Lindsay Light Field Report Gamma Survey and Sample Collection U.S. EPA Region 5 Emergency Response

Site Name:	161 E Grand Ave
Operable Unit:	Lindsay Light II Site OU17
Date of Field Work:	June 14, 2021
EPA/START Personnel:	Adam Peterca (START / Tetra Tech)
	Kirsten Myles (START / Tetra Tech)
	Verneta Simon (USEPA)
	Eugene Jablonowski (USEPA)

Summary of Environmental Conditions

- During historical construction/excavation activities at the 161 E Grand Ave property radioactive contamination in soil/fill has been identified. Current utility installation plans required excavation of soil/fill in areas where radioactive contamination was suspected to be present, but had not been remediated during previous clean-up efforts. Due to the history of contaminated material in the vicinity of the utility excavation and the relatively small size of the excavation EPA and START were present during all excavation activities.
- Excavation was conducted by Electric Conduit Construction (ECC). Radiation monitoring during excavation was conducted by Stan A. Huber Consultants, Inc. (SAHCI).
- Elevated levels of gamma radiation were observed by SAHCI within the excavation. Material with elevated levels of gamma radiation was segregated from other material and placed in designated containers for future disposal.
- Excavation activities terminated at the planned excavation extent based on the requirements for utility installation. When excavation was completed, an area of material with elevated gamma radiation remained in place along the northern wall of the excavated trench.

Description of EPA/START Activities

- Verneta Simon (USEPA), Adam Peterca (START / Tetra Tech), and Kirsten Myles (START / Tetra Tech) arrived at the excavation site at approximately 08:35 on June 14, 2021. Kirsten Myles left the site at approximately 09:40 to respond to an unrelated emergency response. Gene Jablonowski (USEPA) arrived at the excavation site at approximately 10:00.
- The instrument used by Tetra Tech for gamma surveying was a Ludlum Model 2221 scaler/ratemeter (Serial Number 106678) with a Ludlum 44-10 sodium iodide detector (Serial Number PR292700) with a 6-inch lead shield, calibrated on April 21, 2021 with a 7.1 picocurie per gram (pCi/g) cutoff of 5,828 counts per minute (cpm).

- Tetra Tech completed a post-excavation walkover gamma survey of the excavated area at approximately 12:00. The excavated area was considered one survey unit.
 - Gamma readings of the floor of the survey unit ranged from 2,009 to 5,256 cpm. Gamma readings of the walls of the survey unit ranged from 1,612 to 12,000 cpm. The area of the excavation wall with elevated gamma readings above the instrument-specific cutoff level was a known area of contamination that was intentionally left in place. A soil sample was collected from this portion of the excavation wall to document the gamma radiation levels left in place.
- Tetra Tech collected the following samples from the excavation:
 - A 5-point composite soil sample from the floor of the survey unit for gamma spectroscopy analysis (sample field ID LL-210614-F) and a corresponding soil sample for dry weight moisture analysis.
 - A 5-point composite soil sample from the area of the excavation wall that exceeded the instrument-specific cutoff level for gamma spectroscopy analysis (sample field ID LL-210614-W) and a corresponding soil sample for dry weight moisture analysis.

Summary of Sample Results

Samples were sent to ALS Environmental (ALS) in Fort Collins, Colorado for gamma spectroscopy analysis. The results are summarized in the table below.

Sample Field ID	Sample Lab ID	Sample Ra-228 (pCi/g)	Sample Ra-226 (pCi/g)	Ra-228 plus Ra- 226 (pCi/g)
LL-210614-F	2106442-1	0.950	0.518	1.468
LL-210614-W	2106442-2	21.000	2.240	23.240

Table 1: Verification Sampling Analytical Results

Notes: DUP – Duplicate ID – Identification pCi/g – Picocuries per gram

Ra – Radium

Attachments

1. ALS report of gamma spectroscopy results for the samples collected by EPA.

Prepared by:

Name:

Adam Peterca, START / Tetra Tech

Signature:

Atem f. Peterion

Date:

February 3, 2022

Reviewed by:

 Name:
 Eugene Jablonowski, Health Physicist, U.S. EPA Region 5

 Signature:
 EUGENE JABLONOWSKI JABLONOWSKI

 Date:
 2022.02.24 08:39:57 -0600

Date: February 24, 2022



Gamma Spectroscopy Case Narrative

Tetra Tech, Inc.

Lindsay Light - 161 E Grand Alley

Work Order Number: 2106442

- 1. This report consists of analytical results and supporting documentation for two solid samples received by ALS on 06/16/2021.
- 2. These samples were prepared according to the current revision of SOP 739. The samples were sealed in steel cans on 06/19/2029 and stored for at least 21 days to allow ²²²Rn to approach secular equilibrium with its parent, ²²⁶Ra. The degree of ingrowth achieved prior to analysis on 07/11/2021 is at least 97.8%. Conservatively assuming a radon emanation efficiency of approximately 50%, the effective radon progeny ingrowth for these samples would be greater than 98.9%.
- 3. The samples were analyzed for the presence of gamma emitting radionuclides according to the current revision of SOP 713. The analyses were completed on 07/11/2021.
- 4. The results for these samples are reported on a "Dry Weight" basis in units of pCi/gram.
- 5. Sample volumes were insufficient to allow preparation of a duplicate. A duplicate analysis of sample 2106442-1 was performed in lieu of a prepared duplicate.
- 6. Activity concentrations above the calculated MDC are reported in some instances where minimum nuclide identification criteria are not met. Such tentative identifications result when the software attempts to calculate net activity concentrations for analytes where either one or both of the following criteria are not satisfied: the 'diagnostic' peak for a nuclide must be identified above the critical level, or the minimum library peak abundance must be attained. Nuclides not meeting these requirements have been flagged with a "TI" qualifier.



- 7. In cases where there are no peaks found in the peak search routine, the software performs a net quantification. This indicates that nuclides are not detected or supported at any level above the reported MDC. Consequently, these nuclides are flagged with an "NQ" qualifier on the final reports. Please refer to the Technical Bulletin Addendum in section 5 of this report.
- 8. The volume of these samples was not within 0.5 cm of the associated calibration volume as required per the current revision of SOP 739. Therefore, any reported results for these samples are identified with a "J" qualifier, indicating the activity values to be an estimated value. Results are reported without further qualification.
- 9. Technical considerations made in the creation of the gamma spectroscopy library used in this analysis are detailed in the document "Technical Comments Regarding Gamma Spectroscopy Libraries" found in Section 5.
- 10. ALS uses the following convention for reporting significant digits in the TPU and MDC results. The TPU value is rounded to two significant digits. The MDC value is rounded to the same decimal place as the TPU value. In practice, this could result in an MDC reported value of zero for samples with significant activity, including the batch laboratory control sample.
- 11. No further problems were encountered with either the client's samples or the associated quality control samples. All remaining quality control criteria were met.

The data contained in the following report have been reviewed and approved by the personnel listed below. In addition, ALS certifies that the analyses reported herein are true, complete and correct within the limits of the methods employed.

J@an Anderson Radiochemistry Primary Data Reviewer

Radiochemistry Final Data Reviewer

<u>7/15/21</u> Date

7/22/21 Date

0

Section 1

CHAIN OF CUSTODY

ALS -- Fort Collins

Sample Number(s) Cross-Reference Table

OrderNum: 2106442 Client Name: Tetra Tech, Inc. Client Project Name: Lindsay Light - 161 E Grand Alley Client Project Number: Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
LL-210614-F	2106442-1		SOLID	14-Jun-21	12:03
LL-210614-W	2106442-2		SOLID	14-Jun-21	12:14

2106447 REGION 5 Chicago, Illinois 60604									Ship To: ALS FART COLLENS 225 COMMERCE DREWE		ATTN: Airbill Number	Chain of Custody Seal Numbers	5+823 5-63733
CHAIN OF CUSTODY RECORD		ALESS A					 		57260 12/11/9		Date / Time	aboratory File	
CHAIN OF CU	CON-CON-CON-CON-CON-CON-CON-CON-CON-CON-	STATION LOCATION		4-W					ime Received by: (Signature)	Received by: (Signature)	Received for Laboratory by: (Signature)	Distribution: White - Accompanies Shipment: Pick - Coordinator Flad Files: Vallow - Laboratory File	1
ENVIRONMENTAL PROTECTION AGENCY Office of Enforcement	PROJECT NAME LENDSAY LEGHT - 161 E, GRAND It Name and Sign) IECA / ALL A. F. F. F.	A COMP. GRAB							 Date / 1 6/i4/21	gnature) Date / Time	gnature) Date / Time	on: White - Accompanies Shinment	Printed on Recycled Paper/Printed with Soy-Based Ink
ENVIRONMENTAL P Office of E	PROJ. NO. PROJECT NAME LENDSAY LT SAMPLERS: (Print Name and Sign) Abam Reverce Att A	STA. NO. DATE	(/14/21 203						 Relinquished by: (Signature)	Relinquished by: (Signature)	Relinquished by: (<i>Signature)</i>	Dif 17	Brinted on Recyc



ALS Environmental - Fort Collins CONDITION OF SAMPLE UPON RECEIPT FORM

Client:	TETRA TECH	Worko	rder No:	2	106442		
– Project Manager:	JME	Initials:		Date:	06/2	16/2021	
-					N/A	YES	NO
^{1.} Are airbills / shipping	documents present and/or	removable?			,	_	-
Tracking number: 2	•					Х	
	shipping containers intact?				Х		
^{3.} Are custody seals on	sample containers intact?				Х		
^{4.} Is there a COC (chain	-of-custody) present?					Х	
5.	ent with samples received? equested analyses, etc.)	(IDs, dates, times, # c	of samples,	# of		х	
6. Are short-hold sampl	es present?						Х
7. Are all samples withi	n holding times for the requ	ested analyses?				Х	
^{8.} Were all sample cont	ainers received intact? (not	broken or leaking)				Х	
^{9.} Is there sufficient sar	mple for the requested analy	vses?				Х	
10. Are samples in prope Guidelines)	er containers for requested a	nalyses? (form 250, S	ample Handl	ing		х	
^{11.} Are all aqueous samp	oles preserved correctly, if re	equired? (excluding	volatiles)		Х		
17	ring no headspace (VOC, GR ameter? (i.e. size of green pe) free of bu	ıbbles	х		
^{13.} Were the samples sh	ipped on ice?						Х
^{14.} Were cooler temperatu	ires measured at 0.1-6.0°C?	IR gun used*: #5			RAD ONLY		х
Cooler #:	1						
Temperature (°C):	AMB						
# of custody seals on cooler:	0						
External µR/hr reading:	11						
Background µR/hr reading:	12						
Were external µR/hr reading	s ≤ two times background and within D	OT acceptance criteria?	ES				
* Please provide details her	re for NO responses to boxes abo	ove - for 2 thru 5 & 7 th	hru 12, notif	y PM &	continue	w/ login.	
Were unpreserved bo	ottles pH checked? NA	All client bottle	ID's vs ALS la	ab ID's c	double-ch	ecked by	JE
	ontacted? YES / NO / NA Contact:				Date/1	-	1
Project Manager Signatur		nii E	lline	_			

*IR Gun #5, VWR SN 192272629

Section 2



SAMPLE RESULTS SUMMARY

Due to the nature of gamma spectroscopy data, a summary report is not provided.

Please refer to the individual sample results in Section 4.

Section 3

QC RESULTS SUMMARY

Gamma Spectroscopy Results PAI 713 Rev 15 Method Blank Results

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442 Client Name: Tetra Tech, Inc.

Library: NATURAL(SUB

ClientProject ID: Lindsay Light - 161 E Grand Alley

Lab ID: GS210619-1MB

Sample Matrix: SOLID Prep SOP: PAI 739 Rev 13 Date Collected: 19-Jun-21

Date Prepared: 19-Jun-21

Date Analyzed: 11-Jul-21

Prep Batch: GS210619-1 QCBatchID: GS210619-1-1 Run ID: GS210619-1A Count Time: 1000 minutes

Abbreviations:

TPU - Total Propagated Uncertainty

BDL - Below Detection Limit

MDC - Sample specific Minimum Detectable Concentration

Final Aliquot: 500 g Result Units: pCi/g File Name: 210799d01

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.009 +/- 0.052	0.087	1	NA	U
14913-49-6	Bi-212	0.130 +/- 0.094	0.149	1	NA	U
14733-03-0	Bi-214	0.004 +/- 0.035	0.058	1	NA	U
13966-00-2	K-40	0.05 +/- 0.27	0.45	2	NA	U
378783-76-7	Pa-234m	0.9 +/- 1.2	1.9	35	NA	U
15092-94-1	Pb-212	0.011 +/- 0.019	0.032	1	NA	U
15067-28-4	Pb-214	0.013 +/- 0.022	0.037	1	NA	U
15262-20-1	Ra-228	0.009 +/- 0.052	0.087	1	NA	U
14274-82-9	Th-228	0.009 +/- 0.052	0.087	1	NA	U
15065-10-8	Th-234	0.03 +/- 0.23	0.38	2	NA	U
14913-50-9	TI-208	0.006 +/- 0.018	0.030	1	NA	U

Comments:

Qualifiers/Flags:

- ${\sf U}_{\rm c}$ Result is less than the sample specific MDC or less than the associated TP
- Y1 Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 Chemical Yield outside default limits.
- SQ Spectral quality prevents accurate quantitation.
- SI Nuclide identification and/or quantitation is tentative.
- TI Nuclide identification is tentative.
- R Nuclide has exceeded 8 halflives.
- M Requested MDC not met.
- B Analyte concentration greater than MDC.
- B3 Analyte concentration greater than MDC but less than Requested MDC.
- DL Decision Level

Gamma Spectroscopy Results PAI 713 Rev 15 Method Blank Results

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442 Client Name: Tetra Tech, Inc.

ClientProject ID: Lindsay Light - 161 E Grand Alley

Lab ID: GS210619-1M

Library: RA226.LIB

Sample Matrix: SOLID Prep SOP: PAI 739 Rev 13 Date Collected: 19-Jun-21 Date Prepared: 19-Jun-21 Date Analyzed: 11-Jul-21 Prep Batch: GS210619-1 QCBatchID: GS210619-1-1 Run ID: GS210619-1A Count Time: 1000 minutes Final Aliquot: 500 g Result Units: pCi/g File Name: 210799d01A

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.031 +/- 0.014	0.022	1	NA	NQ

Comments:

Qualifiers/Flags:

- ${\sf U}~$ Result is less than the sample specific MDC or less than the associated TP
- Y1 Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 Chemical Yield outside default limits.
- SQ Spectral quality prevents accurate quantitation.
- SI Nuclide identification and/or quantitation is tentative.
- TI Nuclide identification is tentative.
- R Nuclide has exceeded 8 halflives.
- M Requested MDC not met.
- B Analyte concentration greater than MDC.
- B3 Analyte concentration greater than MDC but less than Requested MDC.
- DL Decision Level

Data Package ID: GSS2106442-1

Abbreviations:

TPU - Total Propagated Uncertainty

- MDC Sample specific Minimum Detectable Concentration
- BDL Below Detection Limit

PAI 713 Rev 15

Laboratory Control Sample(s)

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc.

Library: ANALYTICAL.LI

ClientProject ID: Lindsay Light - 161 E Grand Alley

Lab ID: GS210619-1LCS

Sample Matrix: SOLID Prep SOP: PAI 739 Rev 13 Date Collected: 19-Jun-21 Date Prepared: 19-Jun-21 Date Analyzed: 11-Jul-21 Prep Batch: GS210619-1 QCBatchID: GS210619-1-1 Run ID: GS210619-1A Count Time: 30 minutes Final Aliquot: 500 g Result Units: pCi/g File Name: 210798d01

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Contro I Limits	Lab Qualifier
14596-10-2	Am-241	204 +/- 25	8	200.2	102	85 - 115	Р
10198-40-0	Co-60	86 +/- 10	0	85.67	101	85 - 115	Р
10045-97-3	Cs-137	78.6 +/- 9.3	0.6	76.29	103	85 - 115	Р

Comments:

Qualifiers/Flags:

Data Package ID: GSS2106442-1

activity is greater than the reported MDC.

Abbreviations:

PAI 713 Rev 15 Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc. ClientProject ID: Lindsay Light - 161 E Grand Alley

Field ID: LL-210614-F Lab ID: 2106442-1DUP Library: NATURAL(SUB		Sample Matrix: SOLID Prep SOP: PAI 73 Date Collected: 14-Jun Date Prepared: 19-Jun Date Analyzed: 11-Jul-	9 Rev 13 -21 -21	QCBate Ru Count T	atch: GS210619-1 chID: GS210619-1-1 n ID: GS210619-1A 'ime: 1000 minutes asis: Dry Weight	Final Alique Prep Bas Moisture(% Result Unit File Nam			
		Sample Result +/- 2 s TPU	e MDC	Flags	Dupli Result +/- 2 s TPU	cate MDC	Flags	DER	DER Lim
14331-83-0	Ac-228	0.95 +/- 0.13	0.12	J	1.01 +/- 0.13	0.08	J	0.315	2.13
14913-49-6	Bi-212	1.02 +/- 0.24	0.30	J	1.09 +/- 0.19	0.18	J	0.205	2.13
14733-03-0	Bi-214	0.507 +/- 0.078	0.082	J	0.50 +/- 0.10	0.14	J	0.0854	2.13
13966-00-2	K-40	6.75 +/- 0.91	0.61	J	7.21 +/- 0.89	0.29	J	0.362	2.13
378783-76-7	Pa-234m	1.6 +/- 1.8	3.0	U,J	2.9 +/- 1.8	2.8	J	0.516	2.13
15092-94-1	Pb-212	0.97 +/- 0.12	0.05	J	1.08 +/- 0.13	0.04	J	0.613	2.13
15067-28-4	Pb-214	0.523 +/- 0.070	0.053	J	0.574 +/- 0.074	0.053	J	0.497	2.13
15262-20-1	Ra-228	0.95 +/- 0.13	0.12	J	1.01 +/- 0.13	0.08	J	0.315	2.13
14274-82-9	Th-228	0.95 +/- 0.13	0.12	J	1.01 +/- 0.13	0.08	J	0.315	2.13
15065-10-8	Th-234	1.36 +/- 0.43	0.63	J,TI	1.31 +/- 0.30	0.41	J,TI	0.0919	2.13
14913-50-9	TI-208	0.322 +/- 0.045	0.037	J	0.319 +/- 0.041	0.022	J	0.049	2.13

Comments:

Duplicate Qualifiers/Flags:		Abbreviations:
U - Result is less than the sample specific MDC.		TPU - Total Propagated Uncertainty
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.		DER - Duplicate Error Ratio
Y2 - Chemical Yield outside default limits.		BDL - Below Detection Limit
W - DER is greater than Warning Limit of 1.42		NR - Not Reported
D - DER is greater than Control Limit of 2.13		
LT - Result is less than Request MDC, greater than sample specific MDC		
M - Requested MDC not met.	20. Constral quality provide accurate quantitation	
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.	SQ - Spectral quality prevents accurate quantitation.	
L - LCS Recovery below lower control limit.	SI - Nuclide identification and/or quantitation is tentative.	
H - LCS Recovery above upper control limit.	TI - Nuclide identification is tentative.	
P - LCS, Matrix Spike Recovery within control limits.	R - Nuclide has exceeded 8 halflives.	
N - Matrix Spike Recovery outside control limits	G - Sample density differs by more than 15% of LCS density.	

PAI 713 Rev 15 Duplicate Sample Results (DER)

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442 Client Name: Tetra Tech, Inc.

ClientProject ID: Lindsay Light - 161 E Grand Alley

Field ID:LL-210614-FLab ID:2106442-1DUPLibrary:RA226.LIB		Sample Matrix: SOLID Prep SOP: PAI 739 Date Collected: 14-Jun- Date Prepared: 19-Jun- Date Analyzed: 11-Jul-2	21 21	QCBa R Count	Batch: GS210619-1 tchID: GS210619-1-1 un ID: GS210619-1A Time: 1000 minutes Basis: Dry Weight	Final Aliquo Prep Basi Moisture(% Result Unit File Nam			
CASNO	Analyte	Sample Result +/- 2 s TPU	Sample Result +/- 2 s TPU MDC		Dupl Result +/- 2 s TPU	licate MDC	Flags	DER	DER Lim
13982-63-3	Ra-226	0.518 +/- 0.067 0.053			0.566 +/- 0.070	0.053	J	0.492	2.13

Comments:

Duplicate Qualifiers/Flags:		Abbreviations:
U - Result is less than the sample specific MDC.		TPU - Total Propagated Uncertainty
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed	l.	DER - Duplicate Error Ratio
Y2 - Chemical Yield outside default limits.		BDL - Below Detection Limit
W - DER is greater than Warning Limit of 1.42		NR - Not Reported
D - DER is greater than Control Limit of 2.13		NR - Not Reported
LT - Result is less than Request MDC, greater than sample specific MDC		
M - Requested MDC not met.	CO. Spectral quality proverts accurate quantitation	
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.	SQ - Spectral quality prevents accurate quantitation.	
L - LCS Recovery below lower control limit.	SI - Nuclide identification and/or quantitation is tentative.	
H - LCS Recovery above upper control limit.	TI - Nuclide identification is tentative.	
P - LCS, Matrix Spike Recovery within control limits.	R - Nuclide has exceeded 8 halflives.	
N - Matrix Spike Recovery outside control limits	G - Sample density differs by more than 15% of LCS density.	

