
1	10/11/18 04:04	PREP	MHIGHTOWER	Filtered sample into tared beaker, dried, re-weighed

MH 11 OCT 18

SECTION VIII

ANALYTICAL DATA (RADIUM-226)

Eberline Services
Oak Ridge Laboratory
Analysis Sheet

18-10038
Ra226
Run 1

Work Order	18-10038
Analysis Code	Ra226
Run	1
Date Received	10/10/2018
Lab Deadline	10/30/2018
Client	SGS North America Inc.
Project	ENV
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)	471.61
Carrier	
Carrier Conc (mg/ml)	

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/10/18 00:00	1.0000E+00
02	MBL	BLANK		10/10/18 00:00	1.0000E+00
03	DUP	HANSON RELIEF WELL	40	10/08/18 14:00	9.8000E-01
04	TRG	MASON RELIEF WELL	38	10/08/18 11:00	1.0000E+00
05	DO	HANSON RELIEF WELL	40	10/08/18 14:00	9.8000E-01

0047

* 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.

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	2.0159	950.7	629.0	146.88		0.0206	0.0300	0.0094		110.00	3.00^	1.00
02	MBL	2.0121	948.9	585.0	136.86		0.0206	0.0321	0.0115		110.00	3.00^	1.00
03	DUP	2.0129	949.3	848.0	198.31		0.0206	0.0262	0.0056		110.00	2.00	1.00
04	TRG	2.0083	947.1	518.0	121.41		0.0208	0.0261	0.0053		110.00	1.86	1.00
05	DO	2.0107	948.3	706.0	165.28		0.0205	0.0252	0.0047		110.00	1.55	1.00

0048

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

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			10/19/18 09:24	JHARVEY	10/23/18 10:12	JBAILEY		
02	MBL			10/19/18 09:24	JHARVEY	10/23/18 10:12	JBAILEY		
03	DUP			10/19/18 09:24	JHARVEY	10/23/18 10:12	JBAILEY		
04	TRG			10/19/18 09:24	JHARVEY	10/23/18 10:12	JBAILEY		
05	DO			10/19/18 09:24	JHARVEY	10/23/18 10:12	JBAILEY		

0049

* 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.

Client: SGS North America Inc.
Eberline Analytical Work Order: 18-10038
Analysis Code: Ra226
Run: 1

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-226	LCS	LCS	pCi/l	1.01E+01	1.40E+00	2.81E-01	1.00E+01	101.23	OK		OK	
02	RA-226	MBL	BLANK	pCi/l	1.01E-01	1.97E-01	3.69E-01					OK	OK
03	RA-226	DUP	HANSON RELIEF WELL	pCi/l	3.49E+00	7.17E-01	2.60E-01				INV	OK	
04	RA-226	TRG	MASON RELIEF WELL	pCi/l	4.46E+00	7.19E-01	2.42E-01					OK	
05	RA-226	DO	HANSON RELIEF WELL	pCi/l	2.21E+00	4.61E-01	1.80E-01					OK	

Client	Eberline Analytical Work Order	Analysis Code	Run
SGS North America Inc.	18-10038	Ra226	1

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	RA-226	LCS	10/10/18 00:00	1.00E+00	100.00	0.00	110.00		10/23/2018 10:12	
02	RA-226	MBL	10/10/18 00:00	1.00E+00	100.00	0.00	110.00		10/23/2018 10:12	
03	RA-226	DUP	10/08/18 14:00	9.80E-01	100.00	0.00	110.00		10/23/2018 10:12	
04	RA-226	TRG	10/08/18 11:00	1.00E+00	100.00	0.00	110.00		10/23/2018 10:12	
05	RA-226	DO	10/08/18 14:00	9.80E-01	100.00	0.00	110.00		10/23/2018 10:12	

0054

Client: SGS North America Inc.
Eberline Analytical Work Order: 18-10038
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	10/23/18 14:18		A_Spec	Alpha_033	170	2.16 E+02	5.00 E-03	17
02	RA-226	MBL	10/23/18 14:18		A_Spec	Alpha_034	170	1.81 E+00	7.00 E-03	14.2
03	RA-226	DUP	10/23/18 14:18		A_Spec	Alpha_035	170	9.55 E+01	9.00 E-03	14.8
04	RA-226	TRG	10/23/18 14:18		A_Spec	Alpha_036	170	1.58 E+02	1.60 E-02	17.5
05	RA-226	DO	10/23/18 14:18		A_Spec	Alpha_039	170	9.31 E+01	1.10 E-02	17.6

0052

Count Room Report
Client: SGS North America Inc.

18-10038-Ra226-1 (pCi/l) in WA
Tracer ID: Ba-6a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	10/10/18 00:00	1.0000	2.0159	950.7186	629.0000	146.88	3.00^	1.00
02	MBL	BLANK	10/10/18 00:00	1.0000	2.0121	948.9265	585.0000	136.86	3.00^	1.00
03	DUP	HANSON RELIEF WELL	10/08/18 14:00	0.9800	2.0129	949.3038	848.0000	198.31	2.00	1.00
04	TRG	MASON RELIEF WELL	10/08/18 11:00	1.0000	2.0083	947.1344	518.0000	121.41	1.86	1.00
05	DO	HANSON RELIEF WELL	10/08/18 14:00	0.9800	2.0107	948.2662	706.0000	165.28	1.55	1.00

0053

Eberline Analytical
Oak Ridge Laboratory

Spike and Tracer Worksheet

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
18-10038	1	Ra226	10/19/2018 9:17	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	43.970	10/19/2018	0.500	0.5054				10.01	0.460	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	Ba-133	Ba-6a	471.610	10/19/2018	2.0159	2.1500
02	Ba-133	Ba-6a	471.610	10/19/2018	2.0121	2.1500
03	Ba-133	Ba-6a	471.610	10/19/2018	2.0129	2.1500
04	Ba-133	Ba-6a	471.610	10/19/2018	2.0083	2.1500
05	Ba-133	Ba-6a	471.610	10/19/2018	2.0107	2.1500

Balance Printer Tapes

Tracer

LCS

Matrix Spike

0054

Version 2.0 08/99

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 10/19/2018 9:41 AM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
18-10038	1	Ra226	liters	10/30/2018	JHARVEY

Lab Fraction	SGS North America Inc. Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	HANSON RELIEF WELL	DUP					9.8000E-01	9.8000E-01				
04	MASON RELIEF WELL	TRG					1.0000E+00	1.0000E+00				
05	HANSON RELIEF WELL	DO					9.8000E-01	9.8000E-01				

Comments	

0055

Technician: _____ Date: 10/19/18

Eberline Analytical - Oak Ridge
Version 1.1 10/2015

Gravimetric Worksheet

Printed: 10/23/2018 10:46 AM

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
18-10038	1	Ra226			JBAILEY

TRetec Fraction	SGS North America Inc. 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		0.0206	0.0300	**0.0094**	
02	BLANK	MBL		0.0206	0.0321	**0.0115**	
03	DUP	DUP		0.0206	0.0262	**0.0056**	
04	MASON RELIEF WELL	TRG		0.0208	0.0261	**0.0053**	
05	HANSON RELIEF WELL	DO		0.0205	0.0252	**0.0047**	

0056

Technician: JB Date: 10/23/18

KD 10/23/18

2

Apex-Alpha™

Sample Description: SPIKE
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002252
Batch Identification: 1810038A-RA
Sample Identification: 01
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_033
Chamber Serial Number: 04026479A
Detector Serial Number: 91132
Env. Background: System Bkgd 227757
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: 10/23/2018 10:50:42 AM
Acquisition Date/Time: 10/23/2018 2:18:30 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1696 +/- 0.0030 on 2/16/2018 9:34:38 AM
Effective Efficiency: 0.1696 +/- 0.0030

Control Certificate Name: Ra226_Ra-5b
Chem. Recov. of Control: RA-226 0.337435 +/- 0.025837
Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

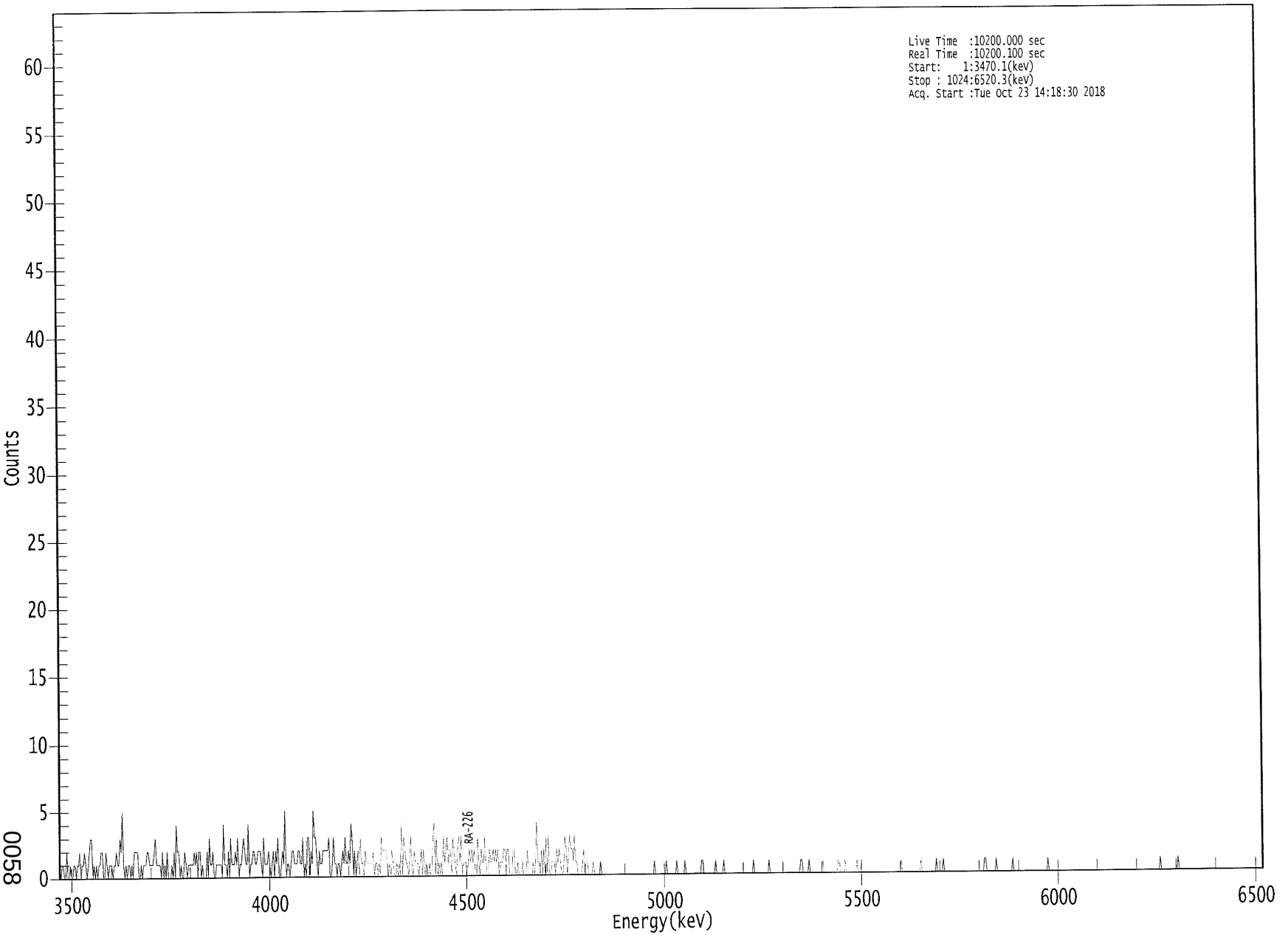
Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.499	6.64	84.69	1.36	0.00E+000	3.0
RA-226	4.509	216.15	13.36	0.85	0.00E+000	3.0

NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.955	5685.50*	3.27E-001 +/- 2.77E-001	3.38E-001 +/- 1.18E-002
RA-226	0.905	4785.00*	1.01E+001 +/- 1.40E+000	2.81E-001 +/- 9.76E-003

AG 10/24/18

0057


Live Time :10200.000 sec
Real Time :10200.100 sec
Start: 1:3470.1(keV)
Stop : 1024:6520.3(keV)
Acq. Start :Tue Oct 23 14:18:30 2018
Counts
8508
0
5
10
15
20
25
30
35
40
45
50
55
60
RA-226
3500
4000
4500
5000
5500
6000
6500
Energy(keV)
ROI Type: 1

2

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

Sample Title: 01

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

0059

369:	2	1	2	1	2	0	1	1

Sample Title: 01

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

0060

801:	0	0	0	0	0	0	0	0

Sample Title: 01

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

Apex-Alpha™

KS 10/23/18

2

Sample Description: BLANK
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002252
Batch Identification: 1810038A-RA
Sample Identification: 02
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_034
Chamber Serial Number: 04026479B
Detector Serial Number: 91136
Env. Background: System Bkgd 227758
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: 10/23/2018 10:50:42 AM
Acquisition Date/Time: 10/23/2018 2:18:32 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1418 +/- 0.0026 on 2/16/2018 9:34:36 AM
Effective Efficiency: 0.1418 +/- 0.0026

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.532	-1.02	208.15	1.02	0.00E+000	0.0
RA-226	4.572	1.81	193.78	1.19	0.00E+000	3.0

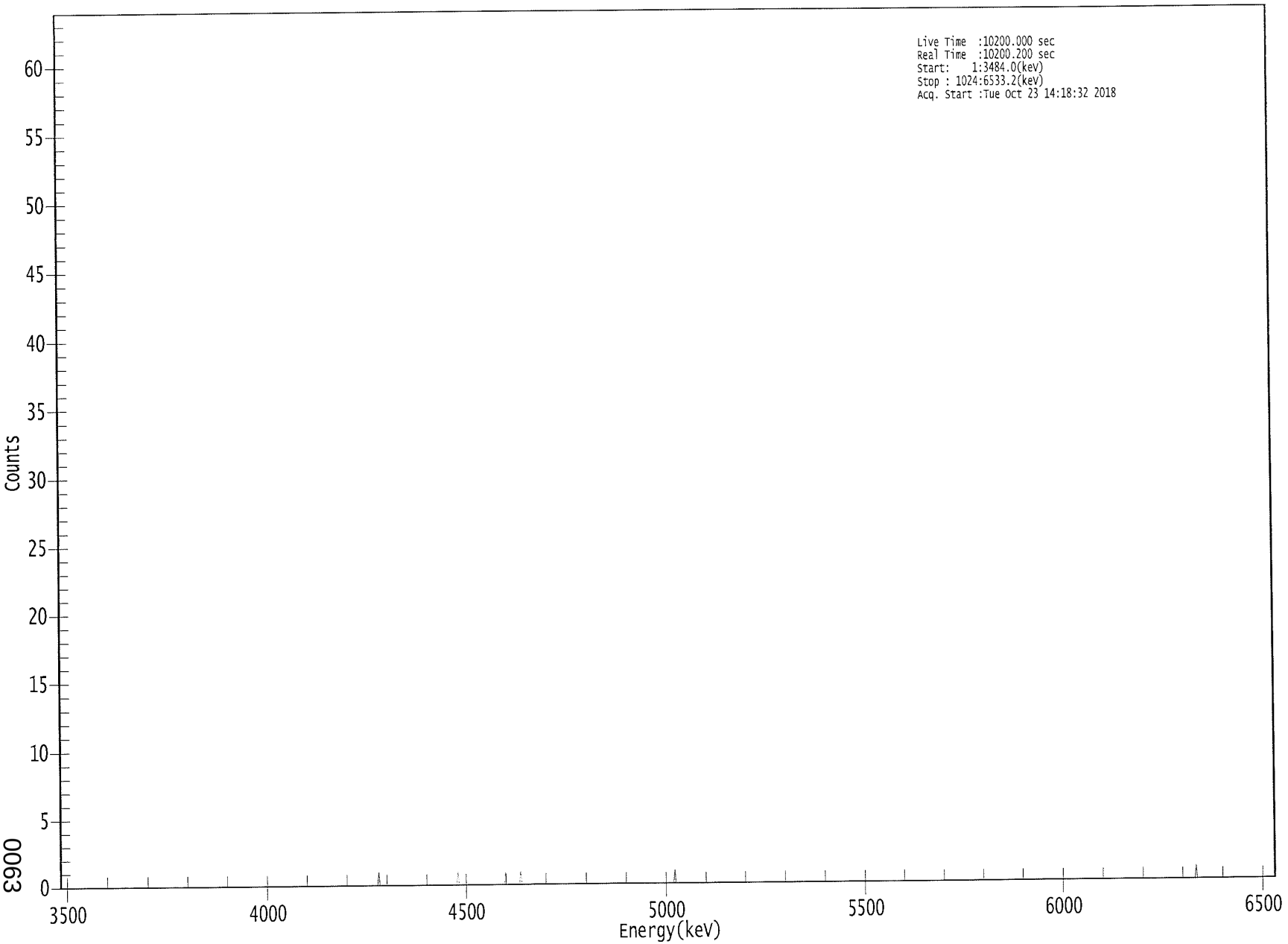
NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.970	5685.50*	-6.01E-002 +/- 1.25E-001	3.71E-001 +/- 1.32E-002
RA-226	0.942	4785.00*	1.01E-001 +/- 1.97E-001	3.69E-001 +/- 1.31E-002

AG 10/24/18

0062

0000225286.CNF



0003

LA48503X

2

2

****
***** 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	1	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	1	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

0064

369:	0	0	0	0	0	0	1	0

Sample Title: 02

Channel								
377:	0	0	0	0	0	0	0	0
385:	0	0	0	1	0	0	0	0
393:	0	0	0	0	0	0	0	0
401:	0	0	0	0	0	0	0	0
409:	0	0	0	0	0	0	0	0
417:	0	0	0	0	0	0	0	0
425:	0	0	0	0	0	0	0	0
433:	0	0	0	0	0	0	0	0
441:	0	0	0	0	0	0	0	0
449:	0	0	0	0	0	0	0	0
457:	0	0	0	0	0	0	0	0
465:	0	0	0	0	0	0	0	0
473:	0	0	0	0	0	0	0	0
481:	0	0	0	0	0	0	0	0
489:	0	0	0	0	0	0	0	0
497:	0	0	0	0	0	0	0	0
505:	0	0	0	0	0	0	0	0
513:	0	0	0	0	1	0	0	0
521:	0	0	0	0	0	0	0	0
529:	0	0	0	0	0	0	0	0
537:	0	0	0	0	0	0	0	0
545:	0	0	0	0	0	0	0	0
553:	0	0	0	0	0	0	0	0
561:	0	0	0	0	0	0	0	0
569:	0	0	0	0	0	0	0	0
577:	0	0	0	0	0	0	0	0
585:	0	0	0	0	0	0	0	0
593:	0	0	0	0	0	0	0	0
601:	0	0	0	0	0	0	0	0
609:	0	0	0	0	0	0	0	0
617:	0	0	0	0	0	0	0	0
625:	0	0	0	0	0	0	0	0
633:	0	0	0	0	0	0	0	0
641:	0	0	0	0	0	0	0	0
649:	0	0	0	0	0	0	0	0
657:	0	0	0	0	0	0	0	0
665:	0	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	1	0	0	0
961:	0	0	0	0	0	0	0	0
969:	0	0	0	0	0	0	0	0
977:	0	0	0	0	0	0	0	0
985:	0	0	0	0	0	0	0	0
993:	0	0	0	0	0	0	0	0
1001:	0	0	0	0	0	0	0	0
1009:	0	0	0	0	0	0	0	0
1017:	0	0	0	0	0	0	0	0