Section 4

INDIVIDUAL SAMPLE RESULTS



Gamma Spectroscopy Results PAI 713 Rev 15 **Sample Results**

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc.

ClientProject ID: Lindsay Light - 161 E Grand Alley

Field ID:LL-210614-FLab ID:2106442-1Library:NATURAL(SUB		2-1 Prep SOP: PAI 739 Rev 13 QCBatchID: GS210619-1-1 Date Collected: 14-Jun-21 Run ID: GS210619-1A NATURAL(SUB Date Prepared: 19-Jun-21 Count Time: 1000 minutes Date Analyzed: 10-Jul-21 Report Basis: Dry Weight		Moisture(%): 11.293 Result Units: pCi/g File Name: 210796d01		
CASNO	Target Nuclide	Result +/- 2 s	s TPU MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	0.95 +/- 0.13	3 0.12	1	NA	J
14913-49-6	Bi-212	1.02 +/- 0.24	4 0.30	1	NA	J
14733-03-0	Bi-214	0.507 +/- 0.07	78 0.082	1	NA	J
13966-00-2	K-40	6.75 +/- 0.91	1 0.61	2	NA	J
378783-76-7	Pa-234m	1.6 +/- 1.8	3.0	35	NA	U,J
15092-94-1	Pb-212	0.97 +/- 0.12	2 0.05	1	NA	J
15067-28-4	Pb-214	0.523 +/- 0.07	70 0.053	1	NA	J
15262-20-1	Ra-228	0.95 +/- 0.13	3 0.12	1	NA	J
14274-82-9	Th-228	0.95 +/- 0.13	3 0.12	1	NA	J
15065-10-8	Th-234	1.36 +/- 0.43	3 0.63	2	NA	J,TI

0.322 +/- 0.045

0.037

SQ - Spectral quality prevents accurate quantitation.

TI - Nuclide identification is tentative R - Nuclide has exceeded 8 halflives.

SI - Nuclide identification and/or quantitation is tentative.

G - Sample density differs by more than 15% of LCS density.

1

NA

J

Comments:

14913-50-9

Qualifiers/Flags:

- U Result is less than the sample specific MDC or less than the associated TP
- Y1 Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
- Y2 Chemical Yield outside default limits.
- M3 The requested MDC was not met, but the reported activity is greater than the reported MDC.

TI-208

M - The requested MDC was not met.

Abbreviations:

- TPU Total Propagated Uncertainty
- MDC Sample specific Minimum Detectable Concentration
- **BDL** Below Detection Limit
- DL Decision Level

Gamma Spectroscopy Results PAI 713 Rev 15 Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc. ClientProject ID: Lindsay Light - 161 E Grand Alley

Field ID: LL-210614-F	Sample Matrix: SOLID	Prep Batch: GS210619-1	Final Aliquot: 426 g	
	Prep SOP: PAI 739 Rev 13	QCBatchID: GS210619-1-1	Prep Basis: As Received	
Lab ID: 2106442-1	Date Collected: 14-Jun-21	Run ID: GS210619-1A	Moisture(%): 11.293	
Library: RA226.LIB	Date Prepared: 19-Jun-21	Count Time: 1000 minutes	Result Units: pCi/g	
	Date Analyzed: 10-Jul-21	Report Basis: Dry Weight	File Name: 210796d01A	

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.518 +/- 0.067	0.053	1	NA	J

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

- M3 The requested MDC was not met, but the reported activity is greater than the reported MDC.
- M The requested MDC was not met.

Abbreviations:

- TPU Total Propagated Uncertainty
- MDC Sample specific Minimum Detectable Concentration
- BDL Below Detection Limit
- DL Decision Level

- SQ Spectral quality prevents accurate quantitation.
- SI Nuclide identification and/or quantitation is tentative.
- TI Nuclide identification is tentative.
- R Nuclide has exceeded 8 halflives.
- G Sample density differs by more than 15% of LCS density.

PAI 713 Rev 15

Sample Duplicate Results

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc.

ClientProject ID: Lindsay Light - 161 E Grand Alley

Field ID: LL-210614-F Lab ID: 2106442-1DUP Library: NATURAL(SUB		Sample Matrix: SOLID Prep SOP: PAI 739 Rev 13 Date Collected: 14-Jun-21 Date Prepared: 19-Jun-21 Date Analyzed: 11-Jul-21	Prep Batch: GS210 QCBatchID: GS210 Run ID: GS210 Count Time: 1000 m Report Basis: Dry We	619-1-1 619-1A M inutes Re	nal Aliquot: 426 Prep Basis: As oisture(%): 11.: esult Units: pCi File Name: 210	Received 293 /g
CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
14331-83-0	Ac-228	1.01 +/- 0.13	0.08	1	NA	J
14913-49-6	Bi-212	1.09 +/- 0.19	0.18	1	NA	J
14733-03-0	Bi-214	0.50 +/- 0.10	0.14	1	NA	J
13966-00-2	K-40	7.21 +/- 0.89	0.29	2	NA	J
378783-76-7	Pa-234m	2.9 +/- 1.8	2.8	35	NA	J
15092-94-1	Pb-212	1.08 +/- 0.13	0.04	1	NA	J
15067-28-4	Pb-214	0.574 +/- 0.074	0.053	1	NA	J
15262-20-1	Ra-228	1.01 +/- 0.13	0.08	1	NA	J
14274-82-9	Th-228	1.01 +/- 0.13	0.08	1	NA	J
15065-10-8	Th-234	1.31 +/- 0.30	0.41	2	NA	J,TI
	1			1	1	

0.319 +/- 0.041

Comments:

14913-50-9

Qualifiers/Flags:

- ${\sf U}~$ Result is less than the sample specific MDC or less than the associated TPU.
- Y1 Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 Chemical Yield outside default limits.

TI-208

M - The requested MDC was not met.

 $\ensuremath{\mathsf{M3}}$ - The requested MDC was not met, but thereported activity is greater than the reported MDC.

 $\mathsf{W}\,$ - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

Abbreviations:

TPU - Total Propagated Uncertainty

MDC - Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

Data Package ID: GSS2106442-1

SQ - Spectral quality prevents accurate quantitation.

SI - Nuclide identification and/or quantitation is tentative.

1

NA

J

TI - Nuclide identification is tentative.

0.022

- R Nuclide has exceeded 8 halflives.
- G Sample density differs by more than 15% of LCS density.

Page 1 of 2

PAI 713 Rev 15

Sample Duplicate Results

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc.

ClientProject ID: Lindsay Light - 161 E Grand Alley

CASNO	Target Nuclide	Rosult 1/- 2 s TPU	I	MDC	Poqueste		Lah
		Date Analyzed: 11-Jul-21 Report Basis: Dry Weight		Report Basis: Dry Weight		File Name: 210)805d02A
Librar	y: RA226.LIB	Date Prepared: 19-Jun-21	Count Time: 1000 minutes			Result Units: pCi/g	
Lab ID: 2106	442-1DUP	Date Collected: 14-Jun-21	Run ID: GS210619-1A		•		
		Prep SOP: PAI 739 Rev 13 QCBatchID: GS210619-1-1 Prep Basis: As Recei				Received	
Field ID: LL-2	10614-F	Sample Matrix: SOLID	Pre	p Batch: GS210	619-1	Final Aliquot: 426	δg

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3	Ra-226	0.566 +/- 0.070	0.053	1	NA	J

Comments:

Qualifiers/Flags:

- ${\sf U}~$ Result is less than the sample specific MDC or less than the associated TPU.
- Y1 Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
- Y2 Chemical Yield outside default limits.
- M The requested MDC was not met.
- $\ensuremath{\mathsf{M3}}$ The requested MDC was not met, but thereported activity is greater than the reported MDC.
- W DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

Abbreviations:

- TPU Total Propagated Uncertainty
- MDC Sample specific Minimum Detectable Concentration

BDL - Below Detection Limit

DL - Decision Level

- SQ Spectral quality prevents accurate quantitation.
- SI Nuclide identification and/or quantitation is tentative.
- TI Nuclide identification is tentative.
- R Nuclide has exceeded 8 halflives.
- G Sample density differs by more than 15% of LCS density.

Gamma Spectroscopy Results PAI 713 Rev 15 Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc.

ClientProject ID: Lindsay Light - 161 E Grand Alley

Field ID: LL-210614-W Lab ID: 2106442-2 Library: NATURAL(SUB		Sample Matrix: SOLID Prep SOP: PAI 739 Rev 13 Date Collected: 14-Jun-21 Date Prepared: 19-Jun-21 Date Analyzed: 10-Jul-21	Prep Batch: GS210619-1 QCBatchID: GS210619-1 Run ID: GS210619-1 Count Time: 1000 minutes Report Basis: Dry Weight	-1 Prep Ba A Moisture s Result Ur	Moisture(%): 8.752 Result Units: pCi/g File Name: 210802d02		
CASNO	Target Nuclide	Result +/- 2 s	STPU MDC	Requested MDC	DL	Lab Qualifier	
14331-83-0	Ac-228	21.0 +/- 2.5	0.1	1	NA	J	
14913-49-6	Bi-212	21.9 +/- 2.6	0.5	1	NA	J	
14733-03-0	Bi-214	2.28 +/- 0.27	0.08	1	NA	J	
13966-00-2	K-40	11.9 +/- 1.4	0.3	2	NA	J	
378783-76-7	Pa-234m	2.4 +/- 1.7	2.7	35	NA	U,J	
15092-94-1	Pb-212	21.7 +/- 2.5	0.1	1	NA	J	
15067-28-4	Pb-214	2.20 +/- 0.27	0.13	1	NA	J	
15262-20-1	Ra-228	21.0 +/- 2.5	0.1	1	NA	J	
14274-82-9	Th-228	21.0 +/- 2.5	0.1	1	NA	J	
15065-10-8	Th-234	12.8 +/- 1.6	0.8	2	NA	J	

6.71 +/- 0.79

0.04

SQ - Spectral quality prevents accurate quantitation.

TI - Nuclide identification is tentative. R - Nuclide has exceeded 8 halflives.

SI - Nuclide identification and/or quantitation is tentative.

G - Sample density differs by more than 15% of LCS density.

1

NA

J

Comments:

14913-50-9

Qualifiers/Flags:

- U Result is less than the sample specific MDC or less than the associated TP
- Y1 Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.

TI-208

M - The requested MDC was not met.

Abbreviations:

- TPU Total Propagated Uncertainty
- MDC Sample specific Minimum Detectable Concentration
- BDL Below Detection Limit
- DL Decision Level

Gamma Spectroscopy Results PAI 713 Rev 15 Sample Results

Lab Name: ALS -- Fort Collins

Work Order Number: 2106442

Client Name: Tetra Tech, Inc.

ClientProject ID: Lindsay Light - 161 E Grand Alley

L	.ibrary: RA226.LIB	Date Prepared: 19-Jun-21 Date Analyzed: 10-Jul-21	Count Time: 1000 minutes Report Basis: Dry Weight	Result Units: pCi/g File Name: 210802d02A
	2106442-2	Date Collected: 14-Jun-21	Run ID: GS210619-1A	Moisture(%): 8.752
	LL-210614-W	Sample Matrix: SOLID Prep SOP: PAI 739 Rev 13	Prep Batch: GS210619-1 QCBatchID: GS210619-1-1	Final Aliquot: 444 g Prep Basis: As Received

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	DL	Lab Qualifier
13982-63-3 Ra-226		2.24 +/- 0.27	0.08	1	NA	J

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC or less than the associated TP

Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.

Y2 - Chemical Yield outside default limits.

- M3 The requested MDC was not met, but the reported activity is greater than the reported MDC.
- M The requested MDC was not met.

Abbreviations:

- TPU Total Propagated Uncertainty
- MDC Sample specific Minimum Detectable Concentration
- BDL Below Detection Limit
- DL Decision Level

Data Package ID: GSS2106442-1

SQ - Spectral quality prevents accurate quantitation.

TI - Nuclide identification is tentative. R - Nuclide has exceeded 8 halflives.

SI - Nuclide identification and/or quantitation is tentative.

G - Sample density differs by more than 15% of LCS density.

Section 5

RAW DATA



210796D01.SPC Analyzed by JH ************************************	****									
SEEKER GAMMA ANALYSIS RESULTS PS Version 1 ALS Laboratory Group - Fort Collins	****									
ALS Laboratory Group - Fort Collins										
	.8.4									
GammaScan										
***************************************	****									
Geo 13 / Solid										
Sample ID: 2106442-1 GS210619-1										
Sampling Start: 06/14/2021 12:00:00 Counting Start: 07/10/2021 14:0	00:48									
Sampling Stop: 06/14/2021 12:00:00 Decay Time 6.26E+002	2 Hrs									
Buildup Time 0.00E+000 Hrs Live Time 6000) Sec									
Sample Size	4 Sec									
Collection Efficiency 1.0000 Spc. File	L.SPC									
Detector $#: 1$ (Detector 1)										
Energy (keV) = $-2.02 + 0.501$ *Ch + $0.00E+00$ *Ch ² + $0.00E+00$ *Ch ³ 07/10/2021										
$FWHM(keV) = 0.74 + 0.020*En + 4.70E - 04*En^2 + 0.00E + 00*En^3 08/22/2020$										
Where En = Sqrt(Energy in keV)										
Search Sensitivity: 1.00 Sigma Multiplier: 2.00 Search Start/End: 80/4	4000									
Search Sensicivicy: 1.00 Signa Mulcipiter: 2.00 Search Start/End: 60/4										
PEAK SEARCH RESULTS										
PK. ENERGY ADDRESS NET/MDA UN- C.L. BKG FWHM										
PK. ENERGY ADDRESS NET/MDA UN- C.L. BKG FWHM # (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG										
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG	3									
# (keV) COUNTS COUNTS COUNTS COUNTS FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET	3 < CL									
# (keV) COUNTS COUNTS COUNTS COUNTS FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET Wide	3									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.85 b	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.99 b	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.99 b	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.83 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.99 b 8 89.80 183.25 458 129 100 1864 0.98 c	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-wide 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.99 b 8 89.80 183.25 458 129 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.83 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.99 b 8 89.80 183.25 458 129 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d 10<	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS (keV) FLAC 1 63.46 130.67 66 110 90 1618 0.83 a NET-WID 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.99 b 8 89.80 183.25 458 129 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d <td< td=""><td>3 < CL</td></td<>	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS COUNTS (keV) FLAC 1 63.46 130.67 66 110 90 1618 0.83 a NET-wide 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d 10 99.30 202.21 143 136 110 2080 1.10 a	3 < CL									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAC 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d 10	G < CL e Pk									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.83 a NET 2 66.55 136.85 215 113 90 1618 0.83 b 3 3 70.97 145.66 423 293 239 5502 2.80 c 4 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d	G < CL e Pk									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.85 b Net-Wide 2 66.55 136.85 215 113 90 1618 0.85 c 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864	G < CL e Pk									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d 10 99.30 202.21 143 136 110 2080 1.10 a <	G < CL e Pk									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.83 a NET-Wide 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.99 b 8 89.80 183.25 458 129 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d 10 99.30 202.21 143 136 110 2080 1.10 a	G < CL e Pk									
# (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS COUNTS (keV) FLAG 1 63.46 130.67 66 110 90 1618 0.83 a NET-Wide 2 66.55 136.85 215 113 90 1618 0.85 b 3 70.97 145.66 423 293 239 5502 2.80 c 4 74.80 153.32 1117 155 115 2266 1.13 d 5 77.03 157.75 1523 147 103 1942 1.04 e 6 84.32 172.30 338 157 125 2485 1.36 a 7 87.26 178.17 743 134 100 1864 0.98 c 9 92.96 189.55 949 178 138 2796 1.40 d 10 99.30 202.21 143 136 110 2080 1.10 a <	G < CL e Pk									

PEAK SEARCH RESULTS

PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
21	241.50	485.98	1198	177	134	2330	1.83	
22	257.03	516.98	75	80	64	2330 944	0.83	
23	270.24	543.33	409	105	80	1258	1.14	
24	277.60	558.02	176	121	97	1631	1.42	
25	283.49	569.78	53	78	63	906		b Net< Cl
26	295.26	593.27	1382	125	83	1276	1.24	
27	300.15	603.03	410	100	75	1117	1.18	b
28	328.13	658.87	294	104	81	1207	1.25	a
29	338.39	679.35	1267	120	79	1161	1.25	a
30	351.92	706.34	2385	131	72	957	1.32	A
31	409.55	821.36	133	80	63	781	1.23	A
32	463.07	928.15	341	78	57	636	1.22	A
33	511.09	1023.98	1801	145	97	1265	2.23	a Wide Pk
34	558.46	1118.51	95	66	52	529	1.15 a	a
35	570.47	1142.48	51	65	52	531	1.20 a	a NET< CL
36	583.28	1168.05	2098	121	65	685	1.61 a	a
37	609.43	1220.23	1761	115	64	766	1.64	A
38	666.15	1333.43	94	66	52	518	1.41	A
39	727.44	1455.74	410	82	59	605	1.72 a	A
40	768.90	1538.47	94	56	43	399	1.15	a .
41	785.96	1572.53	49	44	34	273	1.05 a	
42	795.14	1590.84	217	70	53	487	1.80	
43	803.80	1608.12	124	72	56	532	1.89	
44	835.90	1672.18	56	61	48	457	1.44	
45	860.60	1721.48	237	74	55	494	2.15	
46	911.52	1823.09	1251	91	48	399	1.84	
47	934.41	1868.77	87	56	43	346	1.65	
48	964.96	1929.74	281	83	63	558	2.58	
49	969.16	1938.13	771	77	43	349	1.68 1	
50	1000.70	2001.06	44	50	40	293	1.61	
51	1014.80	2029.20	36	62	50	409		a NET< CL
52	1120.62	2240.39	367	67	45	381	1.93	
53	1238.28	2475.20	136	56	42	344	1.85	
54 55	1378.14	2754.29	80	47	36	212	2.48	
55 56	1408.81	2815.51	46 2165	39	30	178	1.86	
	1461.25	2920.16	3165	120	34	184		A HiResid
57 59	1589.24	3175.57	104	31	20	85	1.32	
58 50	1592.63	3182.35	104	53	41	222	3.36 1	
59 60	1622.24	3241.44	57	32	23	101	1.74	
60 61	1631.13	3259.17	28	31	24	110	2.00 1	
61 62	1730.07	3456.62	53	27	18	68	1.64	
62 63	1764.97	3526.28	338	51	29	129	2.82	
63	1848.96	3693.88	23	21	15	56	1.23 a	1

> ALS Laboratory Group - Fort Collins GammaScan

Background File: DET010707.BKG (210707-1 LONGBKGCAL)

Bkg.File Detector #: 1

BACKGROUND SUBTRACT RESULTS

	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW	
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL	FLAG
2	66.55	215	113	90	80	164	134	NET <cl< td=""></cl<>
4	74.80	1117	155	115	994	209	164	
5	77.03	1523	147	103	1478	232	180	
9	92.96	949	178	138	802	232	185	
14	139.91	139	110	88	58	153	126	NET <cl< td=""></cl<>
16	154.21	153	109	88	111	149	121	NET <cl< td=""></cl<>
17	185.96	788	142	107	691	218	174	
18	198.70	194	133	107	21	211	173	NET <cl< td=""></cl<>
20	238.66	6180	194	93	6087	237	147	
26	295.26	1382	125	83	1338	194	148	
30	351.92	2385	131	72	2283	163	108	
33	511.09	1801	145	97	809	268	216	
34	558.46	95	66	52	-88	135	112	NET <cl< td=""></cl<>
36	583.28	2098	121	65	2017	164	113	
37	609.43	1761	115	64	1636	180	132	
43	803.80	124	72	56	6	109	90	NET <cl< td=""></cl<>
46	911.52	1251	91	48	1182	121	81	
49	969.16	771	77	43	729	122	90	
52	1120.62	367	67	45	340	87	65	
53	1238.28	136	56	42	97	97	78	
56	1461.25	3165	120	34	2519	169	112	
62	1764.97	338	51	29	273	91	70	