Apex-Alpha™

ICB 10/23/18

2

Sample Description: HANSON RELIEF WELL DUP
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002252
Batch Identification: 1810038A-RA
Sample Identification: 03
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_035
Chamber Serial Number: 04026477A
Detector Serial Number: 58771
Env. Background: System Bkgd 227759
Reagent Blank: <not performed>

Sample Size: 9.800E-001 +/- 0.000E+000 liter
Generic Mult. Factor: 2.000E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2018 10:50:42 AM
Acquisition Date/Time: 10/23/2018 2:18:26 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1479 +/- 0.0027 on 2/16/2018 9:34:34 AM
Effective Efficiency: 0.1479 +/- 0.0027

Peak Match Tolerance: 0.350 MeV

PEAK AREA REPORT

Nuclide	Energy (MeV)	Net Pk Area	Pk Area Error %	Ambient Backgnd	Reagent Backgnd	FWHM (keV)
RA-224	5.542	59.47	25.80	1.53	0.00E+000	3.7
RA-226	4.592	95.47	20.25	1.53	0.00E+000	3.7

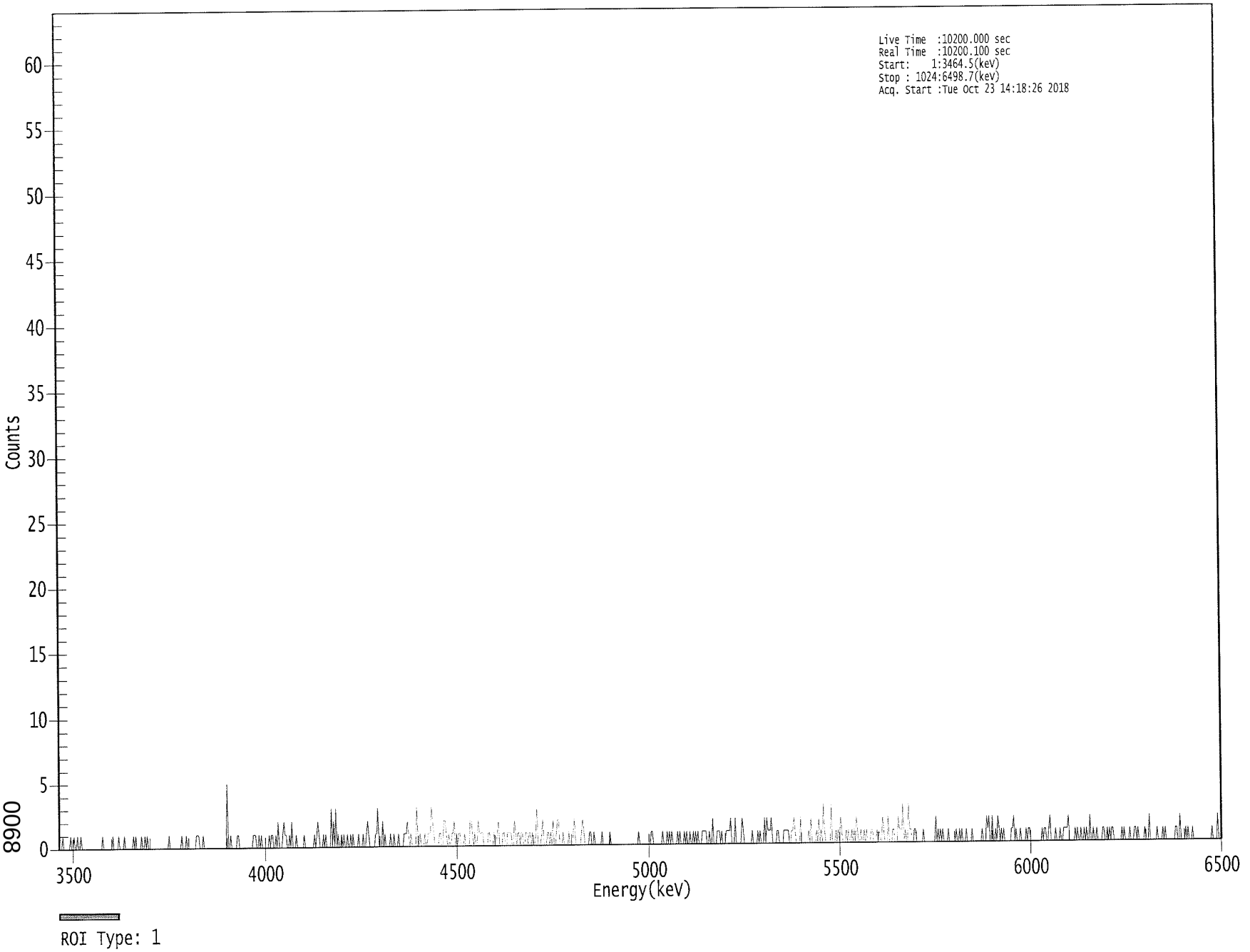
NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.973	5685.50*	2.30E+000 +/- 5.98E-001	2.75E-001 +/- 9.71E-003
RA-226	0.953	4785.00*	3.49E+000 +/- 7.17E-001	2.60E-001 +/- 9.17E-003

AG
10/24/18

0067

0000225288.CNF



2

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

0069

369:	2	1	1	1	1	0	0	0

Sample Title: 03

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

0070

801:	0	0	0	1	0	0	0	0

Sample Title: 03

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

KB 10/23/18

2

Apex-Alpha™

Sample Description: MASON RELIEF WELL
Spectrum File: \\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002252
Batch Identification: 1810038A-RA
Sample Identification: 04
Sample Geometry: Shelf 2
Procedure Description: Ra

Detector Name: Alpha_036
Chamber Serial Number: 04026477B
Detector Serial Number: 84167
Env. Background: System Bkgd 227760
Reagent Blank: <not performed>

Sample Size: 1.000E+000 +/- 0.000E+000 liter
Generic Mult. Factor: 1.860E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time: 10/8/2018 10:50:42 AM
Acquisition Date/Time: 10/23/2018 2:18:28 PM
Acquisition Live Time: 170.0 minutes
Acquisition Real Time: 170.0 minutes

Chem. Recovery Factor: 1.0000 +/- 0.0000
Counting Efficiency: 0.1748 +/- 0.0031 on 2/16/2018 9:34:33 AM
Effective Efficiency: 0.1748 +/- 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	5.537	94.81	20.28	1.19	0.00E+000	4.0
RA-226	4.578	158.28	15.73	2.72	0.00E+000	3.4

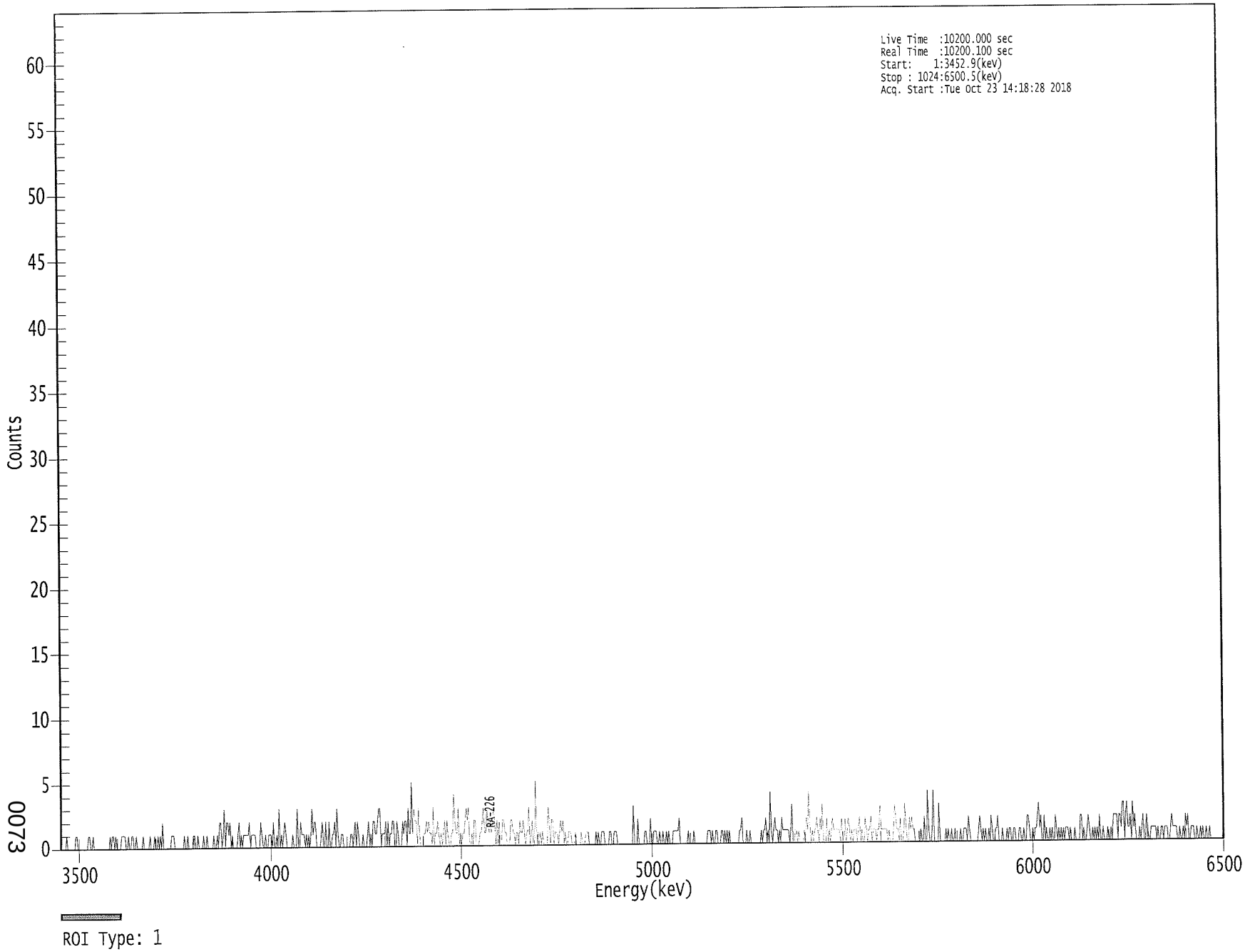
NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.972	5685.50*	2.83E+000 +/- 5.81E-001	1.96E-001 +/- 6.77E-003
RA-226	0.945	4785.00*	4.46E+000 +/- 7.19E-001	2.42E-001 +/- 8.33E-003

AG 10/24/18

0072

0000225289.CNF



2

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

Sample Title: 04

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

0074

369:	1	1	2	3	1	1	3	2

Sample Title: 04

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

0075

801:	0	0	0	0	0	0	0	1

Sample Title: 04

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

Apex-Alpha™

Sample Description:	HANSON RELIEF WELL
Spectrum File:	\\OR-ALPHA1\Canberra\ApexAlpha\Root\Data\00002253
Batch Identification:	1810038A-RA
Sample Identification:	05
Sample Geometry:	Shelf 2
Procedure Description:	Ra
Detector Name:	Alpha_039
Chamber Serial Number:	06027396A
Detector Serial Number:	83109
Env. Background:	System Bkgd 227761
Reagent Blank:	<not performed>
Sample Size:	9.800E-001 +/- 0.000E+000 liter
Generic Mult. Factor:	1.550E+000 Generic Div. Factor: 1.000E+000
Sample Date/Time:	10/8/2018 10:50:42 AM
Acquisition Date/Time:	10/23/2018 2:18:35 PM
Acquisition Live Time:	170.0 minutes
Acquisition Real Time:	170.0 minutes
Chem. Recovery Factor:	1.0000 +/- 0.0000
Counting Efficiency:	0.1765 +/- 0.0031 on 2/16/2018 9:34:28 AM
Effective Efficiency:	0.1765 +/- 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	5.543	23.81	41.33	1.19	0.00E+000	3.0
RA-226	4.594	93.13	20.55	1.87	0.00E+000	3.5

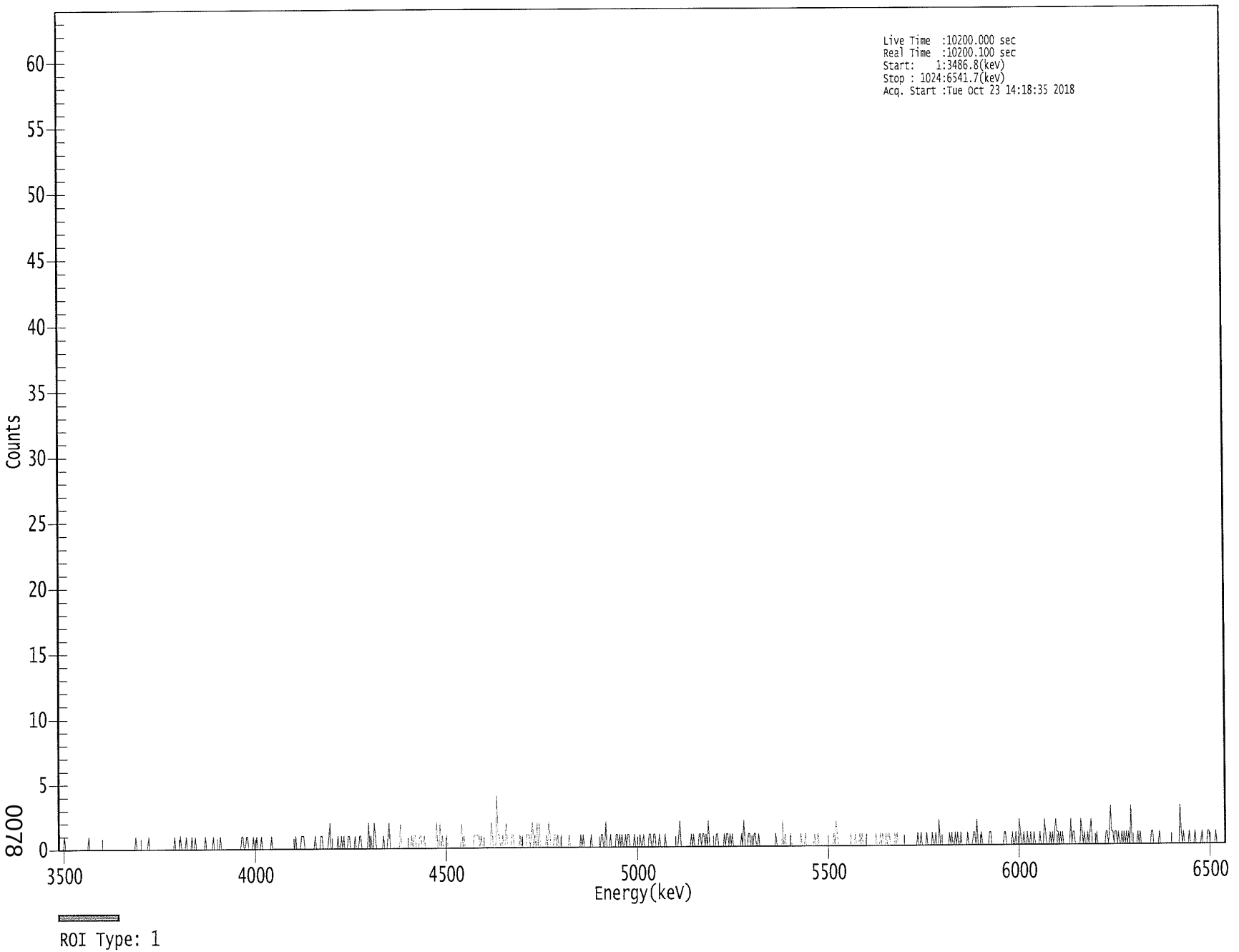
NUCLIDE ANALYSIS RESULTS

Nuclide	Id Conf.	Energy (keV)	Activity (pCi/liter)	MDA (pCi/liter)
RA-224	0.974	5685.50*	5.97E-001 +/- 2.48E-001	1.65E-001 +/- 5.70E-003
RA-226	0.953	4785.00*	2.21E+000 +/- 4.61E-001	1.80E-001 +/- 6.19E-003

AG
10/24/18

0077

0000225287.CNF



ROI Type: 1

2

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

Sample Title: 05

Elapsed Live time: 10200
Elapsed Real Time: 10200

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

0079

369:	1	0	1	0	0	0	0	0

Sample Title: 05

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

0080

801:	0	0	1	1	0	2	0	0

Sample Title: 05

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

10/23/2018 5:37:26 AM

Apex-Alpha™

2

QA SUMMARY REPORT

Review Of QA Results - Pulser Check

Date : 10/23/2018
Time : 5:37:26 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_001	21f	ALL	Not Done	
Alpha_002	21f	ALL	Not Done	
Alpha_003	21f	ALL	Passed	10/23/2018 5:06:49 AM
Alpha_004	21f	ALL	Passed	10/23/2018 5:06:50 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	Not Done	
Alpha_011	21f	ALL	Passed	10/23/2018 5:06:50 AM
Alpha_012	21f	ALL	Passed	10/23/2018 5:06:51 AM
Alpha_013	21f	ALL	Not Done	
Alpha_014	21f	ALL	Passed	10/23/2018 5:06:52 AM
Alpha_015	21f	ALL	Passed	10/23/2018 5:06:53 AM
Alpha_016	21f	ALL	Not Done	
Alpha_033	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:06:54 AM
Alpha_034	Alpha Analyst100DC	Peak Energy	Action	10/23/2018 5:06:56 AM
Alpha_035	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:06:57 AM
Alpha_036	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:06:59 AM
Alpha_037	Alpha Analyst100DC	ALL	Not Done	
Alpha_038	Alpha Analyst100DC	ALL	Not Done	
Alpha_039	Alpha Analyst100DC	Peak FWHM	Action	10/23/2018 5:07:01 AM
Alpha_040	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:03 AM
Alpha_041	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:05 AM
Alpha_042	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:07 AM
Alpha_043	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:09 AM
Alpha_044	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:11 AM
Alpha_045	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:14 AM
Alpha_046	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:16 AM
Alpha_047	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:19 AM
Alpha_048	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:21 AM
Alpha_049	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:24 AM
Alpha_050	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:27 AM
Alpha_051	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:30 AM
Alpha_052	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:33 AM
Alpha_053	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:36 AM
Alpha_054	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:38 AM
Alpha_055	Alpha Analyst100DC	Peak FWHM	Action	10/23/2018 5:07:41 AM
Alpha_056	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:44 AM
Alpha_057	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:46 AM
Alpha_058	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:49 AM

10/23/2018 5:37:26 AM

CHAMBER	DEVICE	PARAMETER	FLAG	DATE
Alpha_059	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:52 AM
Alpha_060	Alpha Analyst100DC	ALL	Passed	10/23/2018 5:07:55 AM

2

APPROVED BY: KP

APPROVAL DATE: 10/23/18

0083

2

****
***** 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

0084

SECTION IX

ANALYTICAL DATA (RADIUM-228)

Work Order	18-10038
Analysis Code	Ra228
Run	1
Date Received	10/10/2018
Lab Deadline	10/30/2018
Client	SGS North America Inc.
Project	ENV
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)	471.61
Carrier	
Carrier Conc (mg/ml)	

0086

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/10/18 00:00	1.0000E+00
02	MBL	BLANK		10/10/18 00:00	1.0000E+00
03	DUP	HANSON RELIEF WELL	40	10/08/18 14:00	9.8000E-01
04	TRG	MASON RELIEF WELL	38	10/08/18 11:00	1.0000E+00
05	DO	HANSON RELIEF WELL	40	10/08/18 14:00	9.8000E-01

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

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	2.0159	950.7	629.0	146.88						110.00		
02	MBL	2.0121	948.9	585.0	136.86						110.00		
03	DUP	2.0129	949.3	848.0	198.31						110.00		
04	TRG	2.0083	947.1	518.0	121.41						110.00		
05	DO	2.0107	948.3	706.0	165.28						110.00		

0087

* 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.

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			10/19/18 09:43	JHARVEY	10/23/18 10:12	JBAILEY		
02	MBL			10/19/18 09:43	JHARVEY	10/23/18 10:12	JBAILEY		
03	DUP			10/19/18 09:43	JHARVEY	10/23/18 10:12	JBAILEY		
04	TRG			10/19/18 09:43	JHARVEY	10/23/18 10:12	JBAILEY		
05	DO			10/19/18 09:43	JHARVEY	10/23/18 10:12	JBAILEY		

0088

* 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.

Eberline Analytical
Oak Ridge Laboratory
Analysis Sheet

18-10038
Ra228
Run 1

Work Order	18-10038
Analysis Code	Ra228
Run	1
Date Received	10/10/2018
Lab Deadline	10/30/2018
Client	SGS North America Inc.
Project	ENV
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)	471.02
Carrier	Yttrium
Carrier Conc (mg/ml)	30.05

Internal Fraction	Sample Desc	Client ID	Login CPM	Sample Date	Sample Aliquot
01	LCS	LCS		10/10/18 00:00	1.0000E+00
02	MBL	BLANK		10/10/18 00:00	1.0000E+00
03	DUP	HANSON RELIEF WELL	40	10/08/18 14:00	9.8000E-01
04	TRG	MASON RELIEF WELL	38	10/08/18 11:00	1.0000E+00
05	DO	HANSON RELIEF WELL	40	10/08/18 14:00	9.8000E-01

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

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	2.0159	949.5	629.0	147.06	2.000	0.0831	0.1374	0.0543	90.35	99.38	1.00	1.00
02	MBL	2.0121	947.7	585.0	137.03	2.000	0.0826	0.1345	0.0519	86.36	94.99	1.00	1.00
03	DUP	2.0129	948.1	848.0	198.56	2.000	0.0834	0.1366	0.0532	88.52	97.37	1.00	1.00
04	TRG	2.0083	945.9	518.0	121.57	2.000	0.0826	0.1362	0.0536	89.18	98.10	1.00	1.00
05	DO	2.0107	947.1	706.0	165.49	2.000	0.0831	0.1371	0.0540	89.85	98.84	1.00	1.00

0090

* 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.

Internal Fraction	Sample Desc	Rough Prep Date	Rough Prep By	Prep Date	Prep By	Sep t0 Date/Time	Sep t0 By	Sep t1 Date/Time	Sep t1 By
01	LCS			10/26/18 08:30	JBAILEY	10/23/18 10:12	JBAILEY	10/26/18 09:01	JBAILEY
02	MBL			10/26/18 08:30	JBAILEY	10/23/18 10:12	JBAILEY	10/26/18 09:01	JBAILEY
03	DUP			10/26/18 08:30	JBAILEY	10/23/18 10:12	JBAILEY	10/26/18 09:01	JBAILEY
04	TRG			10/26/18 08:30	JBAILEY	10/23/18 10:12	JBAILEY	10/26/18 09:01	JBAILEY
05	DO			10/26/18 08:30	JBAILEY	10/23/18 10:12	JBAILEY	10/26/18 09:01	JBAILEY

0091

* 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.

Client	Eberline Analytical Work Order	Analysis Code	Run
SGS North America Inc.	18-10038	Ra228	1

Lab Fraction	Nuclide	Sample Desc	Client Identification	Activity Units	Results	Error Estimate	MDA	LCS Known	LCS %R	LCS Flag	RPD Flag	MDA Flag	Blank Flag
01	RA-228	LCS	LCS	pCi/l	9.74E+00	7.57E-01	8.92E-01	9.06E+00	107.42	OK		OK	
02	RA-228	MBL	BLANK	pCi/l	2.16E-01	4.42E-01	9.20E-01					OK	OK
03	RA-228	DUP	HANSON RELIEF WELL	pCi/l	2.04E+00	5.17E-01	9.03E-01				NA	OK	
04	RA-228	TRG	MASON RELIEF WELL	pCi/l	5.99E+00	6.62E-01	9.16E-01					OK	
05	RA-228	DO	HANSON RELIEF WELL	pCi/l	1.92E+00	5.19E-01	9.15E-01					OK	

Run	Analysis Code	Eberline Analytical Work Order	Client
1	Ra228	18-10038	SGS North America Inc.

Lab Fraction	Nuclide	Sample Desc	Sample Date	Sample Aliquot	Radiometric % Rec	Grav % Rec	Mean % Rec	SAF	Sep t0 Date/Time	Sep t1 Date/Time
01	RA-228	LCS	10/10/18 00:00	1.00E+00	147.06	90.35	99.38	1.00	10/23/2018 10:12	10/26/2018 9:01
02	RA-228	MBL	10/10/18 00:00	1.00E+00	137.03	86.36	94.99	1.00	10/23/2018 10:12	10/26/2018 9:01
03	RA-228	DUP	10/08/18 14:00	9.80E-01	198.56	88.52	97.37	1.00	10/23/2018 10:12	10/26/2018 9:01
04	RA-228	TRG	10/08/18 11:00	1.00E+00	121.57	89.18	98.10	1.00	10/23/2018 10:12	10/26/2018 9:01
05	RA-228	DO	10/08/18 14:00	9.80E-01	165.49	89.85	98.84	1.00	10/23/2018 10:12	10/26/2018 9:01

Client	Eberline Analytical Work Order	Analysis Code	Run
SGS North America Inc.	18-10038	Ra228	1

Lab Fraction	Nuclide	Sample Desc	Counting Date/Time	Halflife (days)	Detect	Carrier	Count Time	Counts	Bkg CPM	Eff
01	RA-228	LCS	10/26/18 10:42		LB4110A	A1	120	1113	1.666666667	0.4803
02	RA-228	MBL	10/26/18 10:42		LB4110A	A2	120	207	1.566666667	0.4724
03	RA-228	DUP	10/26/18 10:42		LB4110A	A3	120	362	1.516666667	0.4719
04	RA-228	TRG	10/26/18 10:42		LB4110A	B2	120	737	1.633333333	0.4691
05	RA-228	DO	10/26/18 10:42		LB4110A	B3	120	338	1.45	0.449

Count Room Report
Client: SGS North America Inc.

18-10038-Ra228-1 (pCi/l) in WA
Tracer ID: Ba-6a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	10/10/18 00:00	1.0000	2.0159	949.5292	629.0000	147.06	1.00	1.00
02	MBL	BLANK	10/10/18 00:00	1.0000	2.0121	947.7393	585.0000	137.03	1.00	1.00
03	DUP	HANSON RELIEF WELL	10/08/18 14:00	0.9800	2.0129	948.1162	848.0000	198.56	1.00	1.00
04	TRG	MASON RELIEF WELL	10/08/18 11:00	1.0000	2.0083	945.9495	518.0000	121.57	1.00	1.00
05	DO	HANSON RELIEF WELL	10/08/18 14:00	0.9800	2.0107	947.0799	706.0000	165.49	1.00	1.00

0095

Count Room Report
Client: SGS North America Inc.

18-10038-Ra228-1 (pCi/l) in WA
Tracer ID: Ba-6a

Internal Fraction	Sample Desc	Client ID	Sample Date	Sample Aliquot	Tracer Aliquot (g)	Tracer ACT (dpm)	Radiometric Tracer (pCi)	Radiometric % Rec	SAF 1*	SAF 2*
01	LCS	LCS	10/10/18 00:00	1.0000	2.0159	950.7186	629.0000	146.88		
02	MBL	BLANK	10/10/18 00:00	1.0000	2.0121	948.9265	585.0000	136.86		
03	DUP	HANSON RELIEF WELL	10/08/18 14:00	0.9800	2.0129	949.3038	848.0000	198.31		
04	TRG	MASON RELIEF WELL	10/08/18 11:00	1.0000	2.0083	947.1344	518.0000	121.41		
05	DO	HANSON RELIEF WELL	10/08/18 14:00	0.9800	2.0107	948.2662	706.0000	165.28		

9006

Eberline Analytical
Oak Ridge Laboratory

Spike and Tracer Worksheet

Internal Work Order	Run	Analysis Code	Date	Technician	Technician Initials	Witness Initials
18-10038	1	Ra228	10/26/2018 8:30	JBAILEY	JB	

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	52.640	10/26/2018	0.380	0.3823				9.06	0.462	0.00	0.000	0.00	0.000	0.00	0.000

Tracers

fraction	Isotope	Sol #	Activity dpm/g	Solution Date	Volume Used (g)	Approx Addition
01	Ba-133	Ba-6a	471.020	10/26/2018	2.0159	2.1500
02	Ba-133	Ba-6a	471.020	10/26/2018	2.0121	2.1500
03	Ba-133	Ba-6a	471.020	10/26/2018	2.0129	2.1500
04	Ba-133	Ba-6a	471.020	10/26/2018	2.0083	2.1500
05	Ba-133	Ba-6a	471.020	10/26/2018	2.0107	2.1500

Balance Printer Tapes

Tracer

LCS

Matrix Spike

0097

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 10/19/2018 9:42 AM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
18-10038	1	Ra228	liters	10/30/2018	JHARVEY

Lab Fraction	SGS North America Inc. Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS					1.0000E+00	1.0000E+00				
02	BLANK	MBL					1.0000E+00	1.0000E+00				
03	HANSON RELIEF WELL	DUP					9.8000E-01	9.8000E-01				
04	MASON RELIEF WELL	TRG					1.0000E+00	1.0000E+00				
05	HANSON RELIEF WELL	DO					9.8000E-01	9.8000E-01				

Comments	

0098

Technician: _____ Date: 10/19/18

Eberline Analytical - Oak Ridge
Version 1.1 10/2015

Gravimetric Worksheet

Printed: 10/26/2018 10:17 AM

Work Order	Run	Analysis Code	Gravimetric Carrier	Carrier Conc (mg/ml)	Technician
18-10038	1	Ra228	Yttrium	30.0500	JBAILEY

TRetec Fraction	SGS North America Inc. 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	2.0000	0.0831	0.1374	0.0543	90.35
02	BLANK	MBL	2.0000	0.0826	0.1345	0.0519	86.36
03	DUP	DUP	2.0000	0.0834	0.1366	0.0532	88.52
04	MASON RELIEF WELL	TRG	2.0000	0.0826	0.1362	0.0536	89.18
05	HANSON RELIEF WELL	DO	2.0000	0.0831	0.1371	0.0540	89.85

0099

Technician: _____ Date: 10/26/18

Detector ID	Sample ID	Alpha	Beta	Count Time	Voltage	TOD
A1	1810038-01	66	1113	120	1410	10/26/2018 10:42:34 AM
A2	1810038-02	23	207	120	1410	10/26/2018 10:42:35 AM
A3	1810038-03	18	362	120	1410	10/26/2018 10:42:35 AM
B2	1810038-04	26	737	120	1410	10/26/2018 10:42:35 AM
B3	1810038-05	11	338	120	1410	10/26/2018 10:42:35 AM

0100

GPC Detector Report
(ALL Backgrounds)

KP
10/26/18

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2017	10/26/2018	1.67E-01	P	-3.64E-02	9.59E-02	2.28E-01
LB4110A - A2	Alpha	11/2/2017	10/26/2018	1.50E-01	P	-4.79E-02	9.80E-02	2.44E-01
LB4110A - A3	Alpha	11/2/2017	10/26/2018	1.67E-01	P	-3.24E-02	1.06E-01	2.44E-01
LB4110A - A4	Alpha	11/2/2017	10/26/2018	2.17E-01	P	-3.03E-02	9.34E-02	2.17E-01
LB4110A - B1	Alpha	11/2/2017	10/26/2018	2.50E-01	P	-3.57E-02	1.15E-01	2.66E-01
LB4110A - B2	Alpha	11/2/2017	10/26/2018	1.33E-01	P	-1.76E-02	1.20E-01	2.58E-01
LB4110A - B3	Alpha	11/2/2017	10/26/2018	8.33E-02	P	-5.29E-02	8.12E-02	2.15E-01
LB4110A - B4	Alpha	11/2/2017	10/26/2018	6.67E-02	P	-3.88E-02	7.98E-02	1.98E-01
LB4110A - C1	Alpha	11/2/2017	10/26/2018	1.00E-01	P	-2.24E-02	8.76E-02	1.98E-01
LB4110A - C2	Alpha	11/2/2017	10/26/2018	6.67E-02	P	-4.04E-02	6.05E-02	1.61E-01
LB4110A - C3	Alpha	11/2/2017	10/26/2018	5.00E-02	P	-5.51E-02	6.88E-02	1.93E-01
LB4110A - C4	Alpha	11/2/2017	10/26/2018	1.33E-01	P	-3.29E-02	8.23E-02	1.97E-01
LB4110A - D1	Alpha	11/2/2017	10/26/2018	2.17E-01	P	-3.10E-02	1.39E-01	3.09E-01
LB4110A - D2	Alpha	11/2/2017	10/26/2018	1.50E-01	P	-1.70E-02	1.26E-01	2.69E-01
LB4110A - D3	Alpha	11/2/2017	10/26/2018	1.17E-01	P	-4.11E-02	1.06E-01	2.53E-01
LB4110A - D4	Alpha	11/2/2017	10/26/2018	1.67E-01	P	-1.76E-02	1.48E-01	3.13E-01
LB4110A - E1	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-4.29E-02	1.10E-01	2.62E-01
LB4110A - E2	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-3.09E-02	6.37E-02	1.58E-01
LB4110A - E3	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-8.81E-02	9.11E-02	2.70E-01
LB4110A - E4	Alpha	11/2/2017	3/23/2018	0.00E+00	P	-4.55E-02	7.04E-02	1.86E-01
LB4110A - F1	Alpha	11/2/2017	10/26/2018	6.67E-02	P	-4.11E-02	7.33E-02	1.88E-01
LB4110A - F2	Alpha	11/2/2017	10/26/2018	5.00E-02	P	-3.27E-02	5.03E-02	1.33E-01
LB4110A - F3	Alpha	11/2/2017	10/26/2018	5.00E-02	P	-5.13E-02	6.14E-02	1.74E-01
LB4110A - F4	Alpha	11/2/2017	10/26/2018	1.00E-01	P	-3.31E-02	7.15E-02	1.76E-01
LB4110A - G1	Alpha	11/2/2017	10/26/2018	6.67E-02	P	-4.52E-02	6.12E-02	1.68E-01
LB4110A - G2	Alpha	11/2/2017	10/26/2018	8.33E-02	P	-4.22E-02	7.63E-02	1.95E-01
LB4110A - G3	Alpha	11/2/2017	10/26/2018	6.67E-02	P	-4.24E-02	8.26E-02	2.08E-01
LB4110A - G4	Alpha	11/2/2017	10/26/2018	8.33E-02	P	-3.43E-02	8.39E-02	2.02E-01

0101

GPC Detector Report
(ALL Backgrounds)

KP
10/26/18

Detector	Alpha/Beta	Calibration Date	Count Date	Bkg CPM	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2017	10/26/2018	1.67E+00	P	8.59E-01	1.37E+00	1.89E+00
LB4110A - A2	Beta	11/2/2017	10/26/2018	1.57E+00	P	9.24E-01	1.51E+00	2.10E+00
LB4110A - A3	Beta	11/2/2017	10/26/2018	1.52E+00	P	1.03E+00	1.51E+00	1.99E+00
LB4110A - A4	Beta	11/2/2017	10/26/2018	1.80E+00	P	9.53E-01	1.42E+00	1.88E+00
LB4110A - B1	Beta	11/2/2017	10/26/2018	1.55E+00	P	1.05E+00	1.54E+00	2.02E+00
LB4110A - B2	Beta	11/2/2017	10/26/2018	1.63E+00	P	6.82E-01	1.52E+00	2.36E+00
LB4110A - B3	Beta	11/2/2017	10/26/2018	1.45E+00	P	9.11E-01	1.36E+00	1.81E+00
LB4110A - B4	Beta	11/2/2017	10/26/2018	1.28E+00	P	7.34E-01	1.36E+00	1.99E+00
LB4110A - C1	Beta	11/2/2017	10/26/2018	1.33E+00	P	8.28E-01	1.26E+00	1.69E+00
LB4110A - C2	Beta	11/2/2017	10/26/2018	9.83E-01	P	-3.46E-01	1.25E+00	2.85E+00
LB4110A - C3	Beta	11/2/2017	10/26/2018	1.98E+00	P	9.82E-01	1.81E+00	2.64E+00
LB4110A - C4	Beta	11/2/2017	10/26/2018	1.55E+00	P	7.88E-01	1.23E+00	1.67E+00
LB4110A - D1	Beta	11/2/2017	10/26/2018	1.27E+00	P	8.60E-01	1.32E+00	1.78E+00
LB4110A - D2	Beta	11/2/2017	10/26/2018	1.62E+00	P	-2.19E-01	1.64E+00	3.51E+00
LB4110A - D3	Beta	11/2/2017	10/26/2018	1.18E+00	P	7.76E-01	1.27E+00	1.77E+00
LB4110A - D4	Beta	11/2/2017	10/26/2018	1.53E+00	P	9.48E-01	1.44E+00	1.94E+00
LB4110A - E1	Beta	11/2/2017	3/23/2018	3.33E-02	P	7.66E-01	1.32E+00	1.88E+00
LB4110A - E2	Beta	11/2/2017	3/23/2018	1.67E-02	P	5.45E-01	9.58E-01	1.37E+00
LB4110A - E3	Beta	11/2/2017	3/23/2018	6.67E-02	P	4.98E-01	1.20E+00	1.91E+00
LB4110A - E4	Beta	11/2/2017	3/23/2018	0.00E+00	P	5.67E-01	1.04E+00	1.50E+00
LB4110A - F1	Beta	11/2/2017	10/26/2018	1.13E+00	P	6.96E-01	1.33E+00	1.97E+00
LB4110A - F2	Beta	11/2/2017	10/26/2018	1.03E+00	P	3.92E-01	8.84E-01	1.38E+00
LB4110A - F3	Beta	11/2/2017	10/26/2018	1.15E+00	P	-2.28E-02	1.19E+00	2.39E+00
LB4110A - F4	Beta	11/2/2017	10/26/2018	1.17E+00	P	4.77E-01	1.12E+00	1.76E+00
LB4110A - G1	Beta	11/2/2017	10/26/2018	1.00E+00	P	6.45E-01	1.34E+00	2.04E+00
LB4110A - G2	Beta	11/2/2017	10/26/2018	2.33E+00	P	1.07E+00	1.81E+00	2.55E+00
LB4110A - G3	Beta	11/2/2017	10/26/2018	1.42E+00	P	7.37E-01	1.47E+00	2.21E+00
LB4110A - G4	Beta	11/2/2017	10/26/2018	1.25E+00	P	5.67E-01	1.45E+00	2.34E+00