210/9	6D01.SPC Analyzed by	, 								
SEEKER	FINAL ACTI									
	ALS Laboratory Group - Fort Collins GammaScan									
******	******	*******	*****	******						
	Geo 13 / Solid									
Sample ID: 21064	42-1 GS210619-1									
Sampling Stop: Buildup Time Sample Size Collection Effici	06/14/2021 12:00:0 06/14/2021 12:00:0 0.00e+000 H 3.78e+002 ency 1.000 nce Interval: 95	00 Decay Ti s Live Tim g Real Tim 00 Spectrum	me e e	60000 Sec 60274 Sec 210796D01.SPC						
Eff=10^[-1.10E+0	Detector # (D01)(Sh13).EFF (Geo 2 +1.44E+02*L +-6.30 1 + -8.38E-01 * En	E+01*L^2 +9.	33E+00*L^3]							
-	URAL(SUB RA228).LI	(Natural.LIB	-							
		MDA CONCENTR								
	N E Concentration T (pCi/g) MDA	Critical Level							
115.18 238.63		-02 -01 1.43E+00 -02 4.71E-02	 7.02E-01 2.33E-02	1.27E+14 1.27E+14 1.27E+14						
300.09 U-235 143.76 185.72	9.80E-01 +- 2.39E N 6.47E-02 +- 6.90E I.D	-02 1.13E-01	5.59E-02	6.17E+12						
	x 3.22E-01 +- 2.53E 1.86E-01 +- 1.28E 3.26E-01 +- 2.65E	-02 -01 2.08E-01 -02 3.69E-02	 1.03E-01 1.82E-02	1.27E+14 1.27E+14						
	x 5.23E-01 +- 3.36E 4.48E-01 +- 6.51E 5.50E-01 +- 3.92E	-02 -02 1.00E-01	4.96E-02	1.40E+07 1.40E+07						
Ra-228 Average: 338.40 911.07 968.90	x 9.53E-01 +- 6.10E 9.81E-01 +- 9.28E 9.17E-01 +- 9.35E 9.73E-01 +- 1.63E	-02 1.25E-01 -02 1.28E-01	6.32E-02	5.04E+04 5.04E+04						
Bi-214 Average:	x 5.07E-01 +- 5.12E 5.03E-01 +- 5.53E 5.31E-01 +- 1.36E	-02 -02 8.21E-02	4.06E-02	1.40E+07 1.40E+07						

210796D01.SPC Analyzed by											
MEASURED or MDA CONCENTRATIONS											
▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋▋											
	TRA	N Edgy R	Concentra			0					
Nucl		ERGY E	Concentr			Critical		8			
NUCL	1 de (keV) T	(pCi/g)	MDA	Level	(hrs)				
Bi-2	12 72	 7 17	1.02E+00 +-	 							
Pa-2			1.62E+00 +-								
Fa-2 K-40								-			
			6.75E+00 +-				1.12E+1	-			
			8.73E-01 +- 1.08E-01 +-				1.95E+0				
Cs-1								-			
CR-T	.37 00	1.02 N	2.86E-03 +-	1.216-02	2.03E-02B	9.92E-03	2.64E+0	5			
МБ	ית השמווס מי	OTAT	1.51E+01 +-	1 7150.01 .							
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~~~~				OWN,SUM or							
			==================	-							
PK.	ENERGY	ADDRES	s net	UN-	C.L.	BKG	THATLER				
#	(keV)	CHANNE		CERTAINTY	COUNTS	COUNTS	FWHM				
	(					COUNTS	(keV)	FLAG			
1	63.46	130.6	7 66	110	90	1618	0.83	Deleted			
2	66.55			164	134	1618	0.85	Deleted			
3	70.97			293	239	5502	2.80	Unknown			
4	74.80			209	164	2266	2.80				
- 5	77.03			232	180			Unknown			
6	84.32			157	125	1942	1.04	Unknown			
7	87.26			137	125	2485	1.36	Unknown			
8	89.80			134		1864	0.99	Unknown			
10	99.30			136	100 110	1864	0.98	Unknown			
11	105.40			130		2080	1.10	1121DEsc			
13	129.18				139	2862	1.53	Unknown			
14	139.91	281.8		114	89	1606	0.75	Unknown			
15	143.84	203.2		153 124	126	1572	0.79	Deleted			
16	154.21	311.7		149	101	1886	0.95	Deleted			
18	198.70	400.5			121	1547	0.74	Deleted			
19	209.21	421.5		211	173	1955	1.15	Deleted			
21	241.50	485.9		122	92	1574	0.94	Unknown			
22	241.50	485.9 516.9		177	134	2330	1.83	Unknown			
23	257.03	543.3		80 105	64	944	0.83	Unknown			
25 25	270.24	543.3		105	80	1258	1.14	Unknown			
25 28	328.13	658.8		78	63 81	906	0.76	Deleted			
31	409.55	821.3		104	81	1207	1.25	Unknown			
32	463.07	928.1		80	63	781	1.23	Unknown			
33	403.07 511.09			78	57	636	1.22	Unknown			
				268	216	1265	2.23	Unknown			
34		1118.5		135	112	529	1.15	Deleted			
35		1142.4		65	52	531	1.20	Deleted			
38		1333.4		66	52	518	1.41	Unknown			
40		1538.4		56	43	399	1.15	Unknown			
41		1572.5		44	34	273	1.05	Unknown			
42		1590.8		70	53	487	1.80	Unknown			
43	803.80	1608.1		109	90	532	1.89	Deleted			
		Page 0	05								

Page 005

## 

# UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
44	835.90	1672.18	56	61	48	457	1.44	Unknown
47	934.41	1868.77	87	56	43	346	1.65	Unknown
48	964.96	1929.74	281	83	63	558	2.58	Unknown
51	1014.80	2029.20	36	62	50	409	2.51	Deleted
53	1238.28	2475.20	97	97	78	344	1.85	Unknown
54	1378.14	2754.29	80	47	36	213	2.48	Unknown
55	1408.81	2815.51	46	39	30	178	1.86	Unknown
57	1589.24	3175.57	104	31	20	85	1.32	Unknown
58	1592.63	3182.35	104	53	41	222	3.36	Unknown
59	1622.24	3241.44	57	32	23	101	1.74	Unknown
60	1631.13	3259.17	28	32	24	110	2.00	Unknown
61	1730.07	3456.62	53	27	18	68	1.64	Unknown
62	1764.97	3526.28	273	91	70	129	2.82	Unknown
63	1848.96	3693.88	23	21	15	56	1.23	Unknown

c:\SEEKER\BIN\210796d01.res Analysis Results Saved.

* * * *		210796D01.	SPC Analyz	HC 20 De					
				LYSIS		*******	G Vora	**********	
022		GAAA			KESU.		S Vers	1011 1.0.4	
		i	ALS Laborat	tory Group GammaSca		lins			
****	*******	******	******	******	*****	******	*****	*******	
	Geo 13 / Solid								
Comm	1. TD. 31	L06442-1 G	9210610 1						
sanp	Te ID: 71	LU6442-1 Gi	8210019-1						
Samp Buil	ling Stop dup Time.	<b>06/</b> :	14/2021 12 . 0.00E+00	:00:00   Co :00:00   D <b>e</b> 00 Hrs   Li	cay Time. ve Time .	• • • • •	. 6.2	26E+002 Hrs 60000 Sec	
				+002 g   Re					
				1.0000   Sp					
				 or #: 1 (D					
Ener	av(keV)=	-2.02 +		0.00E+00*C		ጅ∔ዐዐጵሮኬላ3	07/10	/2021	
				4.70E-04*E					
				En = Sgrt(E					
Sear	ch Sensit	vity: 1.0	00   Sigma	Multiplier	: 2.00   S	earch Sta	rt/End	: 80/4000	
			===========				======		
PEAK SEARCH RESULTS									
====									
	********								
PK.	ENERGY	ADDRESS	NET/MDA	 UN-	C.L.	BKG	FWHM		
PK.	ENERGY	ADDRESS	NET/MDA		C.L.	BKG	FWHM		
PK. # 	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS (	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG	
PK.	ENERGY	ADDRESS	NET/MDA	 UN-	C.L.	BKG	FWHM (keV)	FLAG a NET< CL	
РК. #  1	ENERGY (keV) 63.46	ADDRESS CHANNEL 130.67	NET/MDA COUNTS ( 66	UN- CERTAINTY 110	C.L. COUNTS 90	BKG COUNTS 1618	FWHM (keV) 0.83	FLAG a NET< CL Wide Pk	
PK. #  1 2	ENERGY (keV) 63.46 66.55	ADDRESS CHANNEL 130.67 136.85	NET/MDA COUNTS ( 66 215	UN- CERTAINTY 110 113	C.L. COUNTS 90 90	BKG COUNTS 1618 1618	FWHM (keV) 0.83 0.85	FLAG a NET< CL Wide Pk b	
РК. #  1	ENERGY (keV) 63.46 66.55 70.97	ADDRESS CHANNEL 130.67 136.85 145.66	NET/MDA COUNTS ( 66 215 423	UN- CERTAINTY 110 113 293	C.L. COUNTS 90 90 239	BKG COUNTS 1618 1618 5502	FWHM (keV) 0.83 0.85 2.80	FLAG a NET< CL Wide Pk b c	
PK. #  1 2 3 4	ENERGY (keV)  63.46 66.55 70.97 74.80	ADDRESS CHANNEL 130.67 136.85 145.66 153.32	NET/MDA COUNTS ( 66 215 423 1117	UN- CERTAINTY 110 113 293 155	C.L. COUNTS 90 239 115	BKG COUNTS 1618 1618 5502 2266	FWHM (keV) 0.83 0.85 2.80 1.13	FLAG a NET< CL Wide Pk b c d	
PK. # 1 2 3	ENERGY (keV) 63.46 66.55 70.97	ADDRESS CHANNEL 130.67 136.85 145.66	NET/MDA COUNTS ( 66 215 423 1117 1523	UN- CERTAINTY 110 113 293 155 147	C.L. COUNTS 90 239 115 103	BKG COUNTS 1618 1618 5502 2266 1942	FWHM (keV) 0.83 0.85 2.80 1.13 1.04	FLAG a NET< CL Wide Pk b c d e	
PK. #  1 2 3 4 5	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75	NET/MDA COUNTS ( 66 215 423 1117 1523 338	UN- CERTAINTY 110 113 293 155 147 157	C.L. COUNTS 90 90 239 115 103 125	BKG COUNTS 1618 1618 5502 2266 1942 2485	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36	FLAG a NET< CL Wide Pk b c d e a	
PK. # 1 2 3 4 5 6	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30	NET/MDA COUNTS ( 66 215 423 1117 1523 338 743	UN- CERTAINTY 110 113 293 155 147 157 134	C.L. COUNTS 90 239 115 103 125 100	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99	FLAG a NET < CL Wide Pk b c d e a b	
PK. # 1 2 3 4 5 6 7	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17	NET/MDA COUNTS ( 66 215 423 1117 1523 338	UN- CERTAINTY 110 113 293 155 147 157	C.L. COUNTS 90 239 115 103 125 100 100	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98	FLAG a NET < CL Wide Pk b c d e a b c	
PK. #  1 2 3 4 5 6 7 8	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25	NET/MDA COUNTS ( 66 215 423 1117 1523 338 743 458	UN- CERTAINTY 110 113 293 155 147 157 134 129	C.L. COUNTS 90 239 115 103 125 100	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99	FLAG a NET < CL Wide Pk b c d e a b c d	
PK. #  1 2 3 4 5 6 7 8 9	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55	NET/MDA COUNTS ( 66 215 423 1117 1523 338 743 458 949	UN- CERTAINTY 110 113 293 155 147 157 134 129 178	C.L. COUNTS 90 90 239 115 103 125 100 100 138	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10	FLAG a NET < CL Wide Pk b c d e a b c d a b c d a	
PK. #  1 2 3 4 5 6 7 8 9 10	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21	NET/MDA COUNTS 0 66 215 423 1117 1523 338 743 458 949 143	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136	C.L. COUNTS 90 90 239 115 103 125 100 100 138 110	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53	FLAG a NET < CL Wide Pk b c d e a b c d a a a	
PK. #  1 2 3 4 5 6 7 8 9 10 11	ENERGY (keV)  63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30 105.40	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38	NET/MDA COUNTS ( 66 215 423 1117 1523 338 743 458 949 143 158	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171	C.L. COUNTS 90 239 115 103 125 100 100 138 110 139	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50	FLAG a NET < CL Wide Pk b c d e a b c d a a a a a	
PK. # 1 2 3 4 5 6 7 8 9 10 11 12	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30 105.40 114.93	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40	NET/MDA COUNTS ( 66 215 423 1117 1523 338 743 458 949 143 158 67	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77	C.L. COUNTS 90 239 115 103 125 100 100 138 110 139 62	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53	FLAG a NET < CL Wide Pk b c d e a b c d d a a a a a a	
PK. #  1 2 3 4 5 6 7 8 9 10 11 12 13	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30 105.40 114.93 129.18	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40 261.84	NET/MDA COUNTS 0 66 215 423 1117 1523 338 743 458 949 143 158 67 288	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77 114	C.L. COUNTS 90 239 115 103 125 100 100 138 110 139 62 89	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939 1606	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50 0.75 0.79	FLAG a NET < CL Wide Pk b c d e a b c d d a a a a a a	
PK. #  1 2 3 4 5 6 7 8 9 10 11 12 13 14	ENERGY (keV)  63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30 105.40 114.93 129.18 139.91	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40 261.84 283.25	NET/MDA COUNTS 0 66 215 423 1117 1523 338 743 458 949 143 158 67 288 139	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77 114 110	C.L. COUNTS 90 239 115 103 125 100 100 138 110 139 62 89 88	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939 1606 1572	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50 0.75 0.79	FLAG a NET < CL Wide Pk b c d e a b c d a a a a a a b NET < CL	
PK. #  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30 105.40 114.93 129.18 139.91 143.84	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40 261.84 283.25 291.09	NET/MDA COUNTS 0 66 215 423 1117 1523 338 743 458 949 143 158 67 288 139 100	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77 114 110 124	C.L. COUNTS 90 90 239 115 103 125 100 100 138 110 139 62 89 88 101	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939 1606 1572 1886	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50 0.75 0.79 0.95 0.74	FLAG a NET < CL Wide Pk b c d e a b c d a a a a a b NET < CL a	
PK. #  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	ENERGY (keV) 63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30 105.40 114.93 129.18 139.91 143.84 154.21	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40 261.84 283.25 291.09 311.77	NET/MDA COUNTS 0 66 215 423 1117 1523 338 743 458 949 143 158 67 288 139 100 153	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77 114 110 124 109 142	C.L. COUNTS 90 90 239 115 103 125 100 100 138 110 139 62 89 88 101 88 101 88 107	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939 1606 1572 1886 1547 1966	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50 0.75 0.79 0.95 0.74 1.18	FLAG a NET < CL Wide Pk b c d e a b c d a a a a a a b b c c d b c c d b c c d b c c d b c c d b c c d b c c d b c c d b c c d b c c d b c c d b c c d b c c c c	
PK. #  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	ENERGY (keV) 	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40 261.84 283.25 291.09 311.77 375.15	NET/MDA COUNTS 0 66 215 423 1117 1523 338 743 458 949 143 158 67 288 139 100 153 788	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77 114 110 124 109	C.L. COUNTS 90 90 239 115 103 125 100 100 138 110 139 62 89 88 101 88	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939 1606 1572 1886 1547 1966 1955	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50 0.75 0.79 0.95 0.74 1.18 1.15	FLAG a NET < CL Wide Pk b c d e a b c d a a a a a a a a a a a a a a a a a a	
PK. #  2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	ENERGY (keV)  63.46 66.55 70.97 74.80 77.03 84.32 87.26 89.80 92.96 99.30 105.40 114.93 129.18 139.91 143.84 154.21 185.96 198.70	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40 261.84 283.25 291.09 311.77 375.15 400.56	NET/MDA COUNTS ( 66 215 423 1117 1523 338 743 458 949 143 158 67 288 139 100 153 788 194	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77 114 110 124 109 142 133	C.L. COUNTS 90 239 115 103 125 100 100 138 110 139 62 89 88 101 88 101 88 107 107	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939 1606 1572 1886 1547 1966	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50 0.75 0.79 0.95 0.74 1.18	FLAG a NET < CL Wide Pk b c d e a b c d a a a b b c d a a b b c d a a a a a a a a a a a a a a a a a a	
PK. #  2 3 4 5 6 7 8 9 10 11 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	ENERGY (keV) 	ADDRESS CHANNEL 130.67 136.85 145.66 153.32 157.75 172.30 178.17 183.25 189.55 202.21 214.38 233.40 261.84 283.25 291.09 311.77 375.15 400.56 421.54	NET/MDA COUNTS 0 66 215 423 1117 1523 338 743 458 949 143 158 67 288 139 100 153 788 194 574	UN- CERTAINTY 110 113 293 155 147 157 134 129 178 136 171 77 114 110 124 109 142 133 122	C.L. COUNTS 90 90 239 115 103 125 100 100 138 110 139 62 89 88 101 88 101 88 107 107 92	BKG COUNTS 1618 1618 5502 2266 1942 2485 1864 1864 2796 2080 2862 939 1606 1572 1886 1547 1966 1955 1574	FWHM (keV) 0.83 0.85 2.80 1.13 1.04 1.36 0.99 0.98 1.40 1.10 1.53 0.50 0.75 0.79 0.95 0.74 1.18 1.15 0.94	FLAG a NET < CL Wide Pk b c d e a b c d a a a b b c d a a b b c d a a a a a a a a a a a a a a a a a a	

# 

### PEAK SEARCH RESULTS

PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
21	241.50	485.98	 1198	 177				
22	257.03	516.98	75	80	134 64	2330	1.83 1	
23	270.24	543.33	409	105	80	944 1259	0.83	
24	277.60	558.02	176	105	97	1258 1631	1.14	
25	283.49	569.78	53	78	63	906	1.42 8	D NET< CL
26	295.26	593.27	1382	125	83	1276	1.24	
27	300.15	603.03	410	100	75	1117	1.18	
28	328.13	658.87	294	104	81	1207	1.25 a	
29	338.39	679.35	1267	120	79	1161	1.25 4	
30	351.92	706.34	2385	131	72	957	1.32 4	
31	409.55	821.36	133	80	63	781	1.23 a	
32	463.07	928.15	341	78	57	636	1.22 4	
33	511.09	1023.98	1801	145	97	1265		- Wide Pk
34	558.46	1118.51	95	66	52	529	1.15 a	
35	570.47	1142.48	51	65	52	531		A NET< CL
36	583.28	1168.05	2098	121	65	685	1.61 4	
37	609.43	1220.23	1761	115	64	766	1.64 8	
38	666.15	1333.43	94	66	52	518	1.41 a	
39	727.44	1455.74	410	82	59	605	1.72 a	
40	768.90	1538.47	94	56	43	399	1.15 a	
41	785.96	1572.53	49	44	34	273	1.05 a	1
42	795.14	1590.84	217	70	53	487	1.80 a	1
43	803.80	1608.12	124	72	56	532	1.89 1	<b>&gt;</b>
44	835.90	1672.18	56	61	48	457	1.44 a	L
45	860.60	1721.48	237	74	55	494	2.15 a	L
46	911.52	1823.09	1251	91	48	399	1.84 a	L
47	934.41	1868.77	87	56	43	346	1.65 a	L
48	964.96	1929.74	281	83	63	558	2.58 a	L
49	969.16	1938.13	771	77	43	349	1.68 h	<b>)</b>
50	1000.70	2001.06	44	50	40	293	1.61 a	L
51	1014.80	2029.20	36	62	50	409	2.51 a	NET< CL
52	1120.62	2240.39	367	67	45	381	1.93 a	L
53	1238.28	2475.20	136	56	42	344	1.85 a	
54	1378.14	2754.29	80	47	36	212	2.48 a	L
55	1408.81	2815.51	46	39	30	178	1.86 a	L
56	1461.25	2920.16	3165	120	34	184	2.65 a	HiResid
57	1589.24	3175.57	104	31	20	85	1.32 e	
58	1592.63	3182.35	104	53	41	222	3.36 ł	
59	1622.24	3241.44	57	32	23	101	1.74 s	
60	1631.13	3259.17	28	31	24	110	2.00 1	
61	1730.07	3456.62	53	27	18	68	1.64 a	L
62	1764.97	3526.28	338	51	29	129	2.82 a	
63	1848.96	3693.88	23	21	15	56	1.23 a	L

SEEKER BACKGROUND SUBTRACT RESULTS Vers. 2.2.1

ALS Laboratory Group - Fort Collins GammaScan

Background File:. . . . . DET010707.BKG (210707-1 LONGBKGCAL)

Bkg.File Detector #: 1

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BACKGROUND SUBTRACT RESULTS

	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW	
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL FLAG	
		215		90			134 NET <cl< td=""><td></td></cl<>	
4	74.80		155	115	994	209	164	
5	77.03			103	1478	232	180	
9	92.96	949	178	138	802	232	185	
14	139.91	139	110	88	58	153	126 NET <cl< td=""><td></td></cl<>	
16	154.21	153	109	88	111	149	121 NET <cl< td=""><td></td></cl<>	
17	185.96	788	142	107	691	218	174	
18	198.70	194	133	107	21	211	173 NET <cl< td=""><td></td></cl<>	
20	238.66	6180	194	93	6087	237	147	
26	295.26	1382	125	83	1338	194	148	
30	351.92	2385	131	72	2283	163	108	
33	511.09	1801	145	97	809	268	216	
34	558.46	95	66	52	-88	135		
36	583.28	2098	121	65	2017	164	113	
37	609.43	1761	115	64	1636	180		
43	803.80	124	72	56	6	109	90 NET <cl< td=""><td></td></cl<>	
46	911.52	1251	91	48	1182			
49	969.16	771	77	43	729	122		
52	1120.62	367	67	45	340	87		
53	1238.28	136	56	42		97		
56	1461.25	3165						
62	1764.97		51	29		91		