0102

GPC Detector Report
(ALL Efficiencies)

KP
10/26/18

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Alpha	11/2/2017	10/26/2018	0.2244	P	0.2141	0.2253	0.2364
LB4110A - A2	Alpha	11/2/2017	10/26/2018	0.2141	P	0.1972	0.2113	0.2254
LB4110A - A3	Alpha	11/2/2017	10/26/2018	0.1993	P	0.1837	0.1994	0.2151
LB4110A - A4	Alpha	11/2/2017	10/26/2018	0.2245	P	0.2067	0.2259	0.2450
LB4110A - B1	Alpha	11/2/2017	10/26/2018	0.2276	P	0.2044	0.2232	0.2420
LB4110A - B2	Alpha	11/2/2017	10/26/2018	0.2026	P	0.1839	0.2005	0.2172
LB4110A - B3	Alpha	11/2/2017	10/26/2018	0.2433	P	0.2181	0.2346	0.2511
LB4110A - B4	Alpha	11/2/2017	10/26/2018	0.2327	P	0.2041	0.2217	0.2392
LB4110A - C1	Alpha	11/2/2017	10/26/2018	0.2043	P	0.1951	0.2072	0.2193
LB4110A - C2	Alpha	11/2/2017	10/26/2018	0.2164	P	-0.0857	0.2235	0.5326
LB4110A - C3	Alpha	11/2/2017	10/26/2018	0.2419	P	0.2299	0.2424	0.2549
LB4110A - C4	Alpha	11/2/2017	10/26/2018	0.2172	P	0.1990	0.2147	0.2304
LB4110A - D1	Alpha	11/2/2017	10/26/2018	0.2207	P	0.2101	0.2216	0.2331
LB4110A - D2	Alpha	11/2/2017	10/26/2018	0.2485	P	0.2323	0.2506	0.2689
LB4110A - D3	Alpha	11/2/2017	10/26/2018	0.2488	P	0.2345	0.2495	0.2645
LB4110A - D4	Alpha	11/2/2017	10/26/2018	0.1899	P	0.1765	0.1954	0.2143
LB4110A - E1	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1687	0.2258	0.2830
LB4110A - E2	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1518	0.2051	0.2584
LB4110A - E3	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1547	0.2075	0.2603
LB4110A - E4	Alpha	11/2/2017	3/23/2018	0.0000	F	0.1747	0.2355	0.2963
LB4110A - F1	Alpha	11/2/2017	10/26/2018	0.2098	P	0.1364	0.2099	0.2835
LB4110A - F2	Alpha	11/2/2017	10/26/2018	0.1859	P	0.1287	0.1807	0.2327
LB4110A - F3	Alpha	11/2/2017	10/26/2018	0.2344	P	0.1643	0.2335	0.3028
LB4110A - F4	Alpha	11/2/2017	10/26/2018	0.2121	P	0.1448	0.2068	0.2688
LB4110A - G1	Alpha	11/2/2017	10/26/2018	0.1909	P	0.1829	0.1974	0.2118
LB4110A - G2	Alpha	11/2/2017	10/26/2018	0.2021	P	0.1912	0.2014	0.2115
LB4110A - G3	Alpha	11/2/2017	10/26/2018	0.2167	P	0.2076	0.2228	0.2381
LB4110A - G4	Alpha	11/2/2017	10/26/2018	0.1812	W	0.1772	0.1967	0.2163

0103

Eberline Analytical
Oak Ridge Laboratory

GPC Detector Report
(ALL Efficiencies)

Printed: 10/26/2018 7:06 AM

KP
10/26/18

Detector	Alpha/Beta	Calibration Date	Count Date	Eff	PFW	LCL	Mean	UCL
LB4110A - A1	Beta	11/2/2017	10/26/2018	0.5398	P	0.5108	0.5371	0.5635
LB4110A - A2	Beta	11/2/2017	10/26/2018	0.4699	P	0.4178	0.4641	0.5104
LB4110A - A3	Beta	11/2/2017	10/26/2018	0.4781	P	0.4374	0.4786	0.5198
LB4110A - A4	Beta	11/2/2017	10/26/2018	0.5434	P	0.5004	0.5411	0.5817
LB4110A - B1	Beta	11/2/2017	10/26/2018	0.5451	P	0.5006	0.5404	0.5802
LB4110A - B2	Beta	11/2/2017	10/26/2018	0.5069	P	0.4637	0.4996	0.5356
LB4110A - B3	Beta	11/2/2017	10/26/2018	0.5965	P	0.5458	0.5827	0.6197
LB4110A - B4	Beta	11/2/2017	10/26/2018	0.5699	P	0.5017	0.5445	0.5873
LB4110A - C1	Beta	11/2/2017	10/26/2018	0.4768	P	0.4447	0.4791	0.5136
LB4110A - C2	Beta	11/2/2017	10/26/2018	0.5156	P	0.4911	0.5178	0.5444
LB4110A - C3	Beta	11/2/2017	10/26/2018	0.5993	P	0.5689	0.6000	0.6310
LB4110A - C4	Beta	11/2/2017	10/26/2018	0.5152	P	0.4827	0.5234	0.5642
LB4110A - D1	Beta	11/2/2017	10/26/2018	0.6337	P	0.6158	0.6405	0.6652
LB4110A - D2	Beta	11/2/2017	10/26/2018	0.6427	P	0.5896	0.6419	0.6942
LB4110A - D3	Beta	11/2/2017	10/26/2018	0.6412	P	0.6008	0.6406	0.6804
LB4110A - D4	Beta	11/2/2017	10/26/2018	0.5004	P	0.4641	0.5031	0.5422
LB4110A - E1	Beta	11/2/2017	3/23/2018	0.0436	F	0.4162	0.5409	0.6655
LB4110A - E2	Beta	11/2/2017	3/23/2018	0.0428	F	0.3730	0.4913	0.6097
LB4110A - E3	Beta	11/2/2017	3/23/2018	0.0551	F	0.3852	0.4994	0.6137
LB4110A - E4	Beta	11/2/2017	3/23/2018	0.0569	F	0.4534	0.5890	0.7247
LB4110A - F1	Beta	11/2/2017	10/26/2018	0.5381	P	0.4013	0.5266	0.6519
LB4110A - F2	Beta	11/2/2017	10/26/2018	0.4667	P	0.3906	0.4547	0.5189
LB4110A - F3	Beta	11/2/2017	10/26/2018	0.6113	P	0.4475	0.6035	0.7596
LB4110A - F4	Beta	11/2/2017	10/26/2018	0.5260	P	0.4101	0.5249	0.6397
LB4110A - G1	Beta	11/2/2017	10/26/2018	0.4561	P	0.4327	0.4563	0.4798
LB4110A - G2	Beta	11/2/2017	10/26/2018	0.4749	P	0.4632	0.4840	0.5048
LB4110A - G3	Beta	11/2/2017	10/26/2018	0.5111	P	0.5017	0.5387	0.5757
LB4110A - G4	Beta	11/2/2017	10/26/2018	0.4395	W	0.4276	0.4792	0.5308

0104

SECTION X

BARIUM-133 ANALYTICAL TRACER DATA

Apex-Gamma

Analysis Report for 1810038-01
SPIKE

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1810038-01
Sample Description	: SPIKE
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 10/23/2018 12:49:33PM
Acquisition Started	: 10/23/2018 10:53:49AM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE1
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.4 seconds
Dead Time	: 0.04 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 19 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 6/16/2018
Efficiency Calibration Used Done On	: 2/17/2018
Efficiency Calibration Description	:
Sample Number	: 73379

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 10/23/2018 11:08:52AM

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)

0106

Analysis Report for 1810038-01

SPIKE

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	28.42	26 -	40	28.80	1.01E+02	56.98	3.75E+02	2.48
m	2	30.90	26 -	40	31.28	2.88E+03	115.56	3.02E+02	1.69
m	3	35.21	26 -	40	35.59	7.39E+02	96.98	3.13E+02	2.18
	4	52.94	48 -	56	53.31	4.60E+01	49.92	3.54E+02	1.73
M	5	61.87	58 -	74	62.23	2.94E+02	47.91	2.28E+02	2.00
m	6	66.15	58 -	74	66.52	1.88E+02	50.10	2.35E+02	2.44
	7	81.08	76 -	86	81.45	1.14E+03	92.30	5.29E+02	1.96
	8	87.63	87 -	91	88.00	4.32E+01	34.19	2.08E+02	1.21
	9	94.92	92 -	100	95.28	5.49E+01	43.20	2.46E+02	5.21
	10	102.86	101 -	106	103.22	2.72E+01	29.65	1.56E+02	1.28
M	11	111.87	108 -	120	112.22	2.32E+02	43.68	1.84E+02	1.91
m	12	116.31	108 -	120	116.67	4.38E+01	36.00	2.08E+02	1.92
	13	133.71	131 -	137	134.06	2.73E+01	28.08	1.25E+02	3.91
m	14	148.90	140 -	152	149.25	2.73E+01	28.06	1.05E+02	2.37
	15	207.36	205 -	210	207.69	2.38E+01	27.20	1.24E+02	1.83
M	16	276.60	271 -	288	276.92	8.81E+01	24.29	4.20E+01	2.07
m	17	283.69	271 -	288	284.00	1.51E+01	16.31	4.20E+01	2.07
M	18	303.15	298 -	315	303.46	2.35E+02	34.23	4.99E+01	2.05
m	19	307.95	298 -	315	308.25	3.66E+01	32.19	5.90E+01	2.78
	20	333.82	330 -	337	334.12	7.36E+01	30.33	1.05E+02	1.39
m	21	356.27	350 -	368	356.57	7.47E+02	57.25	5.19E+01	1.84
m	22	361.06	350 -	368	361.36	3.69E+01	48.75	9.56E+01	3.11
	23	377.21	374 -	380	377.50	1.44E+01	17.53	4.53E+01	1.81
M	24	384.08	381 -	399	384.37	1.58E+02	29.97	3.41E+01	2.14
m	25	387.08	381 -	399	387.37	2.35E+02	40.87	2.99E+01	2.14
m	26	391.62	381 -	399	391.91	5.05E+01	23.11	2.53E+01	2.15
M	27	414.98	411 -	431	415.26	4.87E+01	21.13	3.50E+01	2.38
m	28	418.31	411 -	431	418.59	3.03E+01	21.21	3.00E+01	2.11
m	29	422.62	411 -	431	422.91	1.20E+01	18.40	3.50E+01	2.38
M	30	437.27	431 -	447	437.55	1.20E+02	24.19	1.55E+01	2.16
m	31	443.66	431 -	447	443.94	9.24E+00	11.54	1.44E+01	2.40
	32	467.50	462 -	471	467.77	2.28E+01	13.96	1.44E+01	2.21
M	33	507.92	507 -	515	508.18	4.91E+00	3.61	1.88E+00	2.01
	34	563.65	561 -	567	563.90	1.00E+01	6.32	0.00E+00	1.66
	35	585.35	583 -	588	585.60	5.00E+00	4.47	0.00E+00	1.24
	36	609.64	607 -	612	609.88	1.29E+01	9.06	6.13E+00	1.66
	37	700.93	698 -	704	701.15	5.50E+00	7.78	7.00E+00	1.02

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 : 10/23/2018 11:08:52AM

Analysis Report for 1810038-01

SPIKE

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000072210.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	28.42	1.01E+02	56.98			1.01E+02	5.70E+01
m	2	30.90	2.88E+03	115.56			2.88E+03	1.16E+02
m	3	35.21	7.39E+02	96.98			7.39E+02	9.70E+01
	4	52.94	4.60E+01	49.92			4.60E+01	4.99E+01
M	5	61.87	2.94E+02	47.91			2.94E+02	4.79E+01
m	6	66.15	1.88E+02	50.10			1.88E+02	5.01E+01
	7	81.08	1.14E+03	92.30			1.14E+03	9.23E+01
	8	87.63	4.32E+01	34.19	1.23E+00	5.97E-01	4.20E+01	3.42E+01
	9	94.92	5.49E+01	43.20			5.49E+01	4.32E+01
	10	102.86	2.72E+01	29.65			2.72E+01	2.96E+01
M	11	111.87	2.32E+02	43.68			2.32E+02	4.37E+01
m	12	116.31	4.38E+01	36.00			4.38E+01	3.60E+01
	13	133.71	2.73E+01	28.08			2.73E+01	2.81E+01
m	14	148.90	2.73E+01	28.06			2.73E+01	2.81E+01
	15	207.36	2.38E+01	27.20			2.38E+01	2.72E+01
M	16	276.60	8.81E+01	24.29			8.81E+01	2.43E+01
m	17	283.69	1.51E+01	16.31			1.51E+01	1.63E+01
M	18	303.15	2.35E+02	34.23			2.35E+02	3.42E+01
m	19	307.95	3.66E+01	32.19			3.66E+01	3.22E+01
	20	333.82	7.36E+01	30.33			7.36E+01	3.03E+01
m	21	356.27	7.47E+02	57.25			7.47E+02	5.72E+01
m	22	361.06	3.69E+01	48.75			3.69E+01	4.87E+01
	23	377.21	1.44E+01	17.53			1.44E+01	1.75E+01
M	24	384.08	1.58E+02	29.97			1.58E+02	3.00E+01
m	25	387.08	2.35E+02	40.87			2.35E+02	4.09E+01
m	26	391.62	5.05E+01	23.11			5.05E+01	2.31E+01
M	27	414.98	4.87E+01	21.13			4.87E+01	2.11E+01
m	28	418.31	3.03E+01	21.21			3.03E+01	2.12E+01
m	29	422.62	1.20E+01	18.40			1.20E+01	1.84E+01
M	30	437.27	1.20E+02	24.19			1.20E+02	2.42E+01
m	31	443.66	9.24E+00	11.54			9.24E+00	1.15E+01
	32	467.50	2.28E+01	13.96			2.28E+01	1.40E+01
M	33	507.92	4.91E+00	3.61			4.91E+00	3.61E+00
	34	563.65	1.00E+01	6.32			1.00E+01	6.32E+00
	35	585.35	5.00E+00	4.47			5.00E+00	4.47E+00
	36	609.64	1.29E+01	9.06	2.15E+00	1.11E+00	1.08E+01	9.12E+00
	37	700.93	5.50E+00	7.78			5.50E+00	7.78E+00

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

0108

Analysis Report for 1810038-01
SPIKE

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
CD-109	0.99	88.03	*	3.72	2.79E+02	2.30E+02
SN-113	0.97	255.12		1.93		
		391.69	*	61.90	2.99E+01	1.39E+01
I-125	0.99	35.49	*	6.49	7.15E+00	9.39E-01
BA-133	0.99	30.80	*	97.60	5.54E-01	2.22E-02
		302.84	*	17.80	1.04E+03	4.78E+02
		356.01	*	60.00	6.29E+02	8.39E+01
CE-144	0.99	133.54	*	10.80	2.28E+02	2.60E+02
PA-231	1.00	9.28		42.00		
		10.11		20.20		
		283.67	*	1.60	8.55E+02	1.02E+03
		302.67	*	2.30	8.04E+03	3.70E+03
TH-234	0.94	63.29	*	3.80	3.26E+02	5.36E+01
NP-237	0.96	29.37	*	14.00	5.95E-02	3.35E-02
		86.50	*	12.60	8.24E+01	6.80E+01

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

INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
CD-109	0.995	2.79E+02	2.30E+02	

0109

2

Analysis Report for 1810038-01

SPIKE

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.971	2.99E+01	1.39E+01	
	I-125	0.998	7.15E+00	9.39E-01	
X	I-129	0.744			
	BA-133	0.999	5.54E-01	2.22E-02	
	CE-144	0.999	2.28E+02	2.60E+02	
	PA-231	1.000	1.36E+03	9.82E+02	
	TH-234	0.941	3.26E+02	5.36E+01	
	NP-237	0.968	5.95E-02	3.35E-02	

? = 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

0110

Analysis Report for 1810038-01

SPIKE

UNIDENTIFIED PEAKS

Peak Locate Performed on : 10/23/2018 11:08:52AM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	4	52.94	5.10812E-02	54.29		
m	6	66.15	2.08698E-01	13.34	Sum	
	7	81.08	1.26607E+00	4.05		
	9	94.92	6.10112E-02	39.34		
	10	102.86	3.02116E-02	54.52		
M	11	111.87	2.57628E-01	9.42		
m	12	116.31	4.86919E-02	41.07	Sum	
m	14	148.90	3.02807E-02	51.49	Sum	
	15	207.36	2.64083E-02	57.23		
M	16	276.60	9.78530E-02	13.79		
m	19	307.95	4.07094E-02	43.93		
	20	333.82	8.17387E-02	20.62	Sum	
m	22	361.06	4.10466E-02	65.98		
	23	377.21	1.59610E-02	61.01		
M	24	384.08	1.75085E-01	9.51	Sum	
m	25	387.08	2.61278E-01	8.69	Sum	
M	27	414.98	5.40997E-02	21.70		
m	28	418.31	3.37157E-02	34.95	Sum	
m	29	422.62	1.32944E-02	76.88	Sum	
M	30	437.27	1.32998E-01	10.10	Sum	
m	31	443.66	1.02612E-02	62.50	Sum	
	32	467.50	2.53519E-02	30.60		
M	33	507.92	5.46056E-03	36.68		
	34	563.65	1.11111E-02	31.62		
	35	585.35	5.55556E-03	44.72	Sum	
	36	609.64	1.19861E-02	42.28		
	37	700.93	6.11111E-03	70.71		