****	210796D01.SPC Analyzed by								
SEEKER FINAL ACTIVITY REPORT Version 2.2.1									
			ALS Labor	ratory Gro	up - Fort (	Collins			
				Gamma					
****	******	******	*******	********	********	******	*****	*****	
				0 12	(				
				<b>Geo 13</b>	/ Solia				
Samp	Sample ID: 2106442-1 GS210619-1								
Samp	ling Sta	rt: 06/	/14/2021	12:00:00	Counting a	Start:	07/10/20	21 14:00:48	
_	-	p: 06/		•	•			26e+002 Hrs	
								60000 Sec	
								6027 <b>4</b> Sec	
								0796D01.SPC	
				•				<b>val:</b> 95 %	
rff:	aiona- T	ile. (D01)		Ctor #: 1 FF (Geo 13	(Detector	<b>L</b> )			
	-			•	Err Car) 1*L^2 +9.33	38+00*1.431	06/25/2	0.21	
					00E+00 * E1				
Libr	ary File	•••••	RA22	6.LIB (Ra	-226 (215g	steel can)	))		
							-		
			MEASU	RED or MDA	CONCENTRAT	rions			
		N	-						
N				ation		Critical		9	
NUCL	.1 <b>de</b> (	keV) T ( <u>r</u>	pc1/g	)	MDA	Level	(hrs)		
Ra-2	26 Ave	rage:x 5.1	8E-01 +-	2.81E-02		• • • •	1.40E+0	7	
		-			1.00E-01				
		1.92 5.5			5.29E-02				
	60	9.31 5.0	)3E-01 +-	5.53E-02	8.21E-02	4.06E-02			
	112	0.29 5.3	31E-01 +-	1.36E-01	2.06E-01	1.01E-01	1.40E+0	7	
				2.81E-02 ]					
	*******								
				-	ESCAPE PE				
PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM		
#	(keV)	CHANNEL		CERTAINTY		COUNTS	(keV)	FLAG	
1	70.97	145.66	423	293	239	5502	2.80	Unknown	
2	74.80	153.32	994	209	164	2266		Unknown	
3	77.03	157.75	1478	232	180	1942		Unknown	
4	84.32	172.30	338	157	125	2485	1.36	Unknown	
5	87.26		743	134	100	1864	0.99	Unknown	
6	89.80		458	129	100	1864	0.98	Unknown	
7	92.96		802	232	185	2796	1.40	Unknown	
		Page 004							

32 of 173

# 

UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. Counts	BKG COUNTS	FWHM	
						COUNTS	(keV)	FLAG
8	99.30	202.21	143	136	110	2080	1.10	1121DEsc
9	105.40	214.38	158	171	139	2862	1.53	Unknown
10	114.93	233.40	67	77	62	939	0.50	Unknown
11	129.18	261.84	288	114	89	1606	0.75	Unknown
12	185.96	375.15	691	218	174	1966	1.18	Unknown
13	209.21	421.54	574	122	92	1574	0.94	Unknown
14	238.66	480.31	6087	237	147	1483	1.12	Unknown
15	241.50	485.98	1198	177	134	2330	1.83	Unknown
16	257.03	516.98	75	80	64	944	0.83	Unknown
17	270.24	543.33	409	105	80	1258	1.14	Unknown
18	277.60	558.02	176	121	97	1631	1.42	Unknown
20	300.15	603.03	410	100	75	1117	1.18	Unknown
21	328.13	658.87	294	104	81	1207	1.25	Unknown
22	338.39	679.35	1267	120	79	1161	1.25	Unknown
24	409.55	821.36	133	80	63	781	1.23	Unknown
25	463.07	928.15	341	78	57	636	1.22	Unknown
26	511.09	1023.98	809	268	216	1265	2.23	Unknown
27	583.28	1168.05	2017	164	113	685	1.61	Unknown
29	666.15	1333.43	94	66	52	518	1.41	Unknown
30	727.44	1455.74	410	82	59	605	1.72	Unknown
31	768.90	1538.47	94	56	43	399	1.15	Unknown
32	785.96	1572.53	49	44	34	273	1.05	Unknown
33	795.14	1590.84	217	70	53	487	1.80	Unknown
34	835.90	1672.18	56	61	48	457	1.44	Unknown
35	860.60	1721.48	237	74	55	494	2.15	Unknown
36	911.52	1823.09	1182	121	81	399	1.84	Unknown
37	934.41	1868.77	87	56	43	346	1.65	Unknown
38	964.96	1929.74	281	83	63	558	2.58	Unknown
39	969.16	1938.13	729	122	90	349	1.68	Unknown
40	1000.70	2001.06	44	50	40	293	1.61	Unknown
42	1238.28	2475.20	97	97	78	344	1.85	Unknown
43	1378.14	2754.29	80	47	36	213	2.48	Unknown
44	1408.81	2815.51	46	39	30	178	1.86	Unknown
45	1461.25	2920.16	2519	169	112	184	2.65	Unknown
46	1589.24	3175.57	104	31	20	85	1.32	Unknown
47	1592.63	3182.35	104	53	41	222	3.36	Unknown
48	1622.24	3241.44	57	32	23	101	1.74	Unknown
49	1631.13	3259.17	28	32	24	110	2.00	Unknown
50	1730.07	3456.62	53	27	18	68	1.64	Unknown
51	1764.97	3526.28	273	91	70	129	2.82	Unknown
52	1848.96	3693.88	23	21	15	56	1.23	Unknown
							•	

c:\SEEKER\BIN\210796d01A.res Analysis Results Saved.

				A								
210805D02.SPC Analyzed by JI												
****	*******	G A M M	*********	*******************	*********	********	*******	********				
SEEI	KER	GAMM	A ANAI	LISIS	RESUI	JTS P	S Versi	on 1.8.4				
	ALS Laboratory Group - Fort Collins											
				GammaSca								
****	******	*******	*******	******	*******	******	******	********				
			(	Geo 13 / S	oliđ							
Gome	le TD: 21	06442-1D G	0010610 1									
Saup.	Le ID: 21	.00442-1D G	5210619-1									
-	-		4/2021 12:0		-							
-			4/2021 12:0		-							
	-		0.00E+00	•				60000 Sec 60110 Sec				
-			. 3.78E+(									
			••••±			• • • • • •						
			Detector	r#: 2 (D	etector 2)							
			.501*Ch + (									
FWHM	(keV) =	0.59 + 0	.019*En + 4				07/29/	2020				
			Where E	n = Sqrt(E	nergy in ko	ev)						
Searc	ch Sensit	ivity: 1.0	0   Sigma 1	Multiplier	: 2.00   S	arch Sta	rt/End:	80/4000				
====:							=======					
			PEA	K SEARCH R	ESULTS							
====:			PEA					============				
====: PK. #	ENERGY (keV)			UN-		BKG COUNTS	FWHM	FLAG				
PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG						
PK. # 1	ENERGY (keV) 46.34	ADDRESS CHANNEL 95.44	NET/MDA COUNTS CI	UN- ERTAINTY  100	C.L. COUNTS 80	BKG COUNTS 1423	FWHM (keV) 0.59	FLAG a				
PK. # 1 2	ENERGY (keV) 46.34 53.39	ADDRESS CHANNEL 95.44 109.50	NET/MDA COUNTS CI 138 101	UN- ERTAINTY 100 63	C.L. COUNTS 80 49	BKG COUNTS 1423 677	FWHM (keV) 0.59 0.41	FLAG a a				
PK. # 1 2 3	ENERGY (keV) 46.34 53.39 63.28	ADDRESS CHANNEL 95.44 109.50 129.26	NET/MDA COUNTS CI 138 101 351	UN- ERTAINTY 100 63 110	C.L. COUNTS 80 49 85	BKG COUNTS 1423 677 1613	FWHM (keV) 0.59 0.41 0.66	FLAG a a a				
PK. # 1 2 3 4	ENERGY (keV) 46.34 53.39 63.28 66.23	ADDRESS CHANNEL 95.44 109.50 129.26 135.16	NET/MDA COUNTS C 138 101 351 252	UN- ERTAINTY 100 63 110 143	C.L. COUNTS 80 49 85 114	BKG COUNTS 1423 677 1613 2419	FWHM (keV) 0.59 0.41 0.66 0.97	FLAG a a a b				
PK. # 1 2 3	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45	NET/MDA COUNTS CI 138 101 351 252 210	UN- ERTAINTY 100 63 110 143 94	C.L. COUNTS 80 49 85 114 74	BKG COUNTS 1423 677 1613 2419 1335	FWHM (keV) 0.59 0.41 0.66 0.97 0.50	FLAG a a a b a				
PK. # 1 2 3 4 5	ENERGY (keV) 46.34 53.39 63.28 66.23	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45	NET/MDA COUNTS C 138 101 351 252	UN- ERTAINTY 100 63 110 143	C.L. COUNTS 80 49 85 114	BKG COUNTS 1423 677 1613 2419	FWHM (keV) 0.59 0.41 0.66 0.97 0.50	FLAG a a a b a b				
PK. # 1 2 3 4 5 6 7 8	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20	NET/MDA COUNTS C 138 101 351 252 210 1743	UN- ERTAINTY 100 63 110 143 94 153	C.L. COUNTS 80 49 85 114 74 105	BKG COUNTS 1423 677 1613 2419 1335 2225	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88	FLAG a a a b a b c				
PK. # 1 2 3 4 5 6 7 8 9	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86	NET/MDA COUNTS C 138 101 351 252 210 1743 2671 503 1308	UN- ERTAINTY 100 63 110 143 94 153 164 156 152	C.L. COUNTS 80 49 85 114 74 105 105 123 110	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03	FLAG a a a b b a b c a b b c a b b				
PK. # 1 2 3 4 5 6 7 8 9 10	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45	NET/MDA COUNTS C: 138 101 351 252 210 1743 2671 503 1308 817	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92	FLAG a a a b b c a b c a b c				
PK. # 1 2 3 4 5 6 7 8 9 10 11	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35	NET/MDA COUNTS C 138 101 351 252 210 1743 2671 503 1308 817 1702	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 2957	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33	FLAG a a a b a b c a b c a d				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62	NET/MDA COUNTS CI 138 101 351 252 210 1743 2671 503 1308 817 1702 228	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 2957 2721	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37	FLAG a a a b b c a b c d a				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72	NET/MDA COUNTS C 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 221	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99	FLAG a a a b b c a b c d a a a				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96	NET/MDA COUNTS C: 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97	FLAG a a a b b c a b c d a a b b c d b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c c c				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96	NET/MDA COUNTS C 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 221	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97	FLAG a a a b b c d d a a b b c d d a a a b NET < CL a NET < CL				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77	NET/MDA COUNTS CI 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033 1018	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71	FLAG a a a b b c d d a a b b c d d a a a b NET < CL a NET < CL				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58	NET/MDA COUNTS CI 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80 104 115 191	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78 91 155	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2957 2721 2033 2033 1018 1354 1674 3348	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69	FLAG a a a b b c d d d a a b b c c d d a a b b c c d a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b b c c a a b b b c c a a b b b c c a a b b b c c b b b c c c a b b b c c b b b c c c a a b b b c c a a b b b c c a a b b b c c c a a b b b c c c a a b b b c c c a a b b b c c c a a b b b c c c a a b b b c c c a a b b b c c c a a b b b c c c a a b b b c c c a a b b b c c c c				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07 154.09	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58 310.58	NET/MDA COUNTS CI 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229 130	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80 104 115 191 81	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78 91 155 64	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2218 2957 2721 2033 2033 1018 1354 1674 3348 996	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69 0.45	FLAG a a a b b c d d d a a b b c d d a a b b c c d a a b b c c d a a b b c c d a a b b c c d a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c c a b b c c c a b b c c c c				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07 154.09 185.95	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58 310.58 374.19	NET/MDA COUNTS C: 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229 130 1164	UN- ERTAINTY 100 63 110 143 94 153 164 155 162 145 162 131 129 80 104 115 191 81 140	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78 91 155 64 101	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 221	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69 0.45 1.04	FLAG a a a b b c a b c a b b c a b b c a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a a b b c c a a a b b c c c a a a b b c c a a a a				
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07 154.09 185.95 198.40	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58 310.58 374.19	NET/MDA COUNTS CI 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229 130	UN- ERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80 104 115 191 81	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78 91 155 64	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2218 2957 2721 2033 2033 1018 1354 1674 3348 996	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69 0.45	FLAG a a a b b c a b c a b b c a b b c a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a a b b c c a a a b b c c c a a a b b c c a a a a				

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### PEAK SEARCH RESULTS

PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
22	209.19	420.59	733	 115	83	1404		
23	238.60	479.33	8709	216	83	1404 1479	0.90 a	HiResid
24	241.44	484.99	1259	141	101	14/9		HiResid
25	248.91	499.91	47	76	62	844		NET< CL
26	270.30	542.62	652	133	101	1603	1.26 a	
27	277.40	556.79	251	88	68	928	0.74 a	
28	295.25	592.43	1936	127	76	1054	0.74 a	
29	300.11	602.13	573	104	76	1054	1.05 b	
30	328.04	657.90	359	87	65	841		HiResid
31	338.31	678.41	1574	118	72	966		HiResid
32	351.86	705.46	3410	148	75	949	1.09 a	
33	409.51	820.57	248	81	62	706	1.03 a	
34	427.93	857.34	78	81	65	700	1.03 a	
35	462.98	927.34	558	96	68	812	1.54 a	
36	510.98	1023.18	2894	156	93	1220		Wide Pk
37	558.51	1118.07	205	130 67	50	519	2.20 a 0.94 a	
	562.50	1126.04	205	56				
38					44	433	0.88 b	
39	569.95	1140.92	87	57	44	448	0.81 a	
40	583.22	1167.42	2891	129	59	647	1.29 a	
41	597.64	1196.21	89	137	112	1540	2.57 a	NET< CL
	<i></i>	1010 55			<b>6</b> 0			Wide Pk
42	609.34	1219.57	2774	130	63	738	1.29 a	
43	665.33	1331.36	70	62	49	478	1.12 a	
44	692.24	1385.10	34	44	35	302	0.70 a	NET< CL
					• •			Wide Pk
45	694.96	1390.52	176	117	94	1131	2.51 b	
46	705.45	1411.47	31	47	37	344		NET< CL
47	727.35	1455.20	628	80	52	494	1.37 a	
48	755.51	1511.42	114	78	62	598	1.75 a	
49	768.46	1537.29	200	62	45	400	1.08 a	
50	772.48	1545.32	84	52	40	343	0.94 b	
51	782.10	1564.51	71	53	41	339	1.15 a	
52	785.73	1571.76	177	71	54	484	1.69 b	
53	795.00	1590.27	346	76	54	483	1.57 a	
54	803.19	1606.62	127	59	45	396	1.08 a	
55	830.94	1662.04	17	45	37	303	0.87 a	NET< CL
56	835.66	1671.46	86	65	51	485	1.26 b	)
57	860.58	1721.22	365	66	45	389	1.51 a	L
58	904.78	1809.48	45	47	37	297	1.21 a	L
59	911.37	1822.63	2064	105	43	356	1.50 a	L
60	934.07	1867.96	128	74	58	511	2.36 a	L
61	964.85	1929.41	392	62	39	310	1.36 a	L
62	969.05	1937.79	1217	89	46	387	1.56 b	•
63	1001.10	2001.79	120	71	55	470	2.31 a	L
64	1014.08	2027.72	59	62	49	409	1.92 a	L
65	1120.43	2240.05	522	70	44	356	1.60 a	6
		Page 002						
		<b>-</b> · · · -						

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### PEAK SEARCH RESULTS

РК. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (kev)	FLAG
66	1238.15	2475.10	203	56	40	305	1.51	1
67	1303.51	2605.61	54	36	27	158	1.13	1
68	1327.27	2653.05	34	38	30	179	1.27	1
69	1377.69	2753.71	138	49	35	228	1.94	1
70	1401.41	2801.09	48	44	35	224	2.02	1
71	1408.28	2814.79	81	36	26	149	1.37	b
72	1460.96	2919.98	4416	138	31	179	1.95	a HiResid
73	1510.12	3018.14	78	46	35	203	2.43	9
74	1588.21	3174.06	164	45	31	180	1.74	<b>a</b>
75	1592.23	3182.09	90	44	33	196	1.89	b
76	1620.96	3239.45	57	32	23	115	1.47	<b>A</b>
77	1630.69	3258.89	54	34	25	129	1.60	A
78	1729.80	3456.78	87	31	20	86	1.46	A
79	1764.58	3526.22	475	55	27	129	2.17	<b>A</b>
80	1847.91	3692.61	56	33	24	106	1.92	a

SEEKER BACKGROUND SUBTRACT RESULTS Vers. 2.2.1

ALS Laboratory Group - Fort Collins

GammaScan

Background File: . . . . DET020707.BKG (210707-2 LONGBKGCAL)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW	
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL I	LAG
1	46.34			80				
3	63.28	351		85		214		-
4	66.23		143					C <cl< td=""></cl<>
6		1743	153		1620			
7		2671			2546			
8	84.13	503	156			227		
9	87.12	1308	152	110	1270	208	160	
11	92.87	1702	186	137	1282	254	200	
12	99.52	228	162	131	189	252	206 NE	L <cl< td=""></cl<>
17	139.87	251	115	91	70	186	153 NE:	L_>1
18	143.07	229	191	155	174	216	176 NE:	L <cl< td=""></cl<>
20	185.95	1164	140	101	892	204	160	
21	198.40	251	153	123	-66	212	175 NE:	L <cl< td=""></cl<>
23	238.60	8709	216	89	8456	249	138	
24	241.44	1259	141	101	1162	181	138	
28	295.25	1936	127	76	1872	176	126	
32	351.86	3410	148	75	3215	208	143	
36	510.98	2894	156	93	789	316	256	
37	558.51	205	67	50	-115	135	113 NE	L <cl< td=""></cl<>
39	569.95	87	57	44	13	105	86 NE	L-CL
40	583.22	2891	129	59	2790	157	95	
41	597.64	89	137	112	-39	206	170 NE:	L2>J
42	609.34	2774	130	63	2606	192	133	
54	803.19	127	59	45	-36	125	103 NE	L <cl< td=""></cl<>
59	911.37	2064	105	43	1977	152	101	
65	1120.43	522	70	44	480	90	65	
69		138	49	35		74		
72	1460.96		138				81	
79		475	55	27	426	78	55	

******			nalyzed by	*****	*****	*****	*****				
SEEKER	SEEKER FINAL ACTIVITY REPORT Version 2.2.1										
	ALS Laboratory Group - Fort Collins										
			Gamma								
******	*****	*******	********	******	******	******	******				
			Geo 13	/ Solid							
Sample I	D: 210644	2-1D GS21(	0619-1								
			21 12:00:00	-		07/11/2021 1:					
	-		21 12:00:00	-		6.49e+					
-						60					
-						603					
		-	•			210805					
	L Coniiden		•			ce Interval:					
			etector #: 2								
Efficien	cy File: ()		).EFF (Geo 13	•	-,						
	-		2*L +-4.58E+0		7E+00*L^3]	10/10/2020					
Eff.= EX	P[-2.35E-0	1 + -5.841	E-01 * En + -	1.09E-02 *	En^2] Abo	ve 300.00	ceV				
-		•	A228).LI (Na	-							
	**********										
			ASURED or MDA								
	N										
			ntration		Critical	Halflife					
Nuclide	(keV) T			MDA							
Pb-210	46.50 N		+- 3.47E+00		2.84E+00						
Th-234	92.50		+- 2.60E-01			3.92E+13					
U-235			+- 8.74E-02	1.44E-01	7.13E-02						
	185.72	I.D.	• • • •	• • • •	• • • •						
Pb-212	-		+- 3.13E-02	• • • •	• • • •						
			+- 3.17E-02								
			+- 1.91E-01	2.83E-01	<b>1.39E-01</b>	1.27E+14					
<b>T1-208</b>	-		+- 1.70E-02		• • • •						
			+- 7.96E-02								
			+- 1.80E-02								
	860.47		+- 6.88E-02		<b>4.63E-02</b>						
Pb-214	-		+- 3.05E-02		• • • •						
				7.52E-02	3.72E-02						
	351.99			5.26E-02							
Ra-228	AVerage:X	I.01E+00	+- 4.38E-02	• • • •		5.04E+04					
	-			0 668 00							
	338.40	9.25E-01	+- 6.96E-02		4.25E-02	5.04E+04					
	338.40 911.07	9.25E-01 1.04E+00	+- 6.96E-02 +- 7.97E-02	1.08E-01	4.25E-02 5.32E-02	5.04E+04 5.04E+04					
<b>D:</b> 010	338.40 911.07 968.90	9.25E-01 1.04E+00 1.09E+00	+- 6.96E-02 +- 7.97E-02 +- 8.00E-02	1.08E-01 8.45E-02	4.25E-02 5.32E-02 4.10E-02	5.04E+04 5.04E+04 5.04E+04					
Bi-212	338.40 911.07 968.90 727.17	9.25E-01 1.04E+00 1.09E+00 1.09E+00	+- 6.96E-02 +- 7.97E-02 +- 8.00E-02 +- 1.39E-01	1.08E-01 8.45E-02 1.83E-01	4.25E-02 5.32E-02 4.10E-02 8.94E-02	5.04E+04 5.04E+04 5.04E+04 1.27E+14					
Pa-234m	338.40 911.07 968.90 727.17 1001.03	9.25E-01 1.04E+00 1.09E+00 1.09E+00 2.93E+00	+- 6.96E-02 +- 7.97E-02 +- 8.00E-02 +- 1.39E-01 +- 1.72E+00	1.08E-01 8.45E-02 1.83E-01 2.76E+00	4.25E-02 5.32E-02 4.10E-02 8.94E-02 1.35E+00	5.04E+04 5.04E+04 5.04E+04 1.27E+14 3.92E+13					
	338.40 911.07 968.90 727.17 1001.03	9.25E-01 1.04E+00 1.09E+00 1.09E+00 2.93E+00 4.96E-01	+- 6.96E-02 +- 7.97E-02 +- 8.00E-02 +- 1.39E-01	1.08E-01 8.45E-02 1.83E-01 2.76E+00	4.25E-02 5.32E-02 4.10E-02 8.94E-02	5.04E+04 5.04E+04 5.04E+04 1.27E+14					