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

0111

Analysis Report for 1810038-01

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	1.90E-13	1.90E-13	0.00E+00	0.00E+00
	CO-57	122.06		85.51	3.99E+01	3.99E+01	-1.41E+00	1.88E+01
		136.48		10.60	3.57E+02		3.69E+01	1.66E+02
	NI-59	6.92		29.80	2.77E-12	2.77E-12	0.00E+00	0.00E+00
	MO-93	16.59		52.90	8.46E-06	8.46E-06	-1.79E-05	3.79E-06
		18.60		10.00	5.21E-04		2.55E-04	2.51E-04
	NB-93M	16.57		9.43	4.67E-05	4.67E-05	-9.90E-05	2.09E-05
+	CD-109	88.03	*	3.72	3.64E+02	3.64E+02	2.79E+02	1.73E+02
+	SN-113	255.12		1.93	2.09E+03	3.17E+01	-2.09E+01	9.67E+02
		391.69	*	61.90	3.17E+01		2.99E+01	1.50E+01
	SN-119M	23.87		16.10	7.13E-03	7.13E-03	7.44E-03	3.45E-03
		25.10		22.70	7.85E-03		2.94E-03	3.79E-03
+	I-125	35.49	*	6.49	1.38E+00	1.38E+00	7.15E+00	6.76E-01
	I-129	29.78	*	57.00	4.67E-02	4.67E-02	9.48E-01	2.29E-02
		33.60		13.20	6.23E-01		-2.17E+00	3.07E-01
		39.58		7.52	1.48E+00		3.19E-01	7.07E-01
+	BA-133	30.80	*	97.60	2.73E-02	2.73E-02	5.54E-01	1.34E-02
		302.84	*	17.80	2.83E+02		1.04E+03	1.36E+02
		356.01	*	60.00	5.84E+01		6.29E+02	2.81E+01
	CE-139	165.85		80.35	6.50E+01	6.50E+01	2.18E+01	3.04E+01
+	CE-144	133.54	*	10.80	3.81E+02	3.81E+02	2.28E+02	1.79E+02
	HG-203	279.19		77.30	5.68E+01	5.68E+01	2.17E+01	2.68E+01
	PB-210	46.50		4.25	5.99E+00	5.99E+00	-8.26E-01	2.80E+00
+	PA-231	9.28		42.00	2.61E-10	2.61E-10	0.00E+00	0.00E+00
		10.11		20.20	2.08E-09		0.00E+00	0.00E+00
		283.67	*	1.60	3.40E+03		8.55E+02	1.62E+03
		302.67	*	2.30	2.19E+03		8.04E+03	1.05E+03
	TH-231	25.64		14.70	1.40E-02	1.40E-02	1.55E-03	6.73E-03
		84.21		6.40	2.36E+02		-1.89E+03	1.14E+02
	PA-234M	9.89		89.00	3.36E-10	3.36E-10	0.00E+00	0.00E+00
		21.72		64.90	7.13E-04		1.77E-03	3.47E-04
		37.93		23.75	5.66E-01		1.13E+00	2.76E-01
		131.42		20.40	1.61E+02		-1.13E+02	7.45E+01
+	TH-234	63.29	*	3.80	1.39E+02	1.39E+02	3.26E+02	6.81E+01
+	NP-237	29.37	*	14.00	8.43E-02	8.43E-02	5.95E-02	4.14E-02
		86.50	*	12.60	1.07E+02		8.24E+01	5.11E+01
	U-237	97.08		16.30	1.08E+02	7.23E+01	1.63E+01	5.09E+01
		101.07		26.30	7.23E+01		-1.69E+01	3.40E+01
		114.00		12.30	4.32E+02		8.78E+02	2.09E+02
		208.01		22.00	2.49E+02		1.09E+02	1.17E+02
	AM-241	59.54		35.90	7.54E+00	7.54E+00	7.11E+00	3.64E+00
	AM-243	74.67		66.00	9.01E+00	9.01E+00	-5.37E+00	4.26E+00

0112

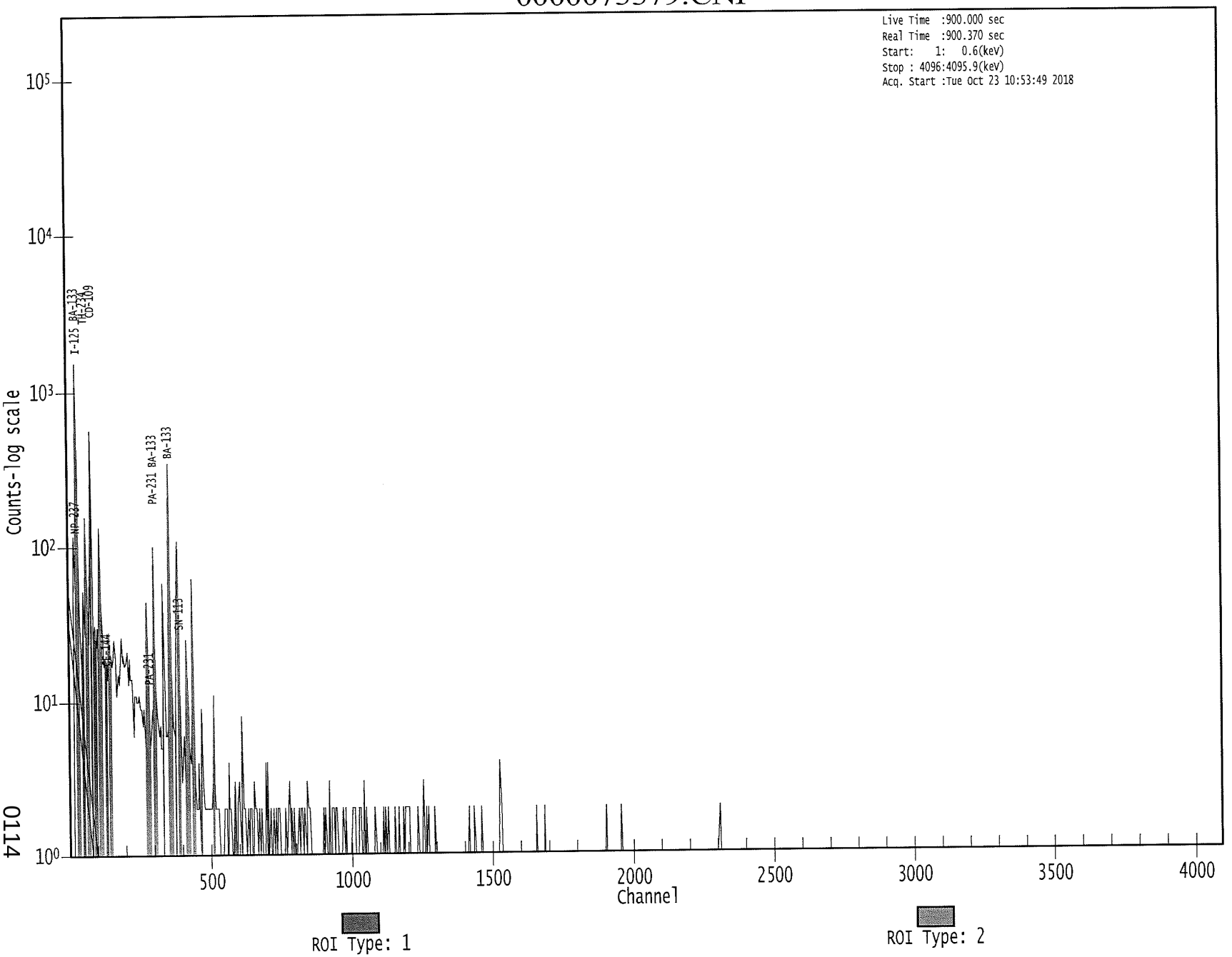
Analysis Report for 1810038-01

SPIKE

+ = 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

0113

0000073379.CNF



0114

LA48503X

2

KS 10/23/18

2

Apex-Gamma

Analysis Report for 1810038-02
BLANK

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1810038-02
Sample Description	: BLANK
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 10/23/2018 12:49:39PM
Acquisition Started	: 10/23/2018 10:53:55AM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE2
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 900.3 seconds
Dead Time	: 0.03 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 28 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/17/2018
Efficiency Calibration Used Done On	: 2/24/2018
Efficiency Calibration Description	:
Sample Number	: 73380

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 10/23/2018 11:09:08AM

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)

0115

Analysis Report for 1810038-02

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	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	35.75	35 -	40	35.53	5.28E+02	86.03	5.34E+02	2.48
	2	53.39	51 -	57	53.16	6.31E+01	38.10	2.14E+02	2.19
	3	62.23	59 -	64	62.00	1.82E+02	43.27	2.30E+02	1.20
	4	81.39	76 -	85	81.15	1.09E+03	81.34	3.25E+02	1.43
M	5	112.08	108 -	119	111.82	1.40E+02	34.56	1.22E+02	1.50
m	6	116.18	108 -	119	115.92	3.18E+01	27.10	1.28E+02	1.51
	7	141.17	135 -	147	140.90	4.21E+01	45.81	2.26E+02	7.01
	8	276.70	272 -	280	276.37	9.12E+01	28.84	7.16E+01	1.71
	9	290.28	287 -	293	289.94	1.46E+01	14.63	2.87E+01	3.50
M	10	303.09	298 -	310	302.74	2.38E+02	33.47	3.73E+01	1.56
m	11	307.43	298 -	310	307.08	2.71E+01	16.61	5.28E+01	1.69
	12	333.85	329 -	336	333.49	5.60E+01	25.14	6.79E+01	1.80
	13	356.24	351 -	362	355.87	7.32E+02	59.80	7.20E+01	1.39
	14	385.64	380 -	389	385.26	2.69E+02	39.10	6.32E+01	4.41
	15	391.67	390 -	395	391.29	3.89E+01	17.55	2.22E+01	1.72
M	16	414.55	407 -	423	414.15	1.42E+01	12.16	2.13E+01	1.65
m	17	419.25	407 -	423	418.85	1.61E+01	13.26	1.23E+01	1.66
	18	437.08	432 -	442	436.67	4.93E+01	24.63	5.33E+01	1.98
	19	467.91	463 -	469	467.49	1.10E+01	11.88	1.81E+01	1.67
	20	484.59	479 -	487	484.16	1.36E+01	10.61	8.89E+00	2.26
	21	555.43	552 -	557	554.96	5.50E+00	6.08	3.00E+00	1.84
	22	650.61	647 -	652	650.09	6.56E+00	6.40	2.88E+00	2.65

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 : 10/23/2018 11:09:08AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000072211.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	35.75	5.28E+02	86.03			5.28E+02	8.60E+01
	2	53.39	6.31E+01	38.10			6.31E+01	3.81E+01
	3	62.23	1.82E+02	43.27			1.82E+02	4.33E+01
	4	81.39	1.09E+03	81.34			1.09E+03	8.13E+01
M	5	112.08	1.40E+02	34.56			1.40E+02	3.46E+01
m	6	116.18	3.18E+01	27.10			3.18E+01	2.71E+01
	7	141.17	4.21E+01	45.81			4.21E+01	4.58E+01

0116

Analysis Report for 1810038-02

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	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	8	276.70	9.12E+01	28.84			9.12E+01	2.88E+01
	9	290.28	1.46E+01	14.63			1.46E+01	1.46E+01
M	10	303.09	2.38E+02	33.47			2.38E+02	3.35E+01
m	11	307.43	2.71E+01	16.61			2.71E+01	1.66E+01
	12	333.85	5.60E+01	25.14			5.60E+01	2.51E+01
	13	356.24	7.32E+02	59.80			7.32E+02	5.98E+01
	14	385.64	2.69E+02	39.10			2.69E+02	3.91E+01
	15	391.67	3.89E+01	17.55			3.89E+01	1.75E+01
M	16	414.55	1.42E+01	12.16			1.42E+01	1.22E+01
m	17	419.25	1.61E+01	13.26			1.61E+01	1.33E+01
	18	437.08	4.93E+01	24.63			4.93E+01	2.46E+01
	19	467.91	1.10E+01	11.88			1.10E+01	1.19E+01
	20	484.59	1.36E+01	10.61			1.36E+01	1.06E+01
	21	555.43	5.50E+00	6.08			5.50E+00	6.08E+00
	22	650.61	6.56E+00	6.40			6.56E+00	6.40E+00

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

NUCLIDE IDENTIFICATION REPORT

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

IDENTIFIED NUCLIDES

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.96	255.12		1.93		
		391.69	*	61.90	2.38E+01	1.09E+01
I-125	0.99	35.49	*	6.49	2.02E+01	3.29E+00
PA-231	1.00	9.28		42.00		
		10.11		20.20		
		283.67		1.60		
		302.67	*	2.30	7.00E+03	2.34E+03

0117

Analysis Report for 1810038-02

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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 : 2.000FWHM
Nuclide confidence index threshold = 0.30
Errors quoted at 2.000sigma

INTERFERENCE CORRECTED REPORT

Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
SN-113	0.968	2.38E+01	1.09E+01	
I-125	0.998	2.02E+01	3.29E+00	
PA-231	1.000	7.00E+03	2.34E+03	

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

Errors quoted at 2.000sigma

0118

Analysis Report for 1810038-02
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UNIDENTIFIED PEAKS

Peak Locate Performed on : 10/23/2018 11:09:08AM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	2	53.39	7.01634E-02	30.17		
	3	62.23	2.02492E-01	11.87	Tol.	TH-234
	4	81.39	1.20615E+00	3.75		
M	5	112.08	1.55921E-01	12.31	Tol.	U-237
m	6	116.18	3.53079E-02	42.64		
	7	141.17	4.68280E-02	54.35		
	8	276.70	1.01325E-01	15.82		
	9	290.28	1.62644E-02	49.97		
m	11	307.43	3.00594E-02	30.70		
	12	333.85	6.22716E-02	22.43		
	13	356.24	8.13351E-01	4.08	Tol.	BA-133
	14	385.64	2.99315E-01	7.26		
M	16	414.55	1.57637E-02	42.84		
m	17	419.25	1.78816E-02	41.19		
	18	437.08	5.48246E-02	24.96		
	19	467.91	1.21667E-02	54.27		
	20	484.59	1.50617E-02	39.12		
	21	555.43	6.11111E-03	55.30		
	22	650.61	7.29167E-03	48.79		

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

0119

Analysis Report for 1810038-02

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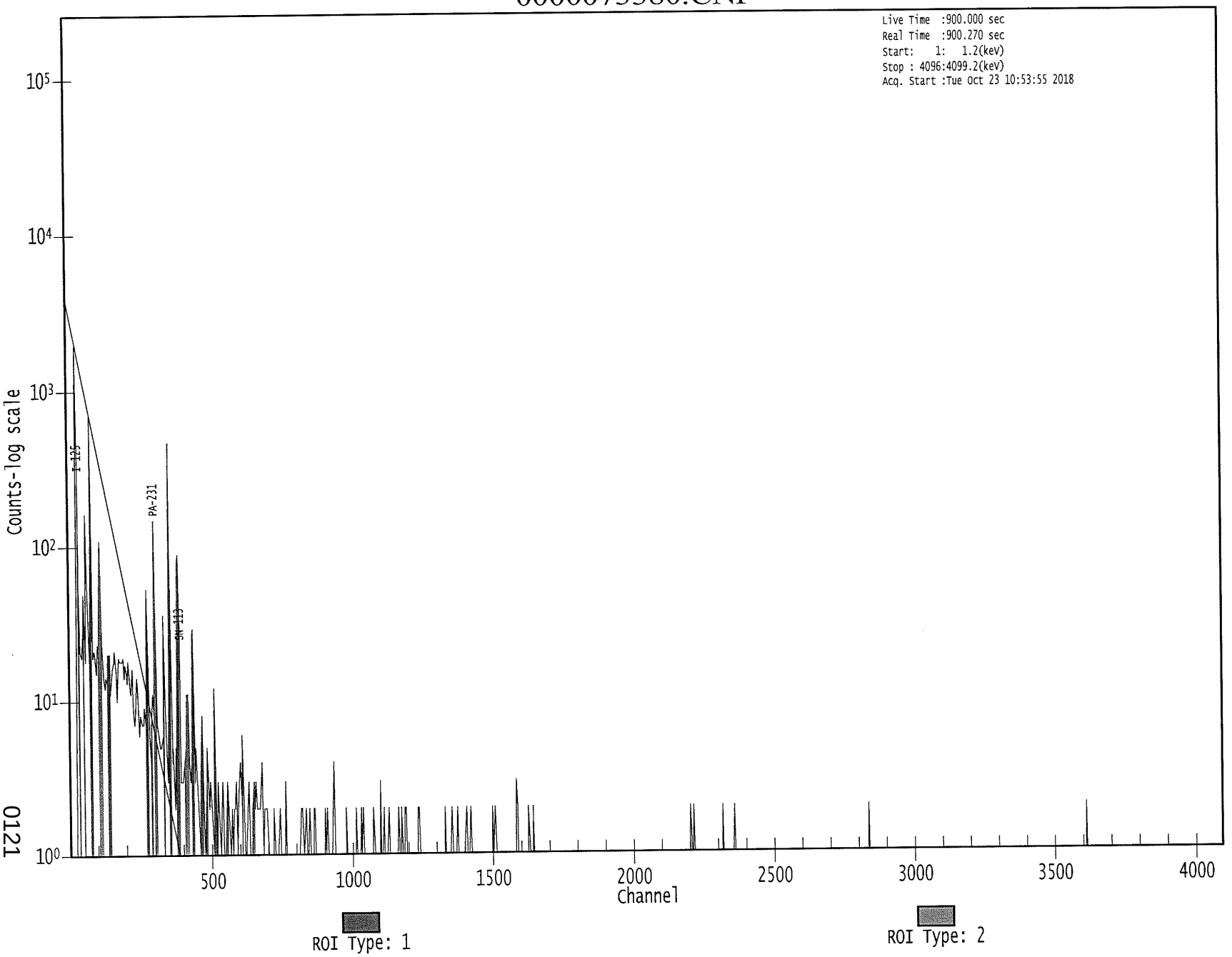
	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	1.20E-10	1.20E-10	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.76E+01	2.76E+01	1.20E+01	1.28E+01
		136.48		10.60	2.71E+02		4.54E+01	1.26E+02
	NI-59	6.92		29.80	9.43E-10	9.43E-10	0.00E+00	0.00E+00
	MO-93	16.59		52.90	1.78E-05	1.78E-05	0.00E+00	0.00E+00
		18.60		10.00	2.91E-04		0.00E+00	0.00E+00
	NB-93M	16.57		9.43	9.85E-05	9.85E-05	0.00E+00	0.00E+00
	CD-109	88.03		3.72	2.74E+02	2.74E+02	-3.79E+01	1.28E+02
+	SN-113	255.12		1.93	1.27E+03	1.41E+01	-2.63E+02	5.77E+02
		391.69	*	61.90	1.41E+01		2.38E+01	6.21E+00
	SN-119M	23.87		16.10	1.77E-03	1.77E-03	0.00E+00	0.00E+00
		25.10		22.70	1.93E-03		0.00E+00	0.00E+00
+	I-125	35.49	*	6.49	8.44E+00	8.44E+00	2.02E+01	4.17E+00
	I-129	29.78		57.00	2.56E-01	2.56E-01	1.65E+00	1.26E-01
		33.60		13.20	1.59E+00		-8.20E+00	7.78E-01
		39.58		7.52	2.57E+00		-1.89E+00	1.20E+00
	BA-133	30.80		97.60	2.17E-01	2.17E-01	2.31E+00	1.07E-01
		302.84		17.80	2.93E+02		9.05E+02	1.41E+02
		356.01		60.00	1.04E+02		5.85E+02	5.11E+01
	CE-139	165.85		80.35	4.41E+01	4.41E+01	2.12E+01	2.05E+01
	CE-144	133.54		10.80	2.36E+02	2.36E+02	1.14E+01	1.09E+02
	HG-203	279.19		77.30	3.67E+01	3.67E+01	-3.58E+00	1.70E+01
	PB-210	46.50		4.25	9.37E+00	9.37E+00	-5.20E+00	4.26E+00
+	PA-231	9.28		42.00	3.13E-08	3.13E-08	0.00E+00	0.00E+00
		10.11		20.20	1.87E-07		0.00E+00	0.00E+00
		283.67		1.60	1.13E+03		3.16E+02	5.02E+02
		302.67	*	2.30	1.41E+03		7.00E+03	6.63E+02
	TH-231	25.64		14.70	3.57E-03	3.57E-03	0.00E+00	0.00E+00
		84.21		6.40	3.15E+02		1.08E+02	1.53E+02
	PA-234M	9.89		89.00	3.24E-08	3.24E-08	0.00E+00	0.00E+00
		21.72		64.90	1.91E-04		0.00E+00	0.00E+00
		37.93		23.75	7.80E-01		-1.88E+00	3.69E-01
		131.42		20.40	1.23E+02		-2.04E+01	5.68E+01
	TH-234	63.29		3.80	1.50E+02	1.50E+02	3.27E+01	7.28E+01
	NP-237	29.37		14.00	3.72E-01	3.72E-01	-9.81E+00	1.81E-01
		86.50		12.60	7.57E+01		-3.45E+01	3.52E+01
	U-237	97.08		16.30	7.89E+01	6.05E+01	-1.86E+01	3.66E+01
		101.07		26.30	6.05E+01		-6.18E+00	2.83E+01
		114.00		12.30	2.96E+02		2.25E+02	1.42E+02
		208.01		22.00	1.71E+02		2.64E+01	7.94E+01
	AM-241	59.54		35.90	6.94E+00	6.94E+00	-4.71E+01	3.27E+00
	AM-243	74.67		66.00	8.96E+00	8.96E+00	-5.52E+00	4.19E+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