====												
MEASURED or MDA CONCENTRATIONS												
		N	<b>-</b> .									
	-		Concentra			Critical	Halflif	e				
Nucl	. <b>1de</b> ()	keV) T	(pCi/g	<b>)</b>	MDA	Level	(hrs)					
	110	 0 20 A			1 377 01							
						6.73E-02 1.72E-01						
K-40						1.40E-01						
						1.11E+00						
Cs-1						6.63E-03						
C9-1	.57 00		./32-03 +-	0.136-03	1.306-025	0.036-03	4.04670	5				
ME	ASURED T	OTAL: 1	.74E+01 +-	7.528+00 1	oCi/a							
				-								
				OWN,SUM or								
====				•								
PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM					
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS		(keV)	FLAG				
2	53.39	109.50	101	63	49	677	0.41	Unknown				
3	63.28	129.26	172	214	175	1613	0.66	Deleted				
4	66.23	135.16	-10	236	194	2419	0.97	Deleted				
5	72.89	148.45	210	94	74	1335	0.50	Unknown				
6	74.77	152.20	1620	207	157	2225	0.88	Unknown				
7	77.03	156.72	. 2546	231	171	2225	0.80	Unknown				
8	84.13	170.90	411	227	184	2588	1.15	Unknown				
9	87.12	176.86	1270	208	160	2218	1.03	Unknown				
10	89.92	182.45	817	145	110	2218	0.92	Unknown				
12	99.52	201.62	189	252	206	2721	1.37	Deleted				
13	105.58	213.72	193	131	105	2033	0.99	Unknown				
14	108.71	219.96	86	129	105	2033	0.97	Deleted				
15	115.41	233.34	59	80	64	1018	0.42	Deleted				
16	129.15		443	104	78	1354	0.71	Unknown				
17	139.87		70	186	153	1674	0.79	Deleted				
19	154.09		130	81	64	996	0.45	Unknown				
21	198.40		-66	212	175	2388	1.25	Deleted				
22	209.19		733	115	83	1404	0.90	Unknown				
24	241.44	484.99	1162	181	138	1726	1.22	Unknown				
25	248.91		47	76	62	844	0.74	Deleted				
26	270.30		652	133	101	1603	1.26	Unknown				
30	328.04		359	87	65	841	0.78	Unknown				
33	409.51		248	81	62	706	1.03	Unknown				
34	427.93		78	81	65	729	1.17	Unknown				
35	462.98		558	96	68	812	1.54	Unknown				
36		1023.18	789	316	256	1220	2.20	Unknown				
37		1118.07	-115	135	113	519	0.94	Deleted				
38		1126.04	81	56	44	433	0.88	Unknown				
39		1140.92	13	105	86	448	0.81	Deleted				
41		1196.21	-39	206	170	1540	2.57	Deleted				
42		1219.57	2606	192	133	738	1.29	SPLIT				
43	665.33	1331.36	70	62	49	478	1.12	Unknown				
		Page 000	D									

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### UNKNOWN, SUM or ESCAPE PEAKS

PK. # 	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. Counts	BKG COUNTS	FWHM (keV)	FLAG
44	692.24	1385.10	34	44	35	302	0.70	Deleted
45	694.96	1390.52	176	117	94	1131	2.51	Unknown
46	705.45	1411.47	31	47	37	344	0.70	Deleted
48	755.51	1511.42	114	78	62	598	1.75	Unknown
49	768.46	1537.29	200	62	45	400	1.08	Unknown
50	772.48	1545.32	84	52	40	343	0.94	Unknown
51	782.10	1564.51	71	53	41	339	1.15	Unknown
52	785.73	1571.76	177	71	54	484	1.69	Unknown
53	795.00	1590.27	346	76	54	483	1.57	Unknown
54	803.19	1606.62	-36	125	103	396	1.08	Deleted
55	830.94	1662.04	17	45	37	303	0.87	Deleted
56	835.66	1671.46	86	65	51	485	1.26	Unknown
58	904.78	1809.48	45	47	37	297	1.21	Unknown
60	934.07	1867.96	128	74	58	511	2.36	Unknown
61	964.85	1929.41	392	62	39	310	1.36	Unknown
64	1014.08	2027.72	59	62	49	409	1.92	Unknown
66	1238.15	2475.10	203	56	40	305	1.51	Unknown
67	1303.51	2605.61	54	36	27	158	1.13	Unknown
68	1327.27	2653.05	34	38	30	179	1.27	Unknown
69	1377.69	2753.71	108	74	58	228	1.94	Unknown
70	1401.41	2801.09	48	45	35	224	2.02	Unknown
71	1408.28	2814.79	81	36	26	149	1.37	Unknown
73	1510.12	3018.14	78	46	35	203	2.43	Unknown
74	1588.21	3174.06	164	45	31	180	1.74	Unknown
75	1592.23	3182.09	90	44	33	196	1.89	Unknown
76	1620.96	3239.45	57	32	23	115	1.47	Unknown
77	1630.69	3258.89	54	34	25	129	1.60	Unknown
78	1729.80	3456.78	87	31	20	86	1.46	Unknown
79	1764.58	3526.22	426	78	55	129	2.17	Unknown
80	1847.91	3692.61	56	33	24	106	1.92	Unknown
82	609.34	1219.57	322	2071	133	738	1.29	1120SEsc

c:\SEEKER\BIN\210805d02.res Analysis Results Saved.

****		10805D02.8	SPC Analyze	ed by JU	******	*****	*****	*****
SEEI	KER	GAMM	A ANA	LYSIS	RESUI	LTS P	S Versi	on 1.8.4
		1	LS Laborat	tory Group		lins		
****	******	******	*******	GammaSca: ***********		******	*****	******
				Geo 13 / S	oliđ			
Sampl	le ID: 21	.06442-1D (	<b>3</b> S210619-1					
Samp Build Samp Colle	ling Stop lup Time. le Size . action Ef	ficiency	L4/2021 12 0.00E+00 . 3.78E	:00:00   Co :00:00   De 00 Hrs   Li +002 g   Re 1.0000   Sp	cay Time. ve Time . al Time . c. File .	· · · · · ·	. 6.4   210	9E+002 Hrs 60000 Sec 60110 Sec 805D02.SPC
Energ	Jy(keV)=	-1.46 + (	Detecto .501*Ch + .019*En +	or #: 2 (D 0.00E+00*C 4.08E-04*E En = Sgrt(E	etector 2) h^2 + 0.001 n^2 + 0.001	E+00*Ch^3 E+00*En^3	07/11/	2021
Searc		 ivitv: 1.(	00   Sicma	Multiplier	• 2.00   S	earch Sta		80/4000
=====								
			PE	AK SEARCH R	ESULTS			
= = = = = :			PE		ESULTS			
PK.	ENERGY	ADDRESS	PE.	AK SEARCH R UN-	ESULTS C.L.	BKG	FWHM	
PK.	ENERGY	ADDRESS	PE.	ak search r	ESULTS C.L.	BKG	FWHM	
PK. #	ENERGY (keV)	ADDRESS CHANNEL	PE NET/MDA COUNTS	AK SEARCH R UN- CERTAINTY	ESULTS C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
PK.	ENERGY	ADDRESS CHANNEL 95.44	PE.	AK SEARCH R UN-	ESULTS C.L.	BKG	FWHM (keV) 0.59	FLAG
PK. # 1	ENERGY (keV) 46.34	ADDRESS CHANNEL 95.44	PE NET/MDA COUNTS 138	AK SEARCH R UN- CERTAINTY 100	C.L. COUNTS	BKG COUNTS 1423	FWHM (keV) 0.59	FLAG a
PK. # 1 2 3 4	ENERGY (keV) 46.34 53.39 63.28 66.23	ADDRESS CHANNEL 95.44 109.50	PE NET/MDA COUNTS 138 101 351 252	AK SEARCH R UN- CERTAINTY 100 63 110 143	C.L. COUNTS 80 49 85 114	BKG COUNTS 1423 677 1613 2419	FWHM (keV) 0.59 0.41 0.66 0.97	FLAG a a b
PK. #  1 2 3 4 5	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45	PE NET/MDA COUNTS 138 101 351 252 210	AK SEARCH R UN- CERTAINTY 100 63 110 143 94	ESULTS C.L. COUNTS 80 49 85 114 74	BKG COUNTS 1423 677 1613 2419 1335	FWHM (keV) 0.59 0.41 0.66 0.97 0.50	FLAG a a b a
PK. # 1 2 3 4 5 6	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20	PE NET/MDA COUNTS 138 101 351 252 210 1743	AK SEARCH R UN- CERTAINTY 100 63 110 143 94 153	ESULTS C.L. COUNTS 80 49 85 114 74 105	BKG COUNTS 1423 677 1613 2419 1335 2225	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88	FLAG a a b a b
PK. # 1 2 3 4 5 6 7	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671	UN- CERTAINTY 100 63 110 143 94 153 164	ESULTS C.L. COUNTS 80 49 85 114 74 105 105	BKG COUNTS 1423 677 1613 2419 1335 2225 2225	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80	FLAG a a b a b c
PK. # 1 2 3 4 5 6 7 8	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503	AK SEARCH R UN- CERTAINTY 100 63 110 143 94 153 164 156	ESULTS C.L. COUNTS 80 49 85 114 74 105 105 123	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15	FLAG a a b a b c a
PK. # 1 2 3 4 5 6 7 8 9	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308	AK SEARCH R UN- CERTAINTY 100 63 110 143 94 153 164 156 152	ESULTS C.L. COUNTS 80 49 85 114 74 105 105 123 110	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03	FLAG a a b a b c a b
PK. # 1 2 3 4 5 6 7 8 9 10	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145	ESULTS C.L. COUNTS 80 49 85 114 74 105 105 123 110 110	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92	FLAG a a b b c a b c a b c
PK. # 1 2 3 4 5 6 7 8 9 10 11	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185	ESULTS C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 2957	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33	FLAG a a b b c a b c d
PK. # 1 2 3 4 5 6 7 8 9 10 11 12	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162	ESULTS C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2957 2721	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37	FLAG a a b b c a b c d a
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2218 2957 2721 2033	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99	FLAG a a b b c a b c d a a a
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97	FLAG a a b b c a b c d a a b c d b c c d b c c d b c c d b c c d b c c d b c c d b c c c c
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2957 2721 2033 2033 1018	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42	FLAG a a a b b c a b c d a a b b c c d a a b b c c d a a b c c d a a b b c c a a b b c c a a b b c c a a a b b c c a a b b c c c c
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80 104	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033 1018 1354	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71	FLAG a a a b b c d a b c d a a b b c c d a a b b c c d a a b b c c d a a b b c c a a b c c a a a b c c a a a b b c c a a a b c c c c
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251	UN- CERTAINTY 100 63 110 143 94 153 164 155 152 145 185 162 131 129 80 104 115	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 105 64 78 91	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033 1018 1354 1674	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79	FLAG a a a b c a b c d a a b NET < CL a NET < CL a a wide Pk
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229	UN- CERTAINTY 100 63 110 143 94 153 164 155 164 152 145 185 162 131 129 80 104 115 191	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78 91 155	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033 1018 1354 1674 3348	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69	FLAG a a b b c a b c d a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a a b b c c a a b b c a a b b c a a b b c a a b b c c a a b b c c a a b b c c a a b b c c a b b c c a b b b c c a b b b c c a b b b c c a b b b c c a b b b c c a b b b c c a b b b c c b b b c c c a b b b c c c a b b b c c c b b c c c b b c c c b b c c c a b b c c c b b c c c c
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07 154.09	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58 310.58	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229 130	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80 104 115 191 81	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78 91 155 64	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033 1018 1354 1674 3348 996	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69 0.45	FLAG a a b b c d a b b c d a b b c c d a a b b c c a b b c c a b b c c a b b c c a b b c c a a b b c c a a b b c c a a b b c a a b b c a a b b c a a b b c c a a b b c c a a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c a b b c c c a b b c c c a b b c c c a b b c c c c
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07 154.09 185.95	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58 310.58 374.19	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229 130 1164	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 162 131 129 80 104 115 191 81 140	C.L. COUNTS 80 49 85 114 74 105 123 110 110 110 137 131 105 105 64 78 91 155 64 101	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033 1018 1354 1674 3348 996 1885	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69 0.45 1.04	FLAG a a a b c d a b c d a b b c d a a b b c c d a a b b c c d a a b b c c d a a b b c c d a a b b c d a a b b c d a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c c a a b b c c c a a b b c c c b b c c c a a b b c c c a a b b c c c c
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	ENERGY (keV) 46.34 53.39 63.28 66.23 72.89 74.77 77.03 84.13 87.12 89.92 92.87 99.52 105.58 108.71 115.41 129.15 139.87 143.07 154.09	ADDRESS CHANNEL 95.44 109.50 129.26 135.16 148.45 152.20 156.72 170.90 176.86 182.45 188.35 201.62 213.72 219.96 233.34 260.77 282.19 288.58 310.58	PE NET/MDA COUNTS 138 101 351 252 210 1743 2671 503 1308 817 1702 228 193 86 59 443 251 229 130	UN- CERTAINTY 100 63 110 143 94 153 164 156 152 145 185 162 131 129 80 104 115 191 81	C.L. COUNTS 80 49 85 114 74 105 105 123 110 110 137 131 105 105 64 78 91 155 64	BKG COUNTS 1423 677 1613 2419 1335 2225 2225 2588 2218 2218 2218 2957 2721 2033 2033 1018 1354 1674 3348 996	FWHM (keV) 0.59 0.41 0.66 0.97 0.50 0.88 0.80 1.15 1.03 0.92 1.33 1.37 0.99 0.97 0.42 0.71 0.79 1.69 0.45	FLAG a a a b c d a b c d a b b c d a a b b c c d a a b b c c d a a b b c c d a a b b c c d a a b b c d a a b b c d a a b b c a a b b c a a b b c a a b b c a a b b c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c a a b b c c c a a b b c c c a a b b c c c b b c c c a a b b c c c a a b b c c c c

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PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	( <b>ke</b> V)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
22	209.19	420.59	733	 115	83			
22	238.60	479.33	8709	216	89	1404	0.90 a	
24	241.44	484.99	1259	141		1479		HiResid HiResid
25	248.91	499.91	47	76	101 62	1726 8 <b>44</b>		NET< CL
26	270.30	542.62	652	133	101	1603	1.26 a	
27	277.40	556.79	251	88	68	928	0.74 a	
28	295.25	592.43	1936	127	76	1054	0.98 a	
29	300.11	602.13	573	104	76	1054	1.05 b	
30	328.04	657.90	359	87	65	841		HiResid
31	338.31	678.41	1574	118	72	966		HiResid
32	351.86	705.46	3410	148	72	949	1.09 a	
33	409.51	820.57	248	81	62	706	1.03 a	
34	427.93	857.34	78	81	65	700	1.03 a	
35	462.98	927.34	558	96	68	812	1.54 a	
36	510.98	1023.18	2894	156	93	1220		Wide Pk
37	558.51	1118.07	205	67	50	519	0.94 a	
38	562.50	1126.04	81	56	44	433	0.88 b	
39	569.95	1140.92	87	57	44	448	0.81 a	
40	583.22	1167.42	2891	129	59	647	1.29 a	
41	597.64	1196.21	89	137	112	1540		NET< CL
•••			05	207		1340	2.J/ a	Wide Pk
42	609.34	1219.57	2774	130	63	738	1.29 a	
43	665.33		70	62	49	478	1.12 a	
44	692.24	1385.10	34	44	35	302		NET< CL
					55	502	0.70 a	Wide Pk
45	694.96	1390.52	176	117	94	1131	2.51 b	
46	705.45	1411.47	31	47	37	344		NET< CL
47	727.35	1455.20	628	80	52	494	1.37 a	-
48	755.51	1511.42	114	78	62	598	1.75 a	
49	768.46	1537.29	200	62	45	400	1.08 a	
50	772.48	1545.32	84	52	40	343	0.94 b	
51	782.10	1564.51	71	53	41	339	1.15 a	
52	785.73	1571.76	177	71	54	484	1.69 b	
53	795.00	1590.27	346	76	54	483	1.57 a	
54	803.19	1606.62	127	59	45	396	1.08 a	
55	830.94	1662.04	17	45	37	303		NET< CL
56	835.66	1671.46	86	65	51	485	1.26 b	
57	860.58	1721.22	365	66	45	389	1.51 a	
58	904.78	1809.48	45	47	37	297	1.21 a	
59	911.37	1822.63	2064	105	43	356	1.50 a	
60	934.07	1867.96	128	74	58	511	2.36 a	
61	964.85	1929.41	392	62	39	310	1.36 a	
62	969.05	1937.79	1217	89	46	387	1.50 a	
63	1001.10	2001.79	120	71	55	470	2.31 a	
64	1014.08	2027.72	59	62	49	409	1.92 a	
65	1120.43	2240.05	522	70	44	356	1.60 a	
		Page 002		,,,		550	2. VV Q	

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PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
66	1238.15	2475.10	203	56	40	305	1.51 4	a
67	1303.51	2605.61	54	36	27	158	1.13 a	a
68	1327.27	2653.05	34	38	30	179	1.27 a	<b>a</b>
69	1377.69	2753.71	138	49	35	228	1.94 a	a
70	1401.41	2801.09	48	44	35	224	2.02	A
71	1408.28	2814.79	81	36	26	149	1.37 1	b
72	1460.96	2919.98	4416	138	31	179	1.95 a	a HiResid
73	1510.12	3018.14	78	46	35	203	2.43	A
74	1588.21	3174.06	164	45	31	180	1.74	A
75	1592.23	3182.09	90	44	33	196	1.89 1	b
76	1620.96	3239.45	57	32	23	115	1.47	A
77	1630.69	3258.89	54	34	25	129	1.60 a	A
78	1729.80	3456.78	87	31	20	86	1.46	a
79	1764.58	3526.22	475	55	27	129	2.17	8.
80	1847.91	3692.61	56	33	24	106	1.92	a

SEEKER BACKGROUND SUBTRACT RESULTS Vers. 2.2.1

ALS Laboratory Group - Fort Collins GammaScan

Background File: . . . . DET020707.BKG (210707-2 LONGBKGCAL)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW	
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL FLAC	3
								-
			100					
3		351		85				Ĺ.
4	66.23		143				194 NET <ci< td=""><td><b>L</b></td></ci<>	<b>L</b>
6	74.77	1743	153	105	1620	207	157	
7	77.03	2671	164	105	2546	231	171	
8	84.13	503	156	123	411	227	184	
9	87.12	1308	152	110	1270	208	160	
11	92.87	1702	186	137	1282	254	200	
12	99.52	228	162	131	189	252	206 NET <ci< td=""><td>L</td></ci<>	L
17	139.87	251	115	91	70	186	153 NET <ci< td=""><td>ما</td></ci<>	ما
18	143.07	229	191	155	174	216	176 NET <ci< td=""><td>L.</td></ci<>	L.
20	185.95	1164	140	101	892	204	160	
21	198.40	251	153	123	-66	212	175 NET <ci< td=""><td>L.</td></ci<>	L.
23	238.60	8709	216	89	8456	249	138	
24	241.44	1259	141	101	1162	181	138	
28	295.25	1936	127	76	1872	176	126	
32	351.86	3410	148	75	3215	208	143	
36	510.98	2894	156	93	789	316	256	
37	558.51	205	67	50	-115	135	113 NET <ci< td=""><td>يا</td></ci<>	يا
39	569.95	87	57	44	13	105	86 NET <ci< td=""><td>L.</td></ci<>	L.
40	583.22	2891	129	59	2790	157	95	
41	597.64	89	137	112	-39	206	170 NET <ci< td=""><td>ما</td></ci<>	ما
42	609.34	2774	130	63	2606	192	133	
54	803.19	127	59	45	-36	125	103 NET <ci< td=""><td>ما</td></ci<>	ما
59	911.37	2064	105	43	1977	152	101	
65	1120.43	522	70	44	480	90	65	
69	1377.69	138	49	35		74		
72	1460.96	4416	138	31	4174	163	81	
79	1764.58	475	55	27	426	78	55	

	210805D02.SPC Analyzed by												
SEEK								ion 2.2.1					
ALS Laboratory Group - Fort Collins													
				Gamma									
****	***************************************												
	Geo 13 / Solid												
Sample TD: $2106442 - 1D$ GS210619-1													
Sample ID: 2106442-1D GS210619-1													
Samp	ling Sta	rt: 06/	14/2021	L2:00:00	Counting 8	Start:	 07/11/20	21 13:16:20					
-	-			L2:00:00	-			49e+002 Hrs					
-	-	-		•	-			60000 Sec					
Samp	le Size		3.7	Be+002 g	Real Time	• • • • •	• • •	60110 Sec					
Coll	ection E	fficiency	• • • •	1.0000	Spectrum 1	File	21	0805D02.SPC					
Cr.	Level Co	nfidence ]	Interval:	95 %	Det. Limit	t Confiden	ce Inter	<b>val:</b> 95 %					
		• • • •			(Detector	2)							
	_			FF (Geo 13	•								
	-				1*L^2 +6.6	•							
EII.	= EXP[-2]	.35E-01 +	-5.84E-0.	L * En + -:	1.09E-02 *	En^2] Aboy	<b>ve</b> 300	.00 keV					
Libr	arv File	•	RA22	5 T.TR (Re.	-226 (215g	steel can	 \						
	_												
					CONCENTRA								
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		N											
			Concentra	ation	N ENERGY E Concentration Critical Halflife								
Nucl	ide (	1						8					
Nuclide (keV) T (pCi/g ) MDA Level (hrs)													
Ra-226 Average:x 5.66E-01 +- 2.38E-02 1.40E+07							(hrs)						
Ra-2		 rage:x 5.6	56E-01 +-	) 2.38E-02	MDA • • • • •	Level	(hrs) 1.40E+0	7					
Ra-2	29	rage:x 5.6 5.21 5.5	56E-01 +- 52E-01 +-	) 2.38E-02 5.19E-02	MDA  7.52E-02	Level	(hrs) 1.40E+0 1.40E+0	 7 7					
 Ra-2	29 35	rage:x 5.6 5.21 5.5 1.92 5.8	56E-01 +- 52E-01 +- 85E-01 +-	) 2.38E-02 5.19E-02 3.78E-02	MDA  7.52E-02 5.25E-02	Level  3.72E-02 2.60E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0	 7 7 7					
 Ra-2	29 35 60	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6	56E-01 +- 52E-01 +- 55E-01 +- 56E-01 +-	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02	MDA  7.52E-02 5.25E-02 5.85E-02	Level  3.72E-02 2.60E-02 2.90E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0	 7 7 7 7					
Ra-2	29 35 60	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6	56E-01 +- 52E-01 +- 55E-01 +- 56E-01 +-	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02	MDA  7.52E-02 5.25E-02	Level  3.72E-02 2.60E-02 2.90E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0	 7 7 7 7					
	29 35 60 112	rage:x 5.6 5.21 5.5 1.92 5.8 9.31 5.6 0.29 4.9	56E-01 +- 52E-01 +- 55E-01 +- 56E-01 +- 96E-01 +-	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01	Level  3.72E-02 2.60E-02 2.90E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0	 7 7 7 7					
ME	29 35 60 112 ASURED T	rage:x 5.6 5.21 5.5 1.92 5.8 9.31 5.6 0.29 4.9 OTAL: 5.6	56E-01 +- 52E-01 +- 55E-01 +- 56E-01 +- 56E-01 +- 56E-01 +-	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 pCi/g	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0	 7 7 7 7					
ME	29 35 60 112 ASURED T	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6	6E-01 +- 52E-01 +- 56E-01 +- 66E-01 +- 56E-01 +- 56E-01 +-	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PE	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0	 7 7 7 7 7					
ME	29 35 60 112 ASURED T	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6	6E-01 +- 52E-01 +- 56E-01 +- 66E-01 +- 56E-01 +- 56E-01 +-	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PE	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0	7 7 7 7 7 7					
ME ====	29 35 60 112 ASURED T =======	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6	6E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- UNKN(	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 DWN,SUM or	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 pCi/g ESCAPE PE	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0	 7 7 7 7 7					
ME ==== ==== PK.	29 35 60 112 ASURED T ======= ENERGY	rage:x 5.6         5.21       5.5         1.92       5.6         9.31       5.6         0.29       4.9         OTAL:       5.6         ADDRESS	6E-01 +- 52E-01 +- 55E-01 +- 66E-01 +- 66E-01 +- 56E-01 +- UNKN(	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 WN,SUM or	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PEA C.L.	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 AKS BKG	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0						
ME ====	29 35 60 112 ASURED T =======	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6	6E-01 +- 52E-01 +- 55E-01 +- 66E-01 +- 66E-01 +- 56E-01 +- UNKN(	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 DWN,SUM or	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PEA C.L.	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0	 7 7 7 7 7					
ME ==== ==== PK. #	29 35 60 112 ASURED T ====== ENERGY (keV)	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6 	6E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- UNKNO NET COUNTS	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 JWN, SUM or UN- CERTAINTY	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 pCi/g ESCAPE PEA C.L. COUNTS	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 AKS BKG COUNTS	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 FWHM (keV)	7 7 7 7 7 7 7 7 7 7					
ME ==== PK. # 	29 35 60 112 ASURED T ======= ENERGY (keV) ====== 53.39	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6 OTAL: 5.6 ADDRESS CHANNEL 109.50	6E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- UNKNO NET COUNTS	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 WN,SUM or UN- CERTAINTY 63	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 pCi/g ESCAPE PEA C.L. COUNTS 49	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 AKS BKG COUNTS 677	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 FWHM (keV) 0.41						
ME ==== PK. #  1 2	29 35 60 112 ASURED T ====== ENERGY (keV)  53.39 72.89	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6 ====================================	6E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 06E-01 +- UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN( UNKN(	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 1 0WN,SUM or UN- CERTAINTY 63 94	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PEZ C.L. COUNTS 49 74	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 AKS BKG COUNTS 677 1335	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 FWHM (keV) 0.41 0.50	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7					
ME ==== PK. # 1 2 3	29 35 60 112 ASURED T ====== ENERGY (keV)  53.39 72.89 74.77	ADDRESS CHANNEL 109.50 148.45 15.21 5.21 5.21 5.25 5.21 5.25 5.21 5.25 5.25	6E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- UNKNO NET COUNTS 101 210 1620	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 JUN- CERTAINTY 63 94 207	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 pCi/g ESCAPE PEA C.L. COUNTS 49 74 157	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 AKS BKG COUNTS 677 1335 2225	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 FWHM (keV) 0.41 0.50 0.88	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7					
ME ==== PK. # 1 2 3 4	29 35 60 112 ASURED T ====== ENERGY (keV) 	rage:x 5.6         5.21 5.5         1.92 5.6         9.31 5.6         0.29 4.5         OTAL: 5.6         ADDRESS         CHANNEL         109.50         148.45         152.20         156.72	6E-01 +- 5E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- UNKNO NET COUNTS 101 210 1620 2546	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 WN,SUM or UN- CERTAINTY 63 94 207 231	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 OCi/g ESCAPE PEA C.L. COUNTS 49 74 157 171	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 AKS BKG COUNTS 677 1335 2225 2225	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 0.41 0.50 0.88 0.80	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7					
ME ==== PK. # 1 2 3	29 35 60 112 ASURED T ====== ENERGY (keV)  53.39 72.89 74.77 77.03 84.13	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6 CTAL: 5.6 ADDRESS CHANNEL 109.50 148.45 152.20 156.72 170.90	6E-01 +- 5E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 0E-01 +- 101	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 0WN,SUM or UN- CERTAINTY 63 94 207 231 227	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PEA C.L. COUNTS 49 74 157 171 184	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 6.73E-02 AKS BKG COUNTS 677 1335 2225 2225 2588	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 FWHM (keV) 0.41 0.50 0.88 0.80 1.15	FLAG Unknown Unknown Unknown Unknown Unknown					
ME ==== PK. #  1 2 3 4 5	29 35 60 112 ASURED T ====== ENERGY (keV)  53.39 72.89 74.77 77.03 84.13 87.12	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6 	6E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 06E-01 +- 01 +- 06E-01 +- 06E-01 +- 01 +- 06E-01 +- 01 +- 06E-01 +- 01 +- 06E-01 +- 01 +- 01 01 +- 01 01 +- 01 +- 01 01 +- 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 -	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 0WN,SUM or UN- CERTAINTY 63 94 207 231 227 208	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PEA C.L. COUNTS 49 74 157 171 184 160	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 AKS BKG COUNTS 677 1335 2225 2288 2218	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 FWHM (keV) 0.41 0.50 0.88 0.80 1.15 1.03	7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7 7					
ME ==== PK. # 1 2 3 4 5 6	29 35 60 112 ASURED T ====== ENERGY (keV)  53.39 72.89 74.77 77.03 84.13	rage:x 5.6 5.21 5.5 1.92 5.6 9.31 5.6 0.29 4.9 OTAL: 5.6 	6E-01 +- 5E-01 +- 5E-01 +- 6E-01 +- 6E-01 +- 6E-01 +- 0E-01 +- 101	) 2.38E-02 5.19E-02 3.78E-02 4.16E-02 9.35E-02 2.38E-02 0WN,SUM or UN- CERTAINTY 63 94 207 231 227	MDA 7.52E-02 5.25E-02 5.85E-02 1.37E-01 PCi/g ESCAPE PEA C.L. COUNTS 49 74 157 171 184	Level 3.72E-02 2.60E-02 2.90E-02 6.73E-02 6.73E-02 AKS BKG COUNTS 677 1335 2225 2225 2588	(hrs) 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 1.40E+0 FWHM (keV) 0.41 0.50 0.88 0.80 1.15	FLAG Unknown Unknown Unknown Unknown Unknown					

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UNKNOWN, SUM or ESCAPE PEAKS

* = = = = = = = = = = = = = = = = = = =	

PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
8	92.87	188.35	1282	254	200	2957	1.33	Unknown
9	105.58	213.72	193	131	105	2033	0.99	Unknown
10	129.15	260.77	443	104	78	1354	0.71	Unknown
11	154.09	310.58	130	81	64	996	0.45	Unknown
12	185.95	374.19	892	204	160	1885	1.04	Unknown
13	209.19	420.59	733	115	83	1404	0.90	Unknown
14	238.60	479.33	8456	249	138	1479	0.92	Unknown
15	241.44	484.99	1162	181	138	1726	1.22	Unknown
16	270.30		652	133	101	1603	1.26	Unknown
17	277.40	556.79	251	88	68	928	0.74	Unknown
19	300.11	602.13	573	104	76	1054	1.05	Unknown
20	328.04	657.90	359	87	65	841	0.78	Unknown
21	338.31	678.41	1574	118	72	966	0.91	Unknown
23	409.51		248	81	62	706	1.03	Unknown
24	427.93	857.34	78	81	65	729	1.17	Unknown
25	462.98	927.34	558	96	68	812	1.54	Unknown
26	510.98	1023.18	789	316	256	1220	2.20	Unknown
27	562.50	1126.04	81	56	44	433	0.88	Unknown
28	583.22	1167.42	2790	157	95	647	1.29	Unknown
30	609.34	1219.57	2284	1017	791	738	1.29	1120SEsc
31	609.34	1219.57	322	2071	133	738	1.29	Unknown
32	665.33	1331.36	70	62	49	478	1.12	Unknown
33	694.96	1390.52	176	117	94	1131	2.51	Unknown
34	727.35	1455.20	628	80	52	494	1.37	1238SEsc
35	755.51	1511.42	114	78	62	598	1.75	Unknown
36	768.46	1537.29	200	62	45	400	1.08	Unknown
37	772.48	1545.32	84	52	40	343	0.94	Unknown
38	782.10	1564.51	71	53	41	339	1.15	Unknown
39	785.73	1571.76	177	71	54	484	1.69	Unknown
40	795.00	1590.27	346	76	54	483	1.57	Unknown
41	835.66	1671.46	86	65	51	485	1.26	Unknown
42	860.58	1721.22	365	66	45	389	1.51	Unknown
43	904.78	1809.48	45	47	37	297	1.21	Unknown
44	911.37	1822.63	1977	152	101	356	1.50	Unknown
45	934.07	1867.96	128	74	58	511	2.36	Unknown
46	964.85	1929.41	392	62	39	310	1.36	Unknown
47	969.05	1937.79	1217	89	46	387	1.56	Unknown
48	1001.10	2001.79	120	71	55	470	2.31	Unknown
49	1014.08	2027.72	59	62	49	409	1.92	Unknown
51	1238.15	2475.10	203	56	40	305	1.51	Unknown
52		2605.61	54		27	158	1.13	Unknown
53		2653.05	34		30	179	1.27	Unknown
54		2753.71	108		58	228	1.94	Unknown
55		2801.09	48		35	224	2.02	Unknown
56		2814.79	81		26	149	1.37	Unknown
57		2919.98	4174		81	179	1.95	Unknown
		Page 00						
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### UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
58	1510.12	3018.14	78	46	35	203	2.43	Unknown
59	1588.21	3174.06	164	45	31	180	1.74	Unknown
60	1592.23	3182.09	90	44	33	196	1.89	Unknown
61	1620.96	3239.45	57	32	23	115	1.47	Unknown
62	1630.69	3258.89	54	34	25	129	1.60	Unknown
63	1729.80	3456.78	87	31	20	86	1.46	Unknown
64	1764.58	3526.22	426	78	55	129	2.17	Unknown
65	1847.91	3692.61	56	33	24	106	1.92	Unknown

c:\SEEKER\BIN\210805d02A.res Analysis Results Saved.

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		210802D02.5	SPC Analyzed	HC Yd								
			A ANAL	**************************************	RESU			**************************************				
		_		-								
ALS Laboratory Group - Fort Collins GammaScan												
GammaJCan ************************************												
Geo 13 / Solid												
Sample ID: 2106442-2 GS210619-1												
			4/2021 12:0									
			4/2021 12:0									
			0.00E+000 . 4.05E+0									
			· · · · 1.									
_	(*)				etector 2)							
			0.501*Ch + 0 0.019*En + 4									
	(184) -	0.33 + 0			nergy in k		0//29/2	2020				
Searc	ch Sensit	ivity: 1.0	0   Sigma M	ultiplier	: 2.00   Se	earch Sta	rt/End:	80/4000				
				SEARCH R								
====												
PK.	FNFDCV	ADDEEGG	NET/MDA	TTNT_	<b>A T</b>	BKG						
#	(keV)		COUNTS CE				FWHM (keV)	FLAG				
1	63.45	129.53	529	268	217	11617	0.51 a	L				
2 3	72.74 74.83	148.09 152.25	1202 22901	434 538	352 366	25025 27012	0.89 0.84					
4	77.13	156.84	40971	658	427	31052	0.84					
5	79.42	161.41	526	315	257	14612	0.83					
6	81.26	165.08	-4692	506	431	31654	1.50	NET< CL				
7	84.33	171.22	5766	514	404	27880	1.09					
8	87.20	176.94	-835	639	527	47451	0.07	NET< CL				
9 10	89.94 93.25	182.41 189.01	-15205 15893	645 527	568 201	54972	3.46	NET< CL				
11	99.60	201.70	3820	527	381 410	24742 26579	0.99 1.10					
12	105.43	213.32	5679	474	370	23311	1.17 a					
13	108.93	220.32	1791	360	287	16651	0.89 t					
14	115.31	233.05	2287	360	286	16448	0.85 a					
15	129.19	260.76	8991	414	302	18433	0.74 a					
16	154.12	310.52	3222	358	280	15759	0.90 a					
17	166.50	335.23	405	284	231	11814	0.72 a	L				
18	186.03	374.21	3870	390	304	17084	0.99 a					
19	199.19	400.48	1091	370	299	16563	0.99 a					
20	203.95	409.97	410	321	262	13803	0.82 b					
21	209.21	420.46 Page 001	15640	396	253	12871	U.80 a	HiResid				
		ra <b>j</b> a nat										

Page 002

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PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV) FLAG	
22	211.98	426.00	38	216	 177	 7723	0.48 b NET< CL	-
			20	210	1//	1145	HiResid	
23	216.05	434.12	1236	358	289	15445		
24	233.36	468.67	266		173	7394		
25	238.74	479.42	183421	917	269	13413	0.97 a HiResid	
26	241.25	484.42	19648	461	301	14378		
27	252.75	507.38	946	279	224	9261	0.96 a	
28	270.40			371	243	10102	1.09 a	
29	277.55			313	215	8563	0.94 a	
30	279.21		503		215	8563	1.06 b	
31	288.33		1264	295	235	9436	1.11 a	
32	295.36		8073	308	206	7816	0.95 a	
33	300.28		11465	329	206	7816	1.02 b	
34	321.64				174	6072		
35		657.77			198	7257		
36		678.42			191	6760		
37		683.71			215	7887		
38	352.03		14177		203	7012	1.08 a	
39	409.72			270	188	6007		
40	440.72		334	179	144	4365	0.97 a	
41	453.14		830		142	4262	0.93 a	
42		927.44	10635	281	157	4857	1.16 a	
43		957.97			123	3463	0.78 a	
44	503.98				153	4624		
45	509.28				169	5284	1.27 b	
46	511.14				169	5284	1.38 c	
47	546.83			199	159	4677		
48	550.17	1101.02	337	215	174	5262	1.40 b	
<b>49</b>	558.67	1117.99	247	141	113	2914	0.77 a	
50 51		1126.24	1874		144	4080		
51 52	571.27	1143.13 1146.79	525	268	218	6993		
52 53	573.10		245	141	113	2914	0.84 b	
53 54	<b>609.62</b>	1219.70	62580 11225	536	157	4573	1.31 a	
55	616.24		11335 167	281 182	151	4189	1.34 a	
56	652.24	1304.76	132	182	148 147	4071	1.35 a	
57	666.19	1332.59	303	165	133	3977	1.39 a NET< CL	
58	702.66	1405.39	303	105	161	3482 4501	1.11 a	
59	702.00	1415.62	422	216			1.42 a	
60	727.64	1415.02	13599	294	175 1 <b>4</b> 7	5001 37 <b>4</b> 6	1.69 b 1.45 a	
61	742.78	1485.48	57	29 <b>4</b> 99	81	1609	0.71 a NET< CL	
62	755.68	1511.21	1737	188	139	3354	1.40 a	
63	763.92	1527.67	1092	175	133	3354	1.40 a 1.44 a	
64	768.80	1537.41	983	173	133	3070	1.53 b	
65	772.75	1545.30	2614	203	133	3411	1.55 b 1.56 c	
66	782.72	1545.30	831	203	115			
00	/04./4	T202.T2	03T	TOT	TTD	2438	1.29 a	

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PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS		LAG
67	786.03	1571.81	1975	177	126	2743	1.42 b	
68	795.43	1590.57	7130	224	122	2567	1.50 a	
69	803.41	1606.49	259	144	115	2306	1.43 a	
70	806.55	1612.75	162	95	75	1281	0.85 b	
71	830.96	1661.48	831	135	101	1875	1.33 a	
72	836.14	1671.82	2915	181	119	2344	1.59 b	
73	840.72	1680.97	1626	166	119	2344	1.65 c	
74	860.99	1721.42	7633	215	103	1958	1.58 a	
75	894.08	1787.47	418	104	78	1332	1.16 a	
76	904.84	1808.95	1108	138	99	1827	1.65 a	
77	911.78	1822.79	43429	434	99	1827	1.59 b	
78	934.54	1868.22	487		91	1521	1.62 a	
79	944.79	1888.68	123	89	71	1092	1.09 a	
80	952.53	1904.13	184	97	77	1218	1.24 a	
81	959.15	1917.36	346	85	63	913	1.02 Ъ	
82	965.27	1929.57	7850	209	91	1522	<b>1.72</b> c	
83	969.48	1937.96	26078	341	91	1522	1.65 đ	
84	976.72	1952.41	64	83	67	986	1.17 a M	NET< CL
85	988.85	1976.62	240	98	77	1149	1.49 a	
86	1001.53	2001.94	104	75	59	804	0.96 a	
87	1034.01	2066.77	260	90	69	988	1.39 a	
88	1040.86	2080.44	108	79	63	865	<b>1.21</b> b	
89	1065.66	2129.93	281	100	77	1158	1.41 a	
90	1079.31	2157.19	705	114	83	1264	1.59 a	
91	1094.91	2188.32	761	150	114	1861	2.54 a	
92	1111.12	2220.68	492	109	82	1238	1.66 a	
93	1120.90	2240.21	2490	149	91	1404	1.89 a	
94	1153.51	2305.29	112	70	55	697	0.97 a	
95	1154.64	2307.55	207	101	79	1162	1.59 b	
96	1156.09	2310.44	187	93	73	1046	1.49 c	
97	1238.84	2475.61	839	115	81	1225	1.68 a	
98	1247.47	2492.83	651	152	117	1960	2.55 b	
99	1282.14	2562.02	228	103	81	1163	1.80 a	
100	1288.20	2574.13	133	121	98	1480	2.24 b	
101	1374.92	2747.22	179	87	68	938	1.68 a	
102	1378.45	2754.27	636	107	78	1125	1.97 b	
103	1385.98	2769.30	84	73	58	750	1.37 c	
104	1402.18	2801.64	213	100	79	1095	2.17 a	
105	1408.78	2814.80	306	81	60	758	1.53 b	
106	1461.44	2919.91	7659	196	73	952	2.20 a B	liResid
107	1496.60	2990.09	1110	103	64	760	1.98 a	
108	1502.31	3001.50	547	95	68	823	2.14 b	
109	1510.11	3017.05	234	84	64	760	1.94 c	
110	1513.57	3023.96	419	92	68	823	2.09 đ	
111	1529.14	3055.05	57	67	54	590	1.58 a	
112	1539.20	3075.13	82	70	56	628	1.71 <b>a</b>	
		Page 003						