0120

0000073380.CNF



Apex-Gamma

Analysis Report for 1810038-03
HANSON RELIEF WELL

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1810038-03
Sample Description	: HANSON RELIEF WELL
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 10/23/2018 12:49:51PM
Acquisition Started	: 10/23/2018 10:54:12AM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 914.7 seconds
Dead Time	: 1.60 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/24/2018
Efficiency Calibration Used Done On	: 11/9/2014
Efficiency Calibration Description	:
Sample Number	: 73382

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 10/23/2018 11:09:33AM
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)

0122

Analysis Report for 1810038-03

HANSON RELIEF WELL

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.77	15 -	23	19.83	1.26E+02	53.06	3.56E+02	2.66
M	2	31.18	24 -	39	30.24	2.80E+03	112.93	2.43E+02	2.25
m	3	35.41	24 -	39	34.47	6.64E+02	89.31	1.78E+02	2.08
	4	52.89	48 -	56	51.96	1.03E+02	40.92	1.97E+02	4.51
M	5	62.03	57 -	73	61.11	2.83E+02	50.08	2.02E+02	2.54
m	6	66.16	57 -	73	65.24	1.48E+02	44.51	1.80E+02	2.32
	7	81.45	76 -	87	80.55	1.15E+03	86.97	3.61E+02	2.23
M	8	112.16	105 -	121	111.28	2.48E+02	44.18	1.65E+02	2.79
m	9	116.56	105 -	121	115.68	5.51E+01	36.96	1.22E+02	2.34
	10	133.89	128 -	137	133.03	2.70E+01	34.03	1.50E+02	7.12
	11	160.89	157 -	165	160.05	3.23E+01	38.88	2.15E+02	2.80
m	12	192.36	182 -	194	191.55	2.62E+01	30.40	1.24E+02	2.78
	13	276.85	271 -	283	276.10	6.95E+01	31.71	8.89E+01	2.85
M	14	295.89	290 -	313	295.16	1.60E+01	18.76	5.46E+01	2.53
m	15	303.51	290 -	313	302.78	1.69E+02	30.72	4.75E+01	2.53
M	16	334.37	326 -	341	333.67	3.99E+01	25.94	6.45E+01	3.27
m	17	339.12	326 -	341	338.43	1.60E+01	21.54	5.45E+01	2.75
	18	356.52	350 -	361	355.84	5.40E+02	52.76	7.73E+01	1.95
M	19	384.15	378 -	395	383.49	1.23E+02	32.52	2.86E+01	2.84
m	20	387.52	378 -	395	386.87	1.45E+02	32.64	1.58E+01	2.29
m	21	391.32	378 -	395	390.67	3.53E+01	28.45	1.21E+01	2.85
	22	416.17	412 -	420	415.54	3.38E+01	20.75	4.64E+01	1.59
	23	437.54	433 -	441	436.93	7.26E+01	19.41	1.28E+01	2.57
	24	745.76	741 -	748	745.43	7.00E+00	5.29	0.00E+00	2.87
	25	839.94	837 -	842	839.70	5.71E+00	6.08	2.57E+00	1.96

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 : 10/23/2018 11:09:33AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000072213.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.77	1.26E+02	53.06			1.26E+02	5.31E+01
M	2	31.18	2.80E+03	112.93			2.80E+03	1.13E+02
m	3	35.41	6.64E+02	89.31			6.64E+02	8.93E+01
	4	52.89	1.03E+02	40.92			1.03E+02	4.09E+01

Analysis Report for 1810038-03

HANSON RELIEF WELL

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	5	62.03	2.83E+02	50.08	2.22E+00	6.78E-01	2.81E+02	5.01E+01
m	6	66.16	1.48E+02	44.51			1.48E+02	4.45E+01
	7	81.45	1.15E+03	86.97			1.15E+03	8.70E+01
M	8	112.16	2.48E+02	44.18	1.93E+00	1.85E+00	2.46E+02	4.42E+01
m	9	116.56	5.51E+01	36.96			5.51E+01	3.70E+01
	10	133.89	2.70E+01	34.03			2.70E+01	3.40E+01
	11	160.89	3.23E+01	38.88			3.23E+01	3.89E+01
m	12	192.36	2.62E+01	30.40			2.62E+01	3.04E+01
	13	276.85	6.95E+01	31.71			6.95E+01	3.17E+01
M	14	295.89	1.60E+01	18.76			1.60E+01	1.88E+01
m	15	303.51	1.69E+02	30.72			1.69E+02	3.07E+01
M	16	334.37	3.99E+01	25.94			3.99E+01	2.59E+01
m	17	339.12	1.60E+01	21.54			1.60E+01	2.15E+01
	18	356.52	5.40E+02	52.76			5.40E+02	5.28E+01
M	19	384.15	1.23E+02	32.52			1.23E+02	3.25E+01
m	20	387.52	1.45E+02	32.64			1.45E+02	3.26E+01
m	21	391.32	3.53E+01	28.45			3.53E+01	2.84E+01
	22	416.17	3.38E+01	20.75			3.38E+01	2.07E+01
	23	437.54	7.26E+01	19.41			7.26E+01	1.94E+01
	24	745.76	7.00E+00	5.29			7.00E+00	5.29E+00
	25	839.94	5.71E+00	6.08			5.71E+00	6.08E+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	5.55E+01	4.53E+01
I-125	1.00	35.49	*	6.49	5.97E+02	8.16E+01
BA-133	0.99	30.80	*	97.60	1.29E+02	5.76E+00
		302.84	*	17.80	8.32E+02	2.97E+02
		356.01	*	60.00	8.48E+02	1.38E+02
CE-144	0.99	133.54	*	10.80	1.15E+02	1.47E+02
TH-234	0.97	63.29	*	3.80	1.20E+03	2.30E+02

0124

Analysis Report for 1810038-03

HANSON RELIEF WELL

2

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

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.944	5.55E+01	4.53E+01	
	I-125	1.000	5.97E+02	8.16E+01	
X	I-129	0.841			
	BA-133	0.996	1.30E+02	5.75E+00	
	CE-144	0.998	1.15E+02	1.47E+02	
	TH-234	0.970	1.20E+03	2.30E+02	
X	NP-237	0.557			

? = 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

0125

Analysis Report for 1810038-03

HANSON RELIEF WELL

2

UNIDENTIFIED PEAKS

Peak Locate Performed on : 10/23/2018 11:09:33AM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	20.77	1.40194E-01	21.03		
	4	52.89	1.14082E-01	19.93		
m	6	66.16	1.64065E-01	15.07	Sum	
	7	81.45	1.28049E+00	3.77		
M	8	112.16	2.72966E-01	9.00		
m	9	116.56	6.12186E-02	33.54		
	11	160.89	3.58730E-02	60.21		
m	12	192.36	2.90578E-02	58.12		
	13	276.85	7.72612E-02	22.80		
M	14	295.89	1.77252E-02	58.80		
M	16	334.37	4.43571E-02	32.49	Sum	
m	17	339.12	1.77632E-02	67.37	Sum	
M	19	384.15	1.36335E-01	13.25		
m	20	387.52	1.60743E-01	11.28	Sum	
	22	416.17	3.75439E-02	30.70		
	23	437.54	8.06399E-02	13.37	Sum	
	24	745.76	7.77778E-03	37.80		
	25	839.94	6.34921E-03	53.22		

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

0126

Analysis Report for 1810038-03

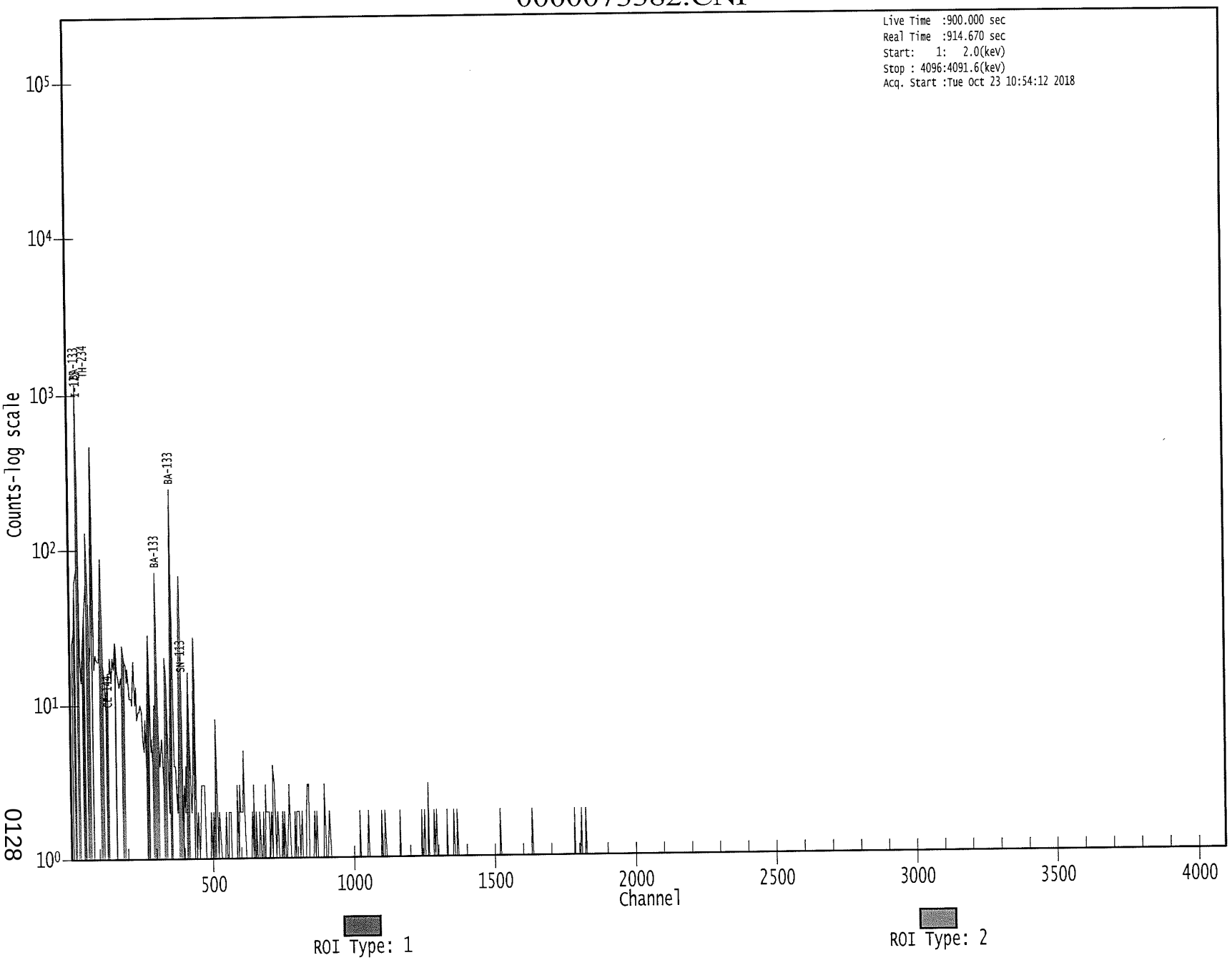
HANSON RELIEF WELL

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	5.43E-03	5.43E-03	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.98E+01	1.98E+01	9.71E-01	9.24E+00
		136.48		10.60	1.93E+02		-5.88E+01	9.04E+01
	NI-59	6.92		29.80	4.85E-02	4.85E-02	-3.62E-02	2.05E-02
	MO-93	16.59		52.90	1.26E+00	1.26E+00	-8.23E-02	6.05E-01
		18.60		10.00	1.06E+01		1.50E+01	5.13E+00
	NB-93M	16.57		9.43	7.05E+00	7.05E+00	-4.60E-01	3.38E+00
	CD-109	88.03		3.72	3.76E+02	3.76E+02	-8.98E+01	1.78E+02
+	SN-113	255.12		1.93	1.31E+03	5.78E+01	3.09E+02	5.99E+02
		391.69	*	61.90	5.78E+01		5.55E+01	2.68E+01
	SN-119M	23.87		16.10	1.17E+01	8.98E+00	-1.78E+01	5.62E+00
		25.10		22.70	8.98E+00		-1.31E+02	4.32E+00
+	I-125	35.49	*	6.49	1.04E+02	1.04E+02	5.97E+02	5.07E+01
	I-129	29.78	*	57.00	9.22E+00	9.22E+00	2.21E+02	4.50E+00
		33.60	*	13.20	5.11E+01		2.94E+02	2.50E+01
		39.58		7.52	6.36E+01		6.78E+00	3.05E+01
+	BA-133	30.80	*	97.60	5.38E+00	5.38E+00	1.29E+02	2.63E+00
		302.84	*	17.80	3.60E+02		8.32E+02	1.73E+02
		356.01	*	60.00	6.87E+01		8.48E+02	3.22E+01
	CE-139	165.85		80.35	3.24E+01	3.24E+01	3.68E+00	1.52E+01
+	CE-144	133.54	*	10.80	2.39E+02	2.39E+02	1.15E+02	1.14E+02
	HG-203	279.19		77.30	5.19E+01	5.19E+01	7.54E+01	2.45E+01
	PB-210	46.50		4.25	1.05E+02	1.05E+02	4.23E+00	4.92E+01
	PA-231	9.28		42.00	1.83E-01	1.83E-01	1.04E-01	8.49E-02
		10.11		20.20	5.61E-01		3.50E-01	2.63E-01
		283.67		1.60	1.54E+03		2.38E+02	6.97E+02
		302.67		2.30	2.49E+03		5.03E+03	1.19E+03
	TH-231	25.64		14.70	1.50E+01	1.50E+01	-5.13E+02	7.22E+00
		84.21		6.40	6.41E+02		3.90E+03	3.15E+02
	PA-234M	9.89		89.00	1.19E-01	1.19E-01	7.46E-02	5.60E-02
		21.72		64.90	2.38E+00		2.11E+00	1.15E+00
		37.93		23.75	3.54E+01		1.31E+02	1.73E+01
		131.42		20.40	9.08E+01		-2.55E+01	4.24E+01
+	TH-234	63.29	*	3.80	4.62E+02	4.62E+02	1.20E+03	2.25E+02
	NP-237	29.37	*	14.00	3.75E+01	3.75E+01	8.98E+02	1.83E+01
		86.50		12.60	1.13E+02		-1.17E+01	5.38E+01
	U-237	97.08		16.30	1.01E+02	6.55E+01	-5.59E+00	4.78E+01
		101.07		26.30	6.55E+01		2.91E+01	3.11E+01
		114.00		12.30	2.69E+02		6.35E+02	1.30E+02
		208.01		22.00	1.24E+02		-3.04E+01	5.80E+01
	AM-241	59.54		35.90	3.77E+01	3.77E+01	6.02E+01	1.83E+01
	AM-243	74.67		66.00	1.74E+01	1.74E+01	3.36E+00	8.27E+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

0127

0000073382.CNF



KB 10/23/18

2

Apex-Gamma

Analysis Report for 1810038-04
MASON RELIEF WELL

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1810038-04
Sample Description	: MASON RELIEF WELL
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 10/23/2018 12:50:03PM
Acquisition Started	: 10/23/2018 10:54:04AM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE3
Geometry	: BAFIL
Live Time	: 900.0 seconds
Real Time	: 903.9 seconds
Dead Time	: 0.43 %
Peak Locate Threshold	: 2.50
Peak Locate Range (in channels)	: 1 - 4096
Peak Area Range (in channels)	: 10 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 7/21/2018
Efficiency Calibration Used Done On	: 7/21/2018
Efficiency Calibration Description	:
Sample Number	: 73381

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 10/23/2018 11:09:20AM

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)

0129

Analysis Report for 1810038-04

MASON RELIEF WELL

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
	1	20.46	18 -	23	20.83	9.89E+01	42.08	2.78E+02	2.11
M	2	31.02	27 -	40	31.38	2.69E+03	113.43	3.25E+02	2.33
m	3	35.29	27 -	40	35.65	6.70E+02	95.59	2.09E+02	2.43
	4	52.92	50 -	56	53.28	6.96E+01	36.58	1.93E+02	3.03
M	5	62.26	57 -	74	62.61	3.31E+02	54.11	2.04E+02	2.73
m	6	66.05	57 -	74	66.40	1.36E+02	54.07	1.91E+02	2.74
m	7	71.33	57 -	74	71.67	3.59E+01	29.43	1.34E+02	2.75
	8	81.30	76 -	88	81.64	1.13E+03	84.91	3.18E+02	2.47
M	9	112.16	108 -	122	112.49	2.27E+02	46.83	2.59E+02	2.42
m	10	116.48	108 -	122	116.81	6.23E+01	46.56	1.98E+02	2.83
	11	133.93	130 -	137	134.25	3.30E+01	32.31	1.52E+02	3.82
	12	161.87	160 -	165	162.17	2.97E+01	29.38	1.43E+02	2.75
	13	178.26	174 -	182	178.56	3.48E+01	34.54	1.62E+02	1.50
	14	276.41	271 -	280	276.67	6.16E+01	31.32	1.05E+02	2.81
M	15	303.11	298 -	321	303.35	1.72E+02	34.70	1.04E+02	2.65
m	16	307.19	298 -	321	307.44	3.11E+01	28.67	6.59E+01	2.27
M	17	334.00	328 -	362	334.23	8.31E+01	24.85	4.53E+00	3.08
m	18	338.77	328 -	362	339.00	3.31E+01	16.78	6.88E+00	2.32
m	19	356.29	328 -	362	356.51	5.97E+02	50.45	2.57E+01	2.30
M	20	375.91	372 -	399	376.13	1.87E+01	18.00	6.87E+01	3.43
m	21	386.84	372 -	399	387.05	2.41E+02	40.17	4.58E+01	3.31
m	22	391.57	372 -	399	391.78	6.87E+01	32.23	1.66E+01	3.13
M	23	415.02	411 -	426	415.22	5.24E+01	20.03	2.37E+01	3.81
m	24	418.45	411 -	426	418.65	2.25E+01	21.38	2.34E+01	3.38
m	25	423.38	411 -	426	423.58	1.67E+01	12.54	1.46E+01	3.82
	26	437.48	433 -	441	437.67	9.20E+01	22.02	1.80E+01	3.00
	27	467.35	461 -	471	467.54	1.91E+01	17.93	3.18E+01	1.18
	28	554.18	550 -	557	554.33	9.00E+00	6.00	0.00E+00	2.75
	29	710.04	707 -	712	710.13	4.58E+00	5.74	2.83E+00	2.72

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 : 10/23/2018 11:09:20AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000072212.CNF

Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.