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PK. #		CHANNEL	COUNTS	UN- CERTAINTY	COUNTS	COUNTS	(keV)	
113	1558.18			82				
114	1581.46	3159.48	696	104	74	902	2.50 a	L
115	1588.99	3174.50	3681	146	66	782	2.09 1	•
116	1593.18	3182.86	2020	127	74	902	2.44	;
117	1621.50	3239.40	1736	114	64	717	2.12 a	L
118	1625.73	3247.83	272	76	56	607	1.84 1	•
119	1631.39	3259.13	1955	120	67	772	2.25 c	;
120	1639.05	3274.42	465	81	56	607	1.85 d	L
121	1662.12	3320.46	101	54	41	389	1.12 a	L
122	1667.21	3330.64	173	78	60	666	1.94 1	•
123	1679.78	3355.72	127	80	63	709	2.16 a	L
124	1686.20	3368.53	123	89	71	818	2.38 1	•
125	1730.47	3456.89	408	87	63	703	2.11 a	L
126	1765.35	3526.53	1957	121	68	786	2.29 a	L
127	1807.06	3609.76	106	82	65			
128	1848.44	3692.37	197	98	77	947	2.54 a	L
129	1887.76	3770.85	73	69	55	601		

ALS Laboratory Group - Fort Collins

GammaScan

Background File:. . . . . DET020707.BKG (210707-2 LONGBKGCAL)

Bkg.File Detector #: 2

BACKGROUND SUBTRACT RESULTS

	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW	
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL	FLAG
	63.45	 529		217		325		
3		22901		366				
4	77.13			427				
7	84.33	5766	514		5674			
8	87.20	-835	639					TET <cl< td=""></cl<>
10	93.25	15893	527	381				
11	99.60	3820	513	410	3781			
18	186.03	3870			3598			
19	199.19	1091	370	299	774			
25	238.74	183421	917	269	183168			
26	241.25	19648	461	301	19551	475		
32	295.36	8073	308	206	8009	331		
38	352.03	14177	343	203	13982	372	237	
45	509.28	1343	218	169	1341	338	272	
46	511.14	19623	348	169	17517	443	292	
49	558.67	247	141	113	-74	184	152 N	ET <cl< td=""></cl<>
51	571.27	525	268	218	451	283	230	
53	583.49	62580	536	157	62478	543	174	
54	609.62	11335	281	151	11166	314	191	
69	803.41	259	144	115	95	181	148 N	ET <cl< td=""></cl<>
77	911.78	43429	434	99	43342	448	135	
93	1120.90	2490	149	91	2447	160	103	
102	1378.45	636	107	78	606	121	91	
106	1461.44	7659	196	73	7417	214	105	
126	1765.35	1957	121	68	1908	133	83	

	210802	D02.SPC A	nalyzed by								
******* SEEKER	************	**************************************	**************************************	**********	**********	**************************************	****				
geenen	F	TNAU	ACTIV.	LTI KI	SPORT	version 2.2	5. L				
		ALS L	aboratory Gro	oup - Fort	Collins						
				aScan							
******	***************************************										
			Geo 13	/ Solid							
Sample ID: 2106442-2 GS210619-1											
Sampling	Start:	06/14/20	 21 12:00:00		Start.	07/10/2021 14:01					
			21 12:00:00			6.26e+002					
						60000	Sec				
			4.05e+002 g								
						210802D02.					
Cr. Leve	e coniiden	ce interv	al: 95 %	Det. Limi	t Confiden	ce Interval: 9	95 %				
		D	etector #:	2 (Detector	: 2)						
Efficier	ncy File: ()		).EFF (Geo 1:								
			2*L +-4.58E+(								
					En^2] Abc	ve 300.00 keV					
Library		RAL (SUB R	A228).LI (Na	•							
			ASURED or MD			=======================================					
	N										
			ntration		Critical						
Nuclide	(keV) T	(pCi/g	-	MDA	Level	(hrs)					
Th-234			+- <b>4.89E</b> -01	• • • •	•••••	3.92E+13					
	-		+- 1.26E+00			3.92E+13					
			+- 5.31E-01								
Pb-212	-		+- 1.08E-01		• • • •						
			+- 2.60E+00								
	238.63 300.09		+- 1.10E-01 +- 5.66E-01								
<b>U-235</b>			+- 1.26E-01	7.12E-01	3.53E-01	1.27E+1 <b>4</b> 6.17E+12					
•	185.72	I.D.	• • • •	••••	••••						
	205.31	3.94E-01	+- 3.08E-01	5.05E-01							
			+- 1.38E-01	2.29E-01	1.14E-01	6.17 <b>E</b> +12					
<b>T1-208</b>	-	6.71E+00	+- 5.47E-02		• • • •						
			+- 2.63E-01								
	583.14	6.68E+00	+- 5.81E-02	3.75E-02	1.86E-02	1.27E+14					
Pb-214	583.14 860.47	6.68E+00 7.37E+00	+- 5.81E-02 +- 2.08E-01	3.75E-02 2.01E-01	1.86E-02 9.94E-02	1.27E+14 1.27E+14					
Pb-214	583.14 860.47	6.68E+00 7.37E+00 2.20E+00	+- 5.81E-02 +- 2.08E-01 +- 8.57E-02	3.75E-02 2.01E-01 	1.86E-02 9.94E-02 	1.27E+14 1.27E+14 1.40E+07					
Pb-214	583.14 860.47 Average:x	6.68E+00 7.37E+00 2.20E+00 2.20E+00	+- 5.81E-02 +- 2.08E-01	3.75E-02 2.01E-01	1.86E-02 9.94E-02  6.30E-02	1.27E+14 1.27E+14 1.40E+07 1.40E+07					
Pb-214 Ra-228	583.14 860.47 Average:x 295.22 351.99	6.68E+00 7.37E+00 2.20E+00 2.20E+00 2.20E+00	+- 5.81E-02 +- 2.08E-01 +- 8.57E-02 +- 9.10E-02	3.75E-02 2.01E-01  1.27E-01	1.86E-02 9.94E-02  6.30E-02 1.90E-01	1.27E+14 1.27E+14 1.40E+07 1.40E+07 1.40E+07					
	583.14 860.47 Average:x 295.22 351.99 Average:x 338.40	6.68E+00 7.37E+00 2.20E+00 2.20E+00 2.20E+00 2.10E+01 2.03E+01	+- 5.81E-02 +- 2.08E-01 +- 8.57E-02 +- 9.10E-02 +- 2.55E-01 +- 1.42E-01 +- 2.46E-01	3.75E-02 2.01E-01  1.27E-01 3.80E-01  2.11E-01	1.86E-02 9.94E-02  6.30E-02 1.90E-01  1.05E-01	1.27E+14 1.27E+14 1.40E+07 1.40E+07 1.40E+07 5.04E+04 5.04E+04					
	583.14 860.47 Average:x 295.22 351.99 Average:x 338.40	6.68E+00 7.37E+00 2.20E+00 2.20E+00 2.20E+00 2.10E+01 2.03E+01 2.12E+01	+- 5.81E-02 +- 2.08E-01 +- 8.57E-02 +- 9.10E-02 +- 2.55E-01 +- 1.42E-01 +- 2.46E-01	3.75E-02 2.01E-01  1.27E-01 3.80E-01  2.11E-01	1.86E-02 9.94E-02  6.30E-02 1.90E-01  1.05E-01	1.27E+14 1.27E+14 1.40E+07 1.40E+07 1.40E+07 5.04E+04 5.04E+04					

# 

### MEASURED or MDA CONCENTRATIONS

	N									
	ENERGY E	Concentr	ation		Critical	Halflife				
Nuclide	(keV) T	(pCi/g	)	MDA	Level	(hrs)				
	968.90	2.18E+01 +-	2.85E-01	1.54E-01	 7.58E-02	5.04E+04				
Bi-214	Average:x	2.27E+00 +-	5.88E-02	• • • •	• • • •	1.40E+07				
	609.32	2.26E+00 +-	6.36E-02	7.79E-02	3.87E-02	1.40E+07				
	1120.28	2.36E+00 +-	1.54E-01	2.02E-01	9.95E-02	1.40E+07				
Bi-212	727.17	2.19E+01 +-	4.73E-01	4.78E-01	2.37E-01	1.27E+14				
Pa-234m	1001.03	2.37E+00 +-	1.69E+00	2.74E+00	1.34E+00	3.92E+13				
K-40	1460.75	1.19E+01 +-	3.45E-01	3.42E-01	1.69E-01	1.12E+13				
Pb-210	46.50 N	4.76E+00 +-	7.56E+00	1.25E+01	6.20E+00	1.95E+05				
Th-227	236.00 N-	-1.07E+01 +-	3.91E+00	6.44E+00P	3.22E+00	1.90E+05				
Cs-137	661.62 N-	-7.11E-03 +-	2.09E-02	3. <b>49E</b> -02B	1.73E-02	2.64E+05				

MEASURED TOTAL: 1.08E+02 +- 1.10E+01 pCi/g

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UNKNOWN, SUM or ESCAPE PEAKS

PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
 2	72.74	 148.09	1202	434	 352	25025	0.89	1095DEsc
3	74.83	152.25	22778	556	384	27012	0.84	1095DEsc
4	77.13	156.84	40846	678	447	31052	0.83	Unknown
5	79.42	161.41	526	315	257	14612	0.83	Unknown
6	81.26	165.08	-4692	506	431	31654	1.50	Deleted
7	84.33	171.22	5674	540	427	27880	1.09	Unknown
8	87.20	176.94	-872	654	540	47451	0.07	Deleted
9	89.94	182.41	-15205	645	568	54972	3.46	Deleted
11	99.60	201.70	3781	548	439	26579	1.10	1121DEsc
12	105.43	213.32	5679	474	370	23311	1.17	Unknown
13	108.93	220.32	1791	360	287	16651	0.89	Unknown
15	129.19	260.76	8991	414	302	18433	0.74	Unknown
16	154.12	310.52	3222	358	280	15759	0.90	Unknown
17	166.50	335.23	405	284	231	11814	0.72	Unknown
19	199.19	400.48	774	398	324	16563	0.99	Unknown
21	209.21	420.46	15640	396	253	12871	0.80	Unknown
22	211.98	426.00	38	216	177	7723	0.48	Deleted
23	216.05	434.12	1236	358	289	15445	1.02	1239DEsc
24	233.36	468.67	266	213	173	7394	0.49	Unknown
26	241.25	484.42	19551	475	316	14378	1.27	Unknown
27	252.75	507.38	946	279	224	9261	0.96	Unknown
28	270.40	542.62	12559	371	243	10102	1.09	Unknown
30	279.21	560.20	503	266	215	8563	1.06	Unknown
31	288.33	578.40	1264	295	235	9436	1.11	Unknown
34	321.64	644.88	503	216	174	6072	0.82	Unknown
35	328.10	657.77	9498	310	198	7257	1.05	Unknown
37	341.09	683.71	1101	270	215	7887	1.10	Unknown
		Page 007						

## 

UNKNOWN, SUM or ESCAPE PEAKS

PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
38	352.03	705.55	13982	372	237	7012	1.08	SPLIT
39	409.72	820.69	5206	270	188	6007	1.12	Unknown
40	440.72	882.56	334	179	144	4365	0.97	1461DEsc
41	453.14	907.35	830	182	142	4262	0.93	Unknown
42	463.20	927.44	10635	281	157	4857	1.16	Unknown
43	478.50	957.97	278	154	123	3463	0.78	1502DEsc
44	503.98	1008.83	453	191	153	4624	1.13	Unknown
45	509.28	1019.41	1341	338	272	5284	1.27	Unknown
46	511.14	1023.12	17517	443	292	5284	1.38	Unknown
47	546.83	1094.36	514	199	159	4677	1.33	Unknown
48	550.17	1101.02	337	215	174	5262	1.40	Unknown
49	558.67	1117.99	-74	184	152	2914	0.77	Deleted
50	562.80	1126.24	1874	195	144	4080	1.21	Unknown
51	571.27	1143.13	451	283	230	6993	1.96	1593DEsc
52	573.10	1146.79	245	141	113	2914	0.84	1593DEsc
55	616.24	1232.91	167	182	148	4071	1.35	1639DEsc
56	652.24	1304.76	132	180	147	3977	1.39	Deleted
57	666.19	1332.59	303	165	133	3482	1.11	1686DEsc
58	702.66	1405.39	337	199	161	4501	1.42	Unknown
59	707.78	1415.62	422	216	175	5001	1.69	1730DEsc
61	742.78	1485.48	57	99	81	1609	0.71	Deleted
62	755.68	1511.21	1737	188	139	3354	1.40	Unknown
63	763.92	1527.67	1092	175	133	3070	1.44	Unknown
64	768.80	1537.41	983	173	133	3070	1.53	Unknown
65	772.75	1545.30	2614	203	144	3411	1.56	1282SEsc
66	782.72	1565.19	831	151	115	2438	1.29	Unknown
67	786.03	1571.81	1975	177	126	2743	1.42	1807DEsc
68	795.43	1590.57	7130	224	122	2567	1.50	Unknown
69	803.41	1606.49	95	181	148	2306	1.43	Deleted
70	806.55	1612.75	162	95	75	1281	0.85	Unknown
71	830.96	1661.48	831	135	101	1875	1.33	Unknown
72	836.14	1671.82	2915	181	119	2344	1.59	Unknown
73	840.72	1680.97	1626	166	119	2344	1.65	Unknown
75	894.08	1787.47	418	104	78	1332	1.16	Unknown
76	904.84	1808.95	1108	138	99	1827	1.65	Unknown
78	934.54	1868.22	487	119	91	1521	1.62	Unknown
79	944.79	1888.68	123	89	71	1092	1.09	Unknown
80	952.53	1904.13	184	97	77	1218	1.24	Unknown
81	959.15	1917.36	346	85	63	913	1.02	Unknown
82	965.27	1929.57	7850	209	91	1522	1.72	Unknown
84		1952.41	64	83	67	986	1.17	Deleted
85	988.85	1976.62	240	98	77	1149	1.49	Unknown
87	1034.01		260	90	69	988	1.39	Unknown
88		2080.44	108	79	63	865	1.21	Unknown
89		2129.93	281	100	77	1158	1.41	Unknown
90	1079.31		705	114	83	1264	1.59	1589SEsc
		Page 008			~~			

### 

INKNOWN SIM OF ESCAPE DEAKS

	UNKNOWN, SUM OF ESCAPE PEAKS									
			===========					==============		
PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG		
91	1094.91	2188.32	761	150	114	 1861	2.54	Unknown		
92	1111.12	2220.68	492	109	82	1238	1.66	1622SEsc		
94	1153.51	2305.29	112	70	55	697	0.97	Unknown		
95	1154.64	2307.55	207	101	79	1162	1.59	1667SEsc		
96	1156.09	2310.44	187	93	73	1046	1.49	1667SEsc		
97	1238.84	2475.61	839	115	81	1225	1.68	Unknown		
98	1247.47	2492.83	651	152	117	1960	2.55	Unknown		
99	1282.14	2562.02	228	103	81	1163	1.80	Unknown		
100	1288.20	2574.13	133	121	98	1480	2.24	Unknown		
101	1374.92	2747.22	179	87	68	938	1.68	Unknown		
102	1378.45	2754.27	606	121	91	1125	1.97	Unknown		
103	1385.98	2769.30	84	73	58	750	1.38	Unknown		
104	1402.18	2801.64	213	100	79	1095	2.17	Unknown		
105	1408.78	2814.80	306	81	60	758	1.53	Unknown		
107	1496.60	2990.09	1110	103	64	760	1.98	Unknown		
108	1502.31	3001.50	547	95	68	823	2.14	Unknown		
109	1510.11	3017.05	234	84	64	760	1.94	Unknown		
110	1513.57	3023.96	419	92	68	823	2.09	Unknown		
111	1529.14	3055.05	57	67	54	590	1.58	Unknown		
112	1539.20	3075.13	82	70	56	628	1.71	Unknown		
113	1558.18	3113.00	247	82	62	684	2.18	Unknown		
114	1581.46	3159.48	696	104	74	903	2.50	Unknown		
115	1588.99	3174.50	3681	146	66	782	2.09	Unknown		
116	1593.18	3182.86	2020	127	74	903	2.44	Unknown		

114

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120

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63

717

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772

607

389

666

709

2.12

1.84

2.25

1.85

1.12

1.94

2.16

Unknown

Unknown

Unknown

Unknown

Unknown

Unknown

Unknown

				••	••			
124	1686.20	3368.53	123	89	71	818	2.38	Unknown
125	1730.47	3456.89	408	87	63	703	2.11	Unknown
126	1765.35	3526.53	1908	133	83	786	2.29	Unknown
127	1807.06	3609.76	106	82	65	753	2.18	Unknown
128	1848.44	3692.37	197	98	77	947	2.54	Unknown
129	1887.76	3770.85	73	69	55	601	1.68	Unknown
131	352.03	705.55	1002	3099	237	7012	1.08	1375DEsc

c:\SEEKER\BIN\210802d02.res Analysis Results Saved.