Analysis Report for 1810038-04

MASON RELIEF WELL

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
	1	20.46	9.89E+01	42.08			9.89E+01	4.21E+01
M	2	31.02	2.69E+03	113.43			2.69E+03	1.13E+02
m	3	35.29	6.70E+02	95.59			6.70E+02	9.56E+01
	4	52.92	6.96E+01	36.58			6.96E+01	3.66E+01
M	5	62.26	3.31E+02	54.11	1.61E+01	2.19E+00	3.15E+02	5.42E+01
m	6	66.05	1.36E+02	54.07			1.36E+02	5.41E+01
m	7	71.33	3.59E+01	29.43			3.59E+01	2.94E+01
	8	81.30	1.13E+03	84.91			1.13E+03	8.49E+01
M	9	112.16	2.27E+02	46.83			2.27E+02	4.68E+01
m	10	116.48	6.23E+01	46.56			6.23E+01	4.66E+01
	11	133.93	3.30E+01	32.31			3.30E+01	3.23E+01
	12	161.87	2.97E+01	29.38			2.97E+01	2.94E+01
	13	178.26	3.48E+01	34.54			3.48E+01	3.45E+01
	14	276.41	6.16E+01	31.32			6.16E+01	3.13E+01
M	15	303.11	1.72E+02	34.70			1.72E+02	3.47E+01
m	16	307.19	3.11E+01	28.67			3.11E+01	2.87E+01
M	17	334.00	8.31E+01	24.85			8.31E+01	2.48E+01
m	18	338.77	3.31E+01	16.78			3.31E+01	1.68E+01
m	19	356.29	5.97E+02	50.45			5.97E+02	5.05E+01
M	20	375.91	1.87E+01	18.00			1.87E+01	1.80E+01
m	21	386.84	2.41E+02	40.17			2.41E+02	4.02E+01
m	22	391.57	6.87E+01	32.23			6.87E+01	3.22E+01
M	23	415.02	5.24E+01	20.03			5.24E+01	2.00E+01
m	24	418.45	2.25E+01	21.38			2.25E+01	2.14E+01
m	25	423.38	1.67E+01	12.54			1.67E+01	1.25E+01
	26	437.48	9.20E+01	22.02			9.20E+01	2.20E+01
	27	467.35	1.91E+01	17.93			1.91E+01	1.79E+01
	28	554.18	9.00E+00	6.00			9.00E+00	6.00E+00
	29	710.04	4.58E+00	5.74			4.58E+00	5.74E+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

0131

Analysis Report for 1810038-04

MASON RELIEF WELL

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.96	255.12		1.93		
		391.69	*	61.90	4.77E+01	2.29E+01
I-125	0.99	35.49	*	6.49	3.14E+01	4.48E+00
BA-133	0.99	30.80	*	97.60	3.62E+00	1.53E-01
		302.84	*	17.80	6.45E+02	2.68E+02
		356.01	*	60.00	5.18E+02	7.34E+01
CE-144	0.99	133.54	*	10.80	1.78E+02	1.84E+02
TH-234	0.98	63.29	*	3.80	5.07E+02	8.89E+01

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

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.964	4.77E+01	2.29E+01	
	I-125	0.999	3.14E+01	4.48E+00	
X	I-129	0.901			
	BA-133	0.999	3.62E+00	1.53E-01	
	CE-144	0.997	1.78E+02	1.84E+02	
	TH-234	0.981	5.07E+02	8.89E+01	
X	NP-237	0.885			

? = 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

0132

Analysis Report for 1810038-04
MASON RELIEF WELL

UNIDENTIFIED PEAKS

Peak Locate Performed on : 10/23/2018 11:09:20AM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	1	20.46	1.09942E-01	21.27	Tol.	MO-93 PA-234M
	4	52.92	7.73059E-02	26.28		
m	6	66.05	1.50729E-01	19.93	Sum	
m	7	71.33	3.98994E-02	40.98	Sum	
	8	81.30	1.25129E+00	3.77		
M	9	112.16	2.52740E-01	10.29	Tol.	U-237
m	10	116.48	6.92029E-02	37.38		
	12	161.87	3.30143E-02	49.43		
	13	178.26	3.86590E-02	49.64		
	14	276.41	6.84064E-02	25.44		
m	16	307.19	3.45788E-02	46.06		
M	17	334.00	9.23439E-02	14.95	Sum	
m	18	338.77	3.67848E-02	25.34	Sum	
M	20	375.91	2.07311E-02	48.24		
m	21	386.84	2.67232E-01	8.35	Sum	
M	23	415.02	5.81940E-02	19.12		
m	24	418.45	2.50001E-02	47.51	Sum	
m	25	423.38	1.85144E-02	37.63	Sum	
	26	437.48	1.02211E-01	11.97	Sum	
	27	467.35	2.12381E-02	46.90		
	28	554.18	1.00000E-02	33.33		
	29	710.04	5.09259E-03	62.67		

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

0133

Analysis Report for 1810038-04

MASON RELIEF WELL

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	1.57E-09	1.57E-09	0.00E+00	0.00E+00
	CO-57	122.06		85.51	2.64E+01	2.64E+01	3.17E+00	1.24E+01
		136.48		10.60	2.79E+02		-7.54E+00	1.32E+02
	NI-59	6.92		29.80	1.09E-07	1.09E-07	2.59E-08	5.01E-08
	MO-93	16.59		52.90	1.21E-03	1.21E-03	7.56E-05	5.79E-04
		18.60		10.00	2.01E-02		-2.00E-03	9.68E-03
	NB-93M	16.57		9.43	6.70E-03	6.70E-03	4.19E-04	3.21E-03
	CD-109	88.03		3.72	2.91E+02	2.91E+02	-1.65E+02	1.38E+02
+	SN-113	255.12		1.93	1.42E+03	5.29E+01	4.95E+02	6.52E+02
		391.69	*	61.90	5.29E+01		4.77E+01	2.55E+01
	SN-119M	23.87		16.10	9.98E-02	9.86E-02	-1.36E-02	4.82E-02
		25.10		22.70	9.86E-02		-1.42E-02	4.76E-02
+	I-125	35.49	*	6.49	5.40E+00	5.40E+00	3.14E+01	2.63E+00
	I-129	29.78	*	57.00	2.72E-01	2.72E-01	6.20E+00	1.33E-01
		33.60	*	13.20	2.66E+00		1.54E+01	1.30E+00
		39.58		7.52	6.05E+00		-2.57E-01	2.92E+00
+	BA-133	30.80	*	97.60	1.59E-01	1.59E-01	3.62E+00	7.76E-02
		302.84	*	17.80	3.77E+02		6.45E+02	1.83E+02
		356.01	*	60.00	6.43E+01		5.18E+02	3.10E+01
	CE-139	165.85		80.35	4.38E+01	4.38E+01	-7.02E+00	2.06E+01
+	CE-144	133.54	*	10.80	2.83E+02	2.83E+02	1.78E+02	1.34E+02
	HG-203	279.19		77.30	4.67E+01	4.67E+01	6.16E+00	2.20E+01
	PB-210	46.50		4.25	1.89E+01	1.89E+01	4.59E+00	8.99E+00
	PA-231	9.28		42.00	4.02E-06	4.02E-06	4.09E-06	1.91E-06
		10.11		20.20	2.11E-05		2.15E-05	1.01E-05
		283.67		1.60	1.33E+03		-3.31E+02	6.03E+02
		302.67		2.30	2.03E+03		3.74E+03	9.77E+02
	TH-231	25.64		14.70	1.93E-01	1.93E-01	-2.56E-02	9.34E-02
		84.21		6.40	3.70E+02		1.18E+03	1.81E+02
	PA-234M	9.89		89.00	3.79E-06	3.79E-06	3.85E-06	1.80E-06
		21.72		64.90	1.21E-02		8.61E-04	5.84E-03
		37.93		23.75	2.50E+00		6.98E+00	1.23E+00
		131.42		20.40	1.31E+02		1.93E+01	6.16E+01
+	TH-234	63.29	*	3.80	1.83E+02	1.83E+02	5.07E+02	8.91E+01
	NP-237	29.37	*	14.00	1.11E+00	1.11E+00	2.52E+01	5.41E-01
		86.50		12.60	9.15E+01		-1.49E+01	4.35E+01
	U-237	97.08		16.30	8.64E+01	5.90E+01	-5.88E+01	4.08E+01
		101.07		26.30	5.90E+01		1.67E+01	2.79E+01
		114.00		12.30	3.21E+02		8.98E+02	1.56E+02
		208.01		22.00	1.55E+02		-2.11E+01	7.22E+01
	AM-241	59.54		35.90	1.34E+01	1.34E+01	2.34E+01	6.51E+00
	AM-243	74.67		66.00	1.02E+01	1.02E+01	-4.97E+01	4.82E+00

0134

Analysis Report for 1810038-04

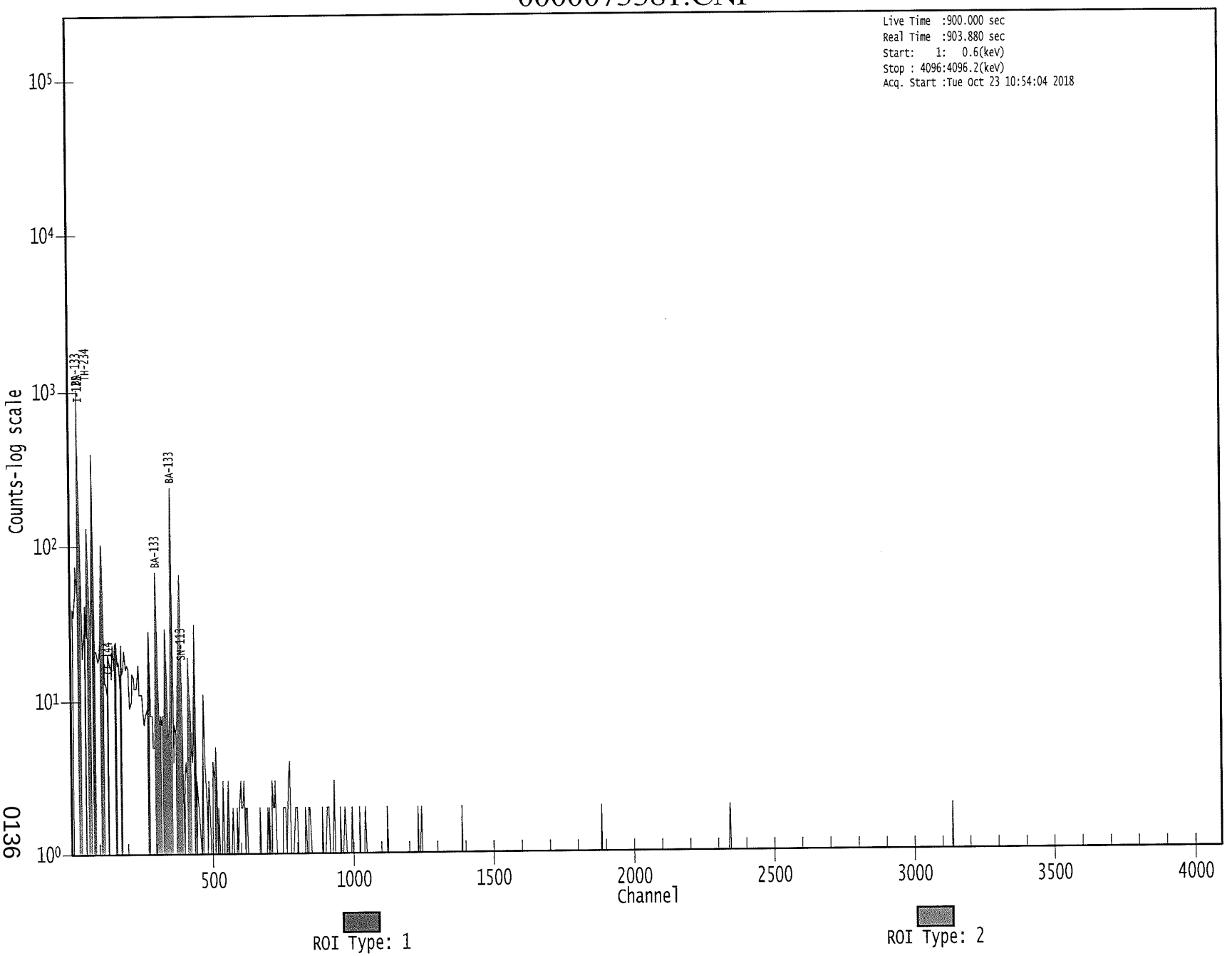
MASON RELIEF WELL

2

+ = 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

0135

0000073381.CNF



0136

KB 10/23/18

2

Apex-Gamma

Analysis Report for 1810038-05
HANSON RELIEF WELL

GAMMA SPECTRUM ANALYSIS

Sample Identification	: 1810038-05
Sample Description	: HANSON RELIEF WELL
Sample Type	: RA RECOVERY
Sample Size	: 1.000E+00 units
Facility	: Countroom
Sample Taken On	: 10/23/2018 12:50:14PM
Acquisition Started	: 10/23/2018 11:11:01AM
Procedure	: BAFIL
Operator	: Administrator
Detector Name	: GE4
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)	: 9 - 4096
Identification Energy Tolerance	: 1.000FWHM
Energy Calibration Used Done On	: 2/24/2018
Efficiency Calibration Used Done On	: 11/9/2014
Efficiency Calibration Description	:
Sample Number	: 73384

PEAK ANALYSIS REPORT

Peak Analysis Performed on : 10/23/2018 11:26:06AM

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)

0137

Analysis Report for 1810038-05

HANSON RELIEF WELL

	Peak No.	Energy (keV)	ROI start	ROI end	Peak Centroid	Net Peak Area	Net Area Uncertainty	Continuum Counts	FWHM (keV)
M	1	31.21	24 -	39	30.27	2.75E+03	110.52	1.68E+02	2.33
m	2	35.52	24 -	39	34.58	6.61E+02	88.45	1.12E+02	2.34
	3	53.11	48 -	56	52.19	9.25E+01	39.63	1.85E+02	2.50
M	4	62.47	57 -	71	61.56	2.41E+02	50.12	1.98E+02	2.54
m	5	66.33	57 -	71	65.42	1.21E+02	46.35	2.24E+02	2.55
	6	81.41	76 -	86	80.51	9.89E+02	78.57	2.91E+02	2.17
M	7	112.27	108 -	119	111.39	2.29E+02	36.51	9.99E+01	2.77
m	8	116.16	108 -	119	115.28	4.89E+01	42.24	1.46E+02	2.88
	9	160.67	157 -	163	159.83	2.70E+01	31.03	1.58E+02	2.25
M	10	194.81	193 -	202	194.00	1.67E+01	14.75	6.65E+01	2.23
M	11	276.95	271 -	282	276.20	7.15E+01	22.33	3.50E+01	2.49
m	12	280.93	271 -	282	280.19	1.06E+01	21.13	3.50E+01	2.49
M	13	303.14	298 -	313	302.42	1.65E+02	28.82	4.04E+01	2.37
m	14	308.13	298 -	313	307.41	3.69E+01	25.77	3.57E+01	2.71
	15	335.09	329 -	340	334.40	7.09E+01	27.42	5.42E+01	2.32
M	16	352.29	349 -	366	351.61	1.48E+01	16.88	1.86E+01	3.21
m	17	356.61	349 -	366	355.93	4.49E+02	44.55	2.73E+01	2.08
M	18	384.52	380 -	394	383.86	7.39E+01	32.21	3.30E+01	2.90
m	19	387.40	380 -	394	386.74	1.32E+02	28.81	1.53E+01	1.87
m	20	391.75	380 -	394	391.10	3.73E+01	28.52	1.35E+01	3.09
	21	416.15	409 -	420	415.52	3.40E+01	20.59	3.60E+01	2.21
M	22	433.93	431 -	440	433.32	1.18E+01	6.32	0.00E+00	4.20
m	23	437.95	431 -	440	437.34	5.54E+01	16.00	0.00E+00	2.26
M	24	464.86	463 -	470	464.27	5.78E+00	3.87	2.16E+00	3.50
m	25	468.43	463 -	470	467.84	1.37E+01	9.54	9.74E+00	2.59
	26	581.93	579 -	583	581.45	4.83E+00	5.50	2.33E+00	1.66
	27	608.52	601 -	612	608.06	1.97E+01	14.97	1.86E+01	2.80
	28	953.33	950 -	955	953.20	5.00E+00	4.47	0.00E+00	2.31

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 : 10/23/2018 11:26:06AM

Env. Background File : \\OR-GAMMA1\ApexRoot\Countroom\Data\0000072213.CNF

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
M	1	31.21	2.75E+03	110.52			2.75E+03	1.11E+02

2

Analysis Report for 1810038-05

HANSON RELIEF WELL

	Peak No.	Energy (keV)	Original Area	Orig. Area Uncertainty	Ambient Background	Backgr. Uncert.	Subtracted Area	Subtracted Uncert.
m	2	35.52	6.61E+02	88.45			6.61E+02	8.85E+01
	3	53.11	9.25E+01	39.63			9.25E+01	3.96E+01
M	4	62.47	2.41E+02	50.12	1.08E+01	1.04E+00	2.30E+02	5.01E+01
m	5	66.33	1.21E+02	46.35			1.21E+02	4.63E+01
	6	81.41	9.89E+02	78.57			9.89E+02	7.86E+01
M	7	112.27	2.29E+02	36.51	1.93E+00	1.85E+00	2.27E+02	3.66E+01
m	8	116.16	4.89E+01	42.24			4.89E+01	4.22E+01
	9	160.67	2.70E+01	31.03			2.70E+01	3.10E+01
M	10	194.81	1.67E+01	14.75			1.67E+01	1.47E+01
M	11	276.95	7.15E+01	22.33			7.15E+01	2.23E+01
m	12	280.93	1.06E+01	21.13			1.06E+01	2.11E+01
M	13	303.14	1.65E+02	28.82			1.65E+02	2.88E+01
m	14	308.13	3.69E+01	25.77			3.69E+01	2.58E+01
	15	335.09	7.09E+01	27.42			7.09E+01	2.74E+01
M	16	352.29	1.48E+01	16.88			1.48E+01	1.69E+01
m	17	356.61	4.49E+02	44.55			4.49E+02	4.46E+01
M	18	384.52	7.39E+01	32.21			7.39E+01	3.22E+01
m	19	387.40	1.32E+02	28.81			1.32E+02	2.88E+01
m	20	391.75	3.73E+01	28.52			3.73E+01	2.85E+01
	21	416.15	3.40E+01	20.59			3.40E+01	2.06E+01
M	22	433.93	1.18E+01	6.32			1.18E+01	6.32E+00
m	23	437.95	5.54E+01	16.00			5.54E+01	1.60E+01
M	24	464.86	5.78E+00	3.87			5.78E+00	3.87E+00
m	25	468.43	1.37E+01	9.54			1.37E+01	9.54E+00
	26	581.93	4.83E+00	5.50	4.35E-01	8.53E-01	4.40E+00	5.57E+00
	27	608.52	1.97E+01	14.97			1.97E+01	1.50E+01
	28	953.33	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

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
SN-113	0.94	255.12		1.93		
		391.69	*	61.90	5.86E+01	4.55E+01

0139

Analysis Report for 1810038-05

HANSON RELIEF WELL

Nuclide Name	Id Confidence	Energy (keV)		Yield(%)	Activity (pCi/units)	Activity Uncertainty
I-125	1.00	35.49	*	6.49	5.98E+02	8.14E+01
BA-133	0.99	30.80	*	97.60	1.27E+02	5.65E+00
		302.84	*	17.80	8.11E+02	2.87E+02
		356.01	*	60.00	7.06E+02	1.16E+02
HG-203	0.94	279.19	*	77.30	1.15E+01	2.33E+01
TH-234	0.98	63.29	*	3.80	9.94E+02	2.28E+02

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

INTERFERENCE CORRECTED REPORT

	Nuclide Name	Nuclide Id Confidence	Wt mean Activity (pCi/units)	Wt mean Activity Uncertainty	Comments
	SN-113	0.947	5.86E+01	4.55E+01	
	I-125	1.000	5.98E+02	8.14E+01	
X	I-129	0.839			
	BA-133	0.996	1.28E+02	5.64E+00	
	HG-203	0.943	1.15E+01	2.33E+01	
	TH-234	0.987	9.94E+02	2.28E+02	
X	NP-237	0.556			

? = 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

0140

Analysis Report for 1810038-05

HANSON RELIEF WELL

2

UNIDENTIFIED PEAKS

Peak Locate Performed on : 10/23/2018 11:26:06AM
Peak Locate From Channel : 1
Peak Locate To Channel : 4096

	Peak No.	Energy (keV)	Peak Size (CPS)	Peak CPS (%) Uncertainty	Peak Type	Tolerance Nuclide
	3	53.11	1.02826E-01	21.41		
m	5	66.33	1.34802E-01	19.10	Sum	
	6	81.41	1.09944E+00	3.97		
M	7	112.27	2.52605E-01	8.04	Tol.	U-237
m	8	116.16	5.43167E-02	43.20		
	9	160.67	2.99581E-02	57.55		
M	10	194.81	1.85806E-02	44.10		
M	11	276.95	7.94554E-02	15.61		
m	14	308.13	4.09834E-02	34.93		
	15	335.09	7.87528E-02	19.35	Sum	
M	16	352.29	1.64479E-02	57.02		
M	18	384.52	8.20651E-02	21.81		
m	19	387.40	1.46593E-01	10.92	Sum	
	21	416.15	3.77778E-02	30.28		
M	22	433.93	1.31321E-02	26.76		
m	23	437.95	6.15609E-02	14.44		
M	24	464.86	6.41679E-03	33.53		
m	25	468.43	1.52505E-02	34.75		
	26	581.93	4.88686E-03	63.27		
	27	608.52	2.18774E-02	38.01		
	28	953.33	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

NUCLIDE MDA REPORT

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

0141

Analysis Report for 1810038-05

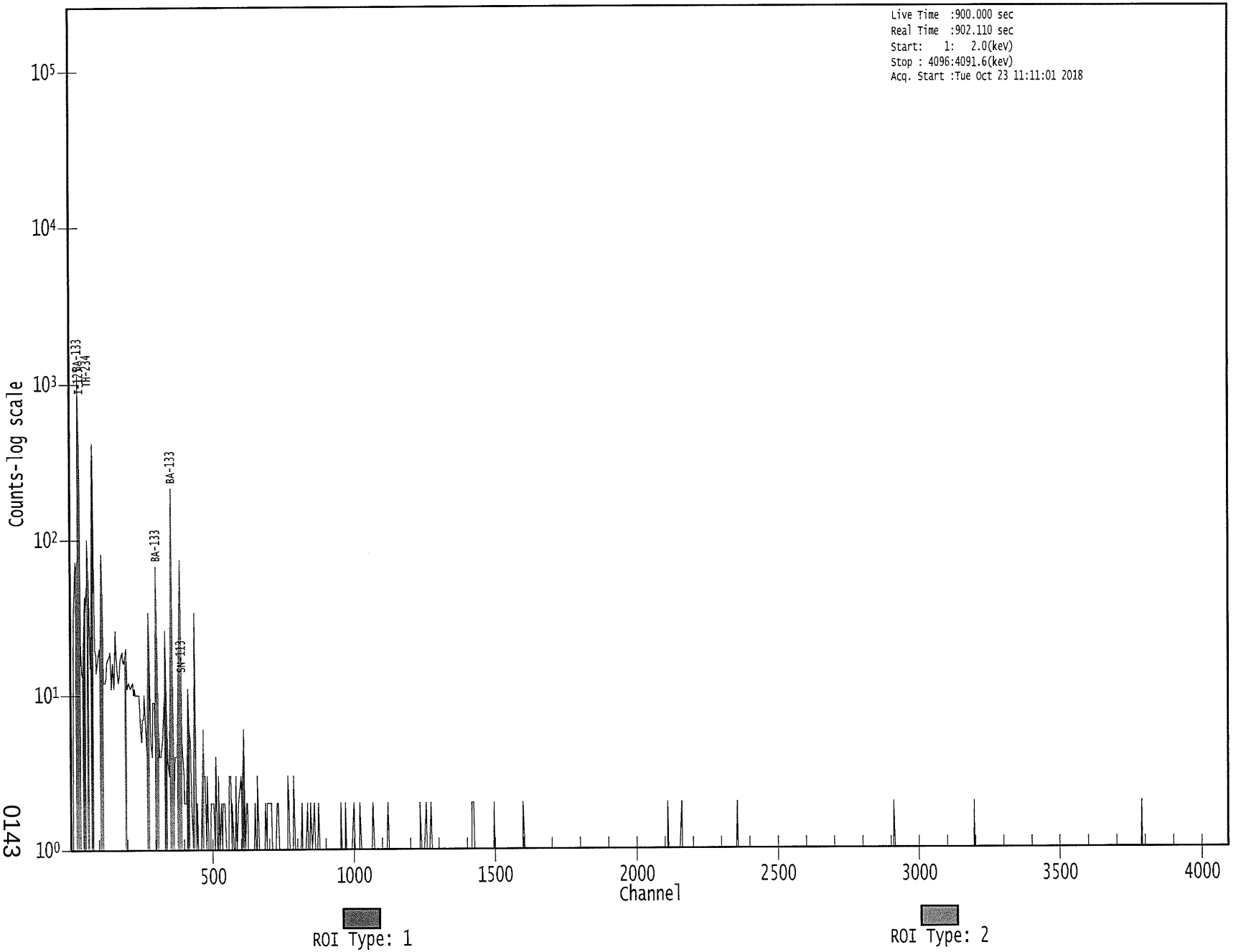
HANSON RELIEF WELL

	Nuclide Name	Energy (keV)		Yield(%)	Line MDA (pCi/units)	Nuclide MDA (pCi/units)	Activity (pCi/units)	Dec. Level (pCi/units)
	FE-55	5.89		24.50	5.43E-03	5.43E-03	0.00E+00	0.00E+00
	CO-57	122.06		85.51	1.97E+01	1.97E+01	6.01E+00	9.17E+00
		136.48		10.60	2.12E+02		-2.79E+01	9.99E+01
	NI-59	6.92		29.80	5.60E-02	5.60E-02	-2.37E-02	2.42E-02
	MO-93	16.59		52.90	1.26E+00	1.26E+00	-3.18E+00	6.03E-01
		18.60		10.00	1.04E+01		9.40E+00	5.02E+00
	NB-93M	16.57		9.43	7.04E+00	7.04E+00	-1.78E+01	3.37E+00
	CD-109	88.03		3.72	3.52E+02	3.52E+02	7.08E+00	1.66E+02
+	SN-113	255.12		1.93	1.21E+03	5.36E+01	-3.34E+02	5.51E+02
		391.69	*	61.90	5.36E+01		5.86E+01	2.47E+01
	SN-119M	23.87		16.10	1.14E+01	8.43E+00	1.30E+01	5.48E+00
		25.10		22.70	8.43E+00		2.51E+00	4.05E+00
+	I-125	35.49	*	6.49	8.62E+01	8.62E+01	5.98E+02	4.19E+01
	I-129	29.78	*	57.00	7.64E+00	7.64E+00	2.17E+02	3.71E+00
		33.60	*	13.20	4.24E+01		2.94E+02	2.06E+01
		39.58		7.52	5.96E+01		4.67E+00	2.85E+01
+	BA-133	30.80	*	97.60	4.46E+00	4.46E+00	1.27E+02	2.17E+00
		302.84	*	17.80	2.40E+02		8.11E+02	1.14E+02
		356.01	*	60.00	7.66E+01		7.06E+02	3.62E+01
	CE-139	165.85		80.35	3.27E+01	3.27E+01	5.73E+00	1.54E+01
	CE-144	133.54		10.80	1.93E+02	1.93E+02	-8.50E+00	9.06E+01
+	HG-203	279.19	*	77.30	4.01E+01	4.01E+01	1.15E+01	1.86E+01
	PB-210	46.50		4.25	1.02E+02	1.02E+02	-1.27E+01	4.80E+01
	PA-231	9.28		42.00	1.88E-01	1.88E-01	5.87E-03	8.72E-02
		10.11		20.20	6.05E-01		2.38E-01	2.85E-01
		283.67		1.60	1.49E+03		1.42E+02	6.75E+02
		302.67		2.30	2.44E+03		4.54E+03	1.17E+03
	TH-231	25.64		14.70	1.42E+01	1.42E+01	-4.43E+00	6.82E+00
		84.21		6.40	5.95E+02		3.30E+03	2.92E+02
	PA-234M	9.89		89.00	1.29E-01	1.29E-01	5.07E-02	6.06E-02
		21.72		64.90	2.31E+00		3.74E+00	1.11E+00
		37.93		23.75	3.37E+01		1.10E+02	1.65E+01
		131.42		20.40	9.97E+01		6.76E+00	4.68E+01
+	TH-234	63.29	*	3.80	4.21E+02	4.21E+02	9.94E+02	2.05E+02
	NP-237	29.37	*	14.00	3.11E+01	3.11E+01	8.84E+02	1.51E+01
		86.50		12.60	1.04E+02		4.36E+00	4.93E+01
	U-237	97.08		16.30	7.68E+01	5.50E+01	-1.10E+02	3.58E+01
		101.07		26.30	5.50E+01		-1.07E+01	2.58E+01
		114.00		12.30	2.57E+02		6.60E+02	1.24E+02
		208.01		22.00	1.27E+02		1.70E+01	5.94E+01
	AM-241	59.54		35.90	3.62E+01	3.62E+01	6.20E+01	1.75E+01
	AM-243	74.67		66.00	1.77E+01	1.77E+01	3.31E+00	8.41E+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

0142

0000073384.CNF



0143

LA48503X

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SECTION XI

ANALYTICAL DATA (TOTAL DISSOLVED SOLIDS)

Eberline Services - Oak Ridge
Version 1.0 9/1999

TDS / TSS Worksheet

Printed: 10/11/2018 4:06 AM

Work Order	Run	Analysis Code	Technician
18-10038	1	TDS	MHIGHTOWER

TRetec Fraction	SGS North America Inc. Client ID	Aliquot ml	Filter Data Filter Tare (g)	Filter Final (g)	Filter Net (g)	TDS/TSS (mg/L)	Maximum Aliq (mL)
04	MASON RELIEF WELL	50.0000	111.3698	111.4016	0.0318	636.0000	157.23
05	HANSON RELIEF WELL	50.0000	98.3835	98.4132	0.0297	594.0000	168.35

0145

Technician: MH Date: 10 / 11 / 18

Eberline Analytical
Oak Ridge Laboratory

Aliquot Worksheet

Printed: 10/11/2018 4:07 AM

Work Order	Run	Analysis Code	Rpt Units	Lab Deadline	Technician
18-10038	1	TDS	liters	10/30/2018	MHIGHTOWER

Lab Fraction	SGS North America Inc. Client ID	Sample Type	Muffle Data	Dilution Data			Aliquot Data		MS Aliquot Data		H-3 Solids Only	
			Ratio Post/Pre	No of Dils	Dil Factor	Ratio	Aliquot	Net Equiv	Aliquot	Net Equiv	Water Added (ml)	H3 Dist Aliq
01	LCS	LCS				1.00E+00	1.0000E+00	1.0000E+00				
02	BLANK	MBL				1.00E+00	1.0000E+00	1.0000E+00				
03	DUP	DUP				1.00E+00	5.0000E-02	5.0000E-02				
04	MASON RELIEF WELL	TRG				1.00E+00	5.0000E-02	5.0000E-02				
05	HANSON RELIEF WELL	TRG				1.00E+00	5.0000E-02	5.0000E-02				

Comments	

0146

Technician: MH Date: 10/11/18

Misc. Forms

Custody Documents and Other Forms

Includes the following where applicable:

- Chain of Custody

HYDRO-ENVIRONMENTAL TECHNOLOGY, INC.
Environmental Consultants
P.O. Box 60295
Lafayette, LA 70596-0295
Phone (337) 261-1963 FAX (337) 261-1953

LA 48503

SAMPLE CHAIN-OF-CUSTODY RECORD

Project Name: Indigo
Project Number: 8060.00
Project Location: DeSoto Parish, Louisiana
Laboratory: Eberline
Collected By: KC/WP
Company: Hydro-Environmental Technology, Inc.
Date: 10/8/2018

	Sample I.D.	Type	Date/Time Sampled		Containers	Analysis Requested/Method	Comments	
1	Mason Relief Well	AQ	10/8/2018	11:00	(2) Liter Plastic HNO3 (1) 250mL Plastic	Radium 226, Radium 228, TDS	4°C	3
2	Hanson Relief Well	AQ	10/8/2018	14:00	(2) Liter Plastic HNO3 (1) 250mL Plastic	Radium 226, Radium 228, TDS	4°C	3

OL

Temp: 4.6 dr 441 No/cs c/o

Relinquished By: Ken J. Ogger
Date/Time: 10/09/18 0900

Relinquished By: REC: Walter Newman
Date/Time: 10.9.18 0900

Relinquished By:
Date/Time:

Relinquished By:
Date/Time:

Analysis Due: Verbal:
Written:

Page 1 of 1

3.1 3

LA48503X: Chain of Custody
Page 1 of 2

SGS Sample Receipt Summary

Job Number: LA48503 **Client:** HYDRO - ENV. **Project:** INDIGO

Date / Time Received: 10/9/2018 9:00:00 AM **Delivery Method:** Client **Airbill #'s:**

Cooler Temps (Initial/Adjusted): #1: (4.6/4.6); DV441

Cooler Security	Y	or	N		Y	or	N
1. Custody Seals Present:	☐		☑	3. COC Present:	☑		☐
2. Custody Seals Intact:	☐		☑	4. Smpl Dates/Time OK	☑		☐

Cooler Temperature	Y	or	N
1. Temp criteria achieved:	☑		☐
2. Thermometer ID:	DV441;		
3. Cooler media:	Ice (direct contact)		
4. No. Coolers:	1		

Quality Control _Preservation	Y	or	N	N/A
1. Trip Blank present / cooler:	☐		☐	☑
2. Trip Blank listed on COC:	☐		☐	☑
3. Samples preserved properly:	☑		☐	
4. VOCs headspace free:	☐		☐	☑

Sample Integrity - Documentation	Y	or	N
1. Sample labels present on bottles:	☑		☐
2. Container labeling complete:	☑		☐
3. Sample container label / COC agree:	☑		☐

Sample Integrity - Condition	Y	or	N
1. Sample recvd within HT:	☑		☐
2. All containers accounted for:	☑		☐
3. Condition of sample:	Intact		

Sample Integrity - Instructions	Y	or	N	N/A
1. Analysis requested is clear:	☑		☐	
2. Bottles received for unspecified tests	☐		☑	
3. Sufficient volume recvd for analysis:	☑		☐	
4. Compositing instructions clear:	☐		☐	☑
5. Filtering instructions clear:	☐		☐	☑

Comments

LA48503X: Chain of Custody
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