1736

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123

1621.50 3239.40

1625.73 3247.83

1631.39 3259.13

1639.05 3274.42

1662.12 3320.46

1667.21 3330.64

1679.78 3355.72

			SPC Analyzed							
			************ A ANAI	v			*********** S Version			
		7	LS Laborato	rv Group	- Fort Coli	lins				
	* * * * * * * * * *			GammaSca	n					
	~ ~ ~ ~ ~ ~ ~ ~ ~ ~	******		******	*****	******	******	*****		
			G	eo 13 / S	olid					
Samp	le ID: 21	.06442-2 GS	8210619-1							
Samp Buil Samp	ling Stop dup Time. le Size .	): 06/1 · · · · ·	4/2021 12:0 4/2021 12:0 0.00E+000 . 4.05E+0 1.	0:00   Co 0:00   De Hrs   Li 02 g   Re	cay Time. ve Time . al Time .	rt: 07 • • • • • • • • • • • •	/10/2021 1 . 6.26E+ 60 60	4:01:00 002 Hrs 000 Sec 274 Sec		
FWHM	Collection Efficiency 1.0000   Spc. File									
sear	cn Sensit	.ivity: 1.0	00   Sigma M	ultiplier	2.00   S	earch Sta	rt/End: 8	0/4000		
====			PEAK ====================================	SEARCH R						
PK. #	ENERGY (keV)		NET/MDA COUNTS CE			BKG COUNTS		LAG		
	63.45	129.53	 529	268	217	 11617	 0.51 a			
2	72.74	148.09	1202	434	352	25025	0.89			
3	74.83	152.25	22901	538	366	27012	0.84			
4	77.13	156.84	40971	658	427	31052	0.83			
5	79.42	161.41	526	315	257	14612	0.83			
6	81.26	165.08	-4692	506	431	31654		ET< CL		
7	84.33	171.22	5766	514	404	27880	1.09			
8 9	87.20 89.94	176.94 182.41	-835 -15205	639 645	527	47451		ET< CL		
10	93.25	182.41	15893	527	568 381	54972 24742	3.46 N 0.99	ET< CL		
11	99.60	201.70	3820	513	410	26579	1.10			
12	105.43	213.32	5679	474	370	23311	1.17 a			
13	108.93	220.32	1791	360	287	16651	0.89 b			
14	115.31	233.05	2287	360	286	16448	0.85 a			
15	129.19	260.76	8991	414	302	18433	0.74 a			
16	154.12	310.52	3222	358	280	15759	0.90 a			
17	166.50	335.23	405	284	231	11814	0.72 a			
18	186.03	374.21	3870	390	304	17084	0.99 a			
19	199.19	400.48	1091	370	299	16563	0.99 a			
20	203.95	409.97	410	321	262	13803	0.82 Ъ			
21										
	209.21	420.46 Page 001	15640	396	253	12871	0.80 a H	iResid		

# 

PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL		CERTAINTY		COUNTS	(keV)	FLAG
22	211.98	426.00	38	216	177	7723	0.48 b	NET< CL
								HiResid
23	216.05	434.12	1236	358	289	15445	1.02 c	HiResid
24	233.36	468.67		213	173	7394	0.49 a	
25	238.74	479.42		917	269	13413	0.97 a	HiResid
26	241.25	484.42		461	301	14378	1.27 b	HiResid
27	252.75	507.38			224	9261	0.96 a	
28	270.40	542.62			243	10102	1.09 a	
29	277.55	556.88	7331	313	215	8563	0.94 a	
30	279.21	560.20	503	266	215	8563	1.06 b	ı
31	288.33	578.40			235	9436	1.11 a	
32	295.36	592.44			206	7816	0.95 a	
33	300.28	602.25			206	7816	<b>1.02</b> b	
34	321.64	644.88		216	174	6072	0.82 a	
35	328.10	657.77			198	7257	1.05 a	
36	338.44	678.42			191	6760	1.04 a	
37	341.09	683.71			215	7887	1.10 b	
38	352.03	705.55	14177		203	7012	1.08 a	
39	409.72	820.69	5206	270	188	6007	1.12 a	
40	440.72	882.56		179	144	4365	0.97 a	
41	453.14	907.35			142	4262	0.93 a	
42		927.44		281	157	4857	1.16 a	
43		957.97	-	154	123	3463	0.78 a	
44	503.98	1008.83	453	191	153	4624	1.13 a	
45	509.28	1019.42		218	169	5284	1.27 b	
46	511.14	1023.12		348	169	5284	1.38 c	
47	546.83	1094.36	514	199	159	4677	1.33 <b>a</b>	
48	550.17	1101.02	337	215	174	5262	<b>1.40</b> b	
49	558.67	1117.99		141	113	2914	0.77 a	
50	562.80	1126.24		195	144	4080	1.21 b	
51	571.27	1143.13	525	268	218	6993	1.96 a	
52 52	573.10	1146.79	245	141	113	2914	0.84 Ъ	
53 54	583.49	1167.54	62580	536	157	4573	1.31 a	
	609.62 616.24	1219.70	11335	281	151	4189	1.34 a	
55 56	652.24	1232.91	167	182	148	4071	1.35 a	
50 57	666.19	1304.76	132	180	147	3977		NET< CL
58		1332.59	303	165	133	3482	1.11 a	
58 59	702.66	1405.39	337	199	161	4501	1.42 a	
	707.78	1415.62	422	216	175	5001	1.69 b	
60 61	727.64	1455.26	13599	294	147	3746	1.45 a	
61 62	742.78	1485.48	57	99	81	1609		NET< CL
62 62	755.68	1511.21	1737	188	139	3354	1.40 a	
63	763.92	1527.67	1092	175	133	3070	1.44 a	
64 65	768.80	1537.41	983	173	133	3070	1.53 b	
65	772.75	1545.30	2614	203	144	3411	1.56 c	
66	782.72	1565.19	831	151	115	2438	1.29 a	
	1	Page 002						

## 

#### PEAK SEARCH RESULTS

PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
67	786.03				126	2743	1.42	
68	795.43				122	2567		
69		1606.49	259		115	2306	1.43	
70	806.55		162		75	1281		
71	830.96	1661.48	831		101	1875	1.33	
72	836.14	1671.82			119	2344	1.59	
73	840.72	1680.97			119	2344	1.65	
74	860.99	1721.42	7633		103	1958	1.58	
75	894.08	1787.47	418		78	1332		
76	904.84	1808.95			99	1827		
77					99	1827	1.59	
78	934.54				91	1521	1.62	
79	944.79		123		71	1092	1.09	
80	952.53	1904.13	184		77	1218	1.24	
81	959.15	1917.36			63	913	1.02	
82	965.27	1929.57			91	1522	1.72	
83	969.48	1937.96			91	1522	1.65	
84	976.72	1952.41	64		67	986		A NET< CL
85	988.85	1976.62			77	1149		
86	1001.53				59	804	0.96	
87	1034.01				69	988		
88	1040.86		108		63	865	1.21	
89	1065.66		281	100	77	1158	1.41	
90 01	1079.31				83	1264	1.59	
91	1094.91 1111.12	2188.32	761		114	1861	2.54	
92 93		2220.68	492	109	82	1238	1.66 a	
94	1120.90	2240.21 2305.29			91	1404	1.89 8	
95	1153.51 1154.64			70	55	697	0.97 8	
95 96	1154.04	2307.55			79	1162		
	1238.84	2310.44 2475.61	187		73	1046	1.49	
97 98	1230.04	24/5.01 2492.83	839	115	81	1225	1.68 a	
99	1282.14	2492.03	651	152	117	1960	2.55 1	
100	1282.14	2502.02	228	103	81	1163	1.80 a	
101	1374.92	2747.22	133	121	98	1480	2.24 1	
101	1378.45	2754.27	179 636	87	68 70	938	1.68	
102	1385.98	2769.30	84	107	78	1125	1.97 1	
103	1402.18	2789.30 2801.64		73	58	750	1.37 0	
105	1402.18		213	100	79	1095	2.17 a	
105	1408.78	2814.80	306	81	60 70	758	1.53 1	
105		2919.91	7659	196	73	952		A HiResid
	1496.60 1502 31	2990.09	1110	103	64	760	1.98 8	
108	1502.31	3001.50	547	95	68	823	2.14 1	
109	1510.11	3017.05	234	84	64	760	1.94	
110	1513.57	3023.96	419	92	68	823	2.09 d	
111	1529.14	3055.05	57	67	54	590	1.58 &	
112	1539.20	3075.13	82	70	56	628	1.71 a	L
		Page 003						

# ______

### PEAK SEARCH RESULTS

PK. #	(keV)	CHANNEL	COUNTS	UN- CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
				82				 8
114				104				
115	1588.99		3681		66			
116	1593.18	3182.86	2020		74			
117	1621.50	3239.40	1736	114	64			
118	1625.73	3247.83	272	76	56			
119	1631.39	3259.13	1955	120	67	772		
120	1639.05	3274.42	465	81	56	607	1.85	đ
121	1662.12	3320.46	101	54	41	389	1.12	a
122	1667.21	3330.64	173	78	60	666	1.94	Ъ
123	1679.78	3355.72	127	80	63	709	2.16	a
124	1686.20	3368.53	123	89	71	818	2.38	Ъ
125	1730.47	3456.89	408	87	63	703	2.11	a
126	1765.35	3526.53	1957	121	68	786	2.29	a
127	1807.06	3609.76	106	82	65	753	2.18	a
128	1848.44	3692.37	197	98	77	947	2.54	a
129	1887.76	3770.85	73	69	55	601	1.68	a

SEEKER BACKGROUND SUBTRACT RESULTS Vers. 2.2.1

ALS Laboratory Group - Fort Collins GammaScan

Background File:. . . . . DET020707.BKG (210707-2 LONGBKGCAL)

Bkg.File Detector #: 2

# 

BACKGROUND SUBTRACT RESULTS

PK# 			OLD UN- CERTAINTY			NEW UN- CERTAINTY		FLAG
1		529		217	350	325	266	
3	74.83	22901	538	366	22778	556	384	
4	77.13	40971	658	427	40846	678	447	
7	84.33	5766	514	404	5674	540	427	
8	87.20	-835	639	527	-872	654	540 N	ET <cl< td=""></cl<>
10	93.25	15893	527	381	15473	555	408	
11	99.60	3820	513	410	3781	548	439	
18	186.03	3870	390	304	3598	417	329	
19	199.19	1091	370	299	774	398	324	
25	238.74	183421	917	269			289	
26	241.25	19648	461	301	19551	475	316	
32	295.36	8073	308	206	8009	331	229	
38	352.03	14177	343	203	13982	372	237	
45	509.28	1343	218	169	1341	338	272	
46	511.14	19623	348	169	17517	443	292	
49	558.67	247	141	113	-74	184	152 N	ET <cl< td=""></cl<>
51	571.27	525	268	218	451	283	230	
53	583.49	62580	536	157	62478	543	174	
54	609.62	11335	281	151	11166	314	191	
69	803.41	259	144	115	95	181		ET <cl< td=""></cl<>
77	911.78	43429	434	99	43342	448	135	
93	1120.90	2490	149	91	2447	160	103	
102	1378.45	636	107	78	606	121		
106	1461.44	7659	196	73	7417	214		
126	1765.35	1957	121	68	1908	133	83	

***:	* * * * * * * * *	210802D02.		yzed by	*****	******	ah ah ah ah ah ah ah ah a			
SEE	KER	FIN	ALA	CTIVI	TY RE	PORT	Ver	sion 2.2.1		
			ALS Labo	ratory Gro	-	Collins				
***	******	*****	******	Gamma.		* * * * * * * * * * *	***	* * * * * * * * * * * *		
						******	*****	* * * * * * * * * * * * * *		
				Geo 13	/ Solid					
Sam	Sample ID: 2106442-2 GS210619-1									
	Sampling Start: 06/14/2021 12:00:00   Counting Start: 07/10/2021 14:01:00									
Sampling Stop: 06/14/2021 12:00:00   Decay Time 6.26e+002 Hrs Buildup Time										
	Buildup Time.       .       .       0.00e+000 Hrs       Live Time       .       .       60000 Sec         Sample Size       .       .       4.05e+002 g       Real Time       .       .       60274 Sec									
Coll	lection E	fficiency						L0802D02.SPC		
								<b>rval:</b> 95 %		
	· •			ctor #: 2		2)				
		ile: (D02)								
	Eff=10^[-8.02E+01 +1.04E+02*L +-4.58E+01*L^2 +6.67E+00*L^3] 10/10/2020 Eff.= EXP[-2.35E-01 + -5.84E-01 * En + -1.09E-02 * En^2] Above 300.00 keV									
		•336-01 T		L ~ En + 				).00 kev		
		•••••								
===:								=======================================		
				RED or MDA						
===:	=========	======================================	*======				*******			
	EN	ERGY E	Concentra	ation		Critical	Walflid	-		
Nuc]		keV) T (p				Level				
Ra-2		rage:x 2.2			• • • •	• • • •				
		5.21 2.20			1.27E-01					
					3.79E-01					
		9.31 2.20 0.29 2.24								
	114	0.29 2.2	867UU +-	4.48E-UI	5.95E-01	2.96E-01	<b>1.40E+0</b>	)7		
ME	ASURED T	OTAL: 2.24	4E+00 +-	5.07E-02 g	Ci/g					
		===============================								
				OWN,SUM or						
							_ = = = = = = = = = =	: = = = = = = = = = = = = = = = = = = =		
PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM			
#	(keV)	CHANNEL		CERTAINTY		COUNTS	(keV)	FLAG		
1	63.45		350	325	266	11617	0.51	Unknown		
2	72.74		1202	434	352	25025	0.89	1095DEsc		
3	74.83		22778	556	384	27012	0.84	1095DEsc		
4 5	77.13		40846	678 31 5	447	31052	0.83	Unknown		
5 6	79.42 84.33		526 5674	315 540	257 427	14612 27880		Unknown		
7	93.25		15473	540	427	27880	0.99	Unknown Unknown		
		Page 006	204/3	555	200	42/24	•• • • • •	OTTTIOMI		
	Page 006									

## 

UNKNOWN, SUM or ESCAPE PEAKS

PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL		CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
								1101
8	99.60		3781	548	439	26579	1.10	1121DEsc
9	105.43		5679	474	370	23311	1.17	Unknown
10	108.93	220.32	1791	360	287	16651	0.89	Unknown
11	115.31	233.05	2287	360	286	16448	0.85	Unknown
12	129.19	260.76	8991	414	302	18433	0.74	Unknown
13	154.12	310.52	3222	358	280	15759	0.90	Unknown
14	166.50	335.23	405	284	231	11814	0.72	Unknown
15	186.03	374.21	3598	417	329	17084	0.99	Unknown
16	199.19	400.48	774	398	324	16563	0.99	Unknown
17	203.95		410	321	262	13803	0.82	Unknown
18	209.21	420.46	15640	396	253	12871	0.80	Unknown
19	216.05		1236	358	289	15445	1.02	1239DEsc
20	233.36	468.67	266	213	173	7394	0.49	Unknown
21	238.74	479.42	183168	925	289	13413	0.97	Unknown
22	241.25	484.42	19551	475	316	14378	1.27	Unknown
23	252.75		946	279	224	9261	0.96	Unknown
24	270.40		12559	371	243	10102	1.09	Unknown
25	277.55	556.88	7331	313	215	8563	0.94	Unknown
26	279.21	560.20	503	266	215	8563	1.06	Unknown
27	288.33	578.40	1264	295	235	9436	1.11	Unknown
29	300.28	602.25	11465	329	206	7816	1.02	Unknown
30	321.64	644.88	503	216	174	6072	0.82	Unknown
31	328.10	657.77	9498	310	198	7257	1.05	Unknown
32	338.44	678.42	37015	450	191	6760	1.04	Unknown
33	341.09	683.71	1101	270	215	7887	1.10	Unknown
34	352.03	705.55	13982	372	237	7012	1.08	1375DEsc
36	352.03	705.55	1002	3099	237	7012	1.08	Unknown
37	409.72	820.69	5206	270	188	6007	1.12	Unknown
38	440.72	882.56	334	179	144	4365	0.97	1461DEsc
39	453.14	907.35	830	182	142	4262	0.93	Unknown
40	463.20	927.44	10635	281	157	4857	1.16	Unknown
41	478.50	957.97	278	154	123	3463	0.78	1502DEsc
42	503.98	1008.83	453	191	153	4624	1.13	Unknown
43	509.28	1019.41	1341	338	272	5284	1.27	Unknown
44	511.14	1023.12	17517	443	292	5284	1.38	Unknown
45	546.83	1094.36	514	199	159	4677	1.33	Unknown
46	550.17	1101.02	337	215	174	5262	1.40	Unknown
47	562.80	1126.24	1874	195	144	4080	1.21	Unknown
48	571.27	1143.13	451	283	230	6993	1.96	1593DEsc
49	573.10	1146.79	245	141	113	2914	0.84	1593DEsc
50	583.49	1167.54	62478	543	174	4573	1.31	1095SEsc
52		1232.91	167	182	148	4071	1.35	1639DEsc
53		1332.59	303	165	133	3482	1.11	1686DEsc
54		1405.39	337	199	161	4501	1.42	Unknown
55		1415.62	422	216	175	5001	1.69	1730DEsc
56		1455.26	13599	294	147	3746	1.45	1239SEsc
		Dage 007				-/		

Page 007

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UNKNOWN, SUM OF ESCAPE PEAKS

PK.	ENERGY	ADDRESS	NET	UN-	C.L.	BKG	FWHM	
#	(keV)	CHANNEL	COUNTS	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG
57		1511.21	1737	188	139	3354	1.40	Unknown
58		1527.67	1092	175	133	3070	1.44	Unknown
59		1537.41	983	173	133	3070	1.53	Unknown
60		1545.30	2614	203	144	3411	1.56	1282SEsc
61		1565.19	831	151	115	2438	1.29	Unknown
62		1571.81	1975	177	126	2743	1.42	1807DEsc
63		1590.57	7130	224	122	2567	1.50	Unknown
64 CE		1612.75	162	95	75	1281	0.85	Unknown
65		1661.48	831	135	101	1875	1.33	Unknown
66		1671.82	2915	181	119	2344	1.59	Unknown
67 60		1680.97	1626	166	119	2344	1.65	Unknown
68		1721.42	7633	215	103	1958	1.58	Unknown
69 70		1787.47	418	104	78	1332	1.16	Unknown
70		1808.95	1108	138	99	1827	1.65	Unknown
71		1822.79	43342	448	135	1827	1.59	Unknown
72		1868.22	487	119	91	1521	1.62	Unknown
73	944.79		123	89	71	1092	1.09	Unknown
74	952.53		184	97	77	1218	1.24	Unknown
75 76		1917.36	346	85	63	913	1.02	Unknown
70	965.27		7850	209	91	1522	1.72	Unknown
	969.48		26078	341	91	1522	1.65	Unknown
78		1976.62	240	98	77	1149	1.49	Unknown
79 80	1001.53		104	75	59	804	0.96	1514SEsc
80 81	1034.01		260	90	69	988	1.39	Unknown
82	1040.86 1065.66		108	79	63	865	1.21	Unknown
83			281	100	77	1158	1.41	Unknown
84	1079.31		705	114	83	1264	1.59	1589 <b>SEs</b> c
85	1094.91 1111.12		761	150	114	1861	2.54	Unknown
86	1120.90		492	109	82	1238	1.66	1622SEsc
			2447	160	103	1404	1.89	SPLIT
87 88	1153.51 115 <b>4.64</b>		112	70	55	697	0.97	Unknown
89	1154.04		207	101	79	1162	1.59	1667 <b>SEs</b> c
90	1238.84		187	93	73	1046	1.49	1667 <b>SEs</b> c
90 91	1247.47		839	115	81	1225	1.68	Unknown
92	1282.14		651	152	117	1960	2.55	Unknown
93	1282.14		228	103	81	1163	1.80	Unknown
93 94	1374.92		133	121	98	1480	2.24	Unknown
			179	87	68	938	1.68	Unknown
95 06	1378.45		606	121	91	1125	1.97	Unknown
96 07	1385.98		84	73	58	750	1.38	Unknown
97	1402.18		213	100	79	1095	2.17	Unknown
98	1408.78		306	81	60	758	1.53	Unknown
99	1461.44		7417	214	105	952	2.20	Unknown
100	1496.60		1110	103	64	760	1.98	Unknown
101	1502.31		547	95	68	823	2.14	Unknown
102	1510.11		234	84	64	760	1.94	Unknown
		Page 008						

# 

# UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
103	1513.57	3023.96	419	92	68	823	2.09	Unknown
104	1529.14	3055.05	57	67	54	590	1.58	Unknown
105	1539.20	3075.13	82	70	56	628	1.71	Unknown
106	1558.18	3113.00	247	82	62	684	2.18	Unknown
107	1581.46	3159.48	696	104	74	903	2.50	Unknown
108	1588.99	3174.50	3681	146	66	782	2.09	Unknown
109	1593.18	3182.86	2020	127	74	903	2.44	Unknown
110	1621.50	3239.40	1736	114	64	717	2.12	Unknown
111	1625.73	3247.83	272	76	56	607	1.84	Unknown
112	1631.39	3259.13	1955	120	67	772	2.25	Unknown
113	1639.05	3274.42	465	81	56	607	1.85	Unknown
114	1662.12	3320.46	101	54	41	389	1.12	Unknown
115	1667.21	3330.64	173	78	60	666	1.94	Unknown
116	1679.78	3355.72	127	80	63	709	2.16	Unknown
117	1686.20	3368.53	123	89	71	818	2.38	Unknown
118	1730.47	3456.89	408	87	63	703	2.11	Unknown
119	1765.35	3526.53	1908	133	83	786	2.29	Unknown
120	1807.06	3609.76	106	82	65	753	2.18	Unknown
121	1848.44	3692.37	197	98	77	947	2.54	Unknown
122	1887.76	3770.85	73	69	55	601	1.68	Unknown
124	1120.90	2240.21	122	983	103	1404	1.89	

c:\SEEKER\BIN\210802d02A.res Analysis Results Saved.

210799D01.SPC Analyzed by Jul											
****		*******			******	********	******	****			
SEEI				v	RESU	LTS P	S Versi	on 1.8.4			
		А	LS Laborat		- Fort Coli	lins					
	GammaScan										
****	*******	*******	*******	*******	******	******	*****	*****			
Geo 13 / Solid											
Samp]	le ID: GS	5210619-1MB	GS210619-	1							
Samol	ling Star	 -+• 07/1	1/2021 13.		unting Sta						
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					etector 1)						
Ener	rv(keV)=	-1.99 + 0		-	$h^2 + 0.001$	E+00*CP*3	07/11/	2021			
-					$n^2 + 0.001$		• • •				
	(	0072 0			nergy in k		00/22/	2020			
Searc	ch Sensit	vity: 1.0	0   Sigma	Multiplier	: 2.00   S	earch Sta	rt/End:	80/4000			
====											
			PEA	K SEARCH R	ESULTS						
====:								=========			
PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM				
#	(keV)	CHANNEL	COUNTS C	ERTAINTY	COUNTS	COUNTS	(keV)	FLAG			
1	53.86	111.47	69	109	89	1253		a NET< CL			
2	66.45	136.61	104	59	46	517	0.47				
3	69.37	142.43	13	56	46	517		b NET< CL			
4	74.94	153.55	95	60	47	547	0.49				
5	84.63	172.90	92	84	67	839	0.95 a				
6	92.59	188.79	172	102	81	1048	1.37 a				
7	97.05	197.68	55	61	49	524	0.66 1				
8	139.94	283.29	181	64	48	512	0.73 a				
9	154.18	311.72	62	83	67	829		a NET< CL			
10	185.72	374.67	162	103	82	1059	1.35 a				
11	198.32	399.84	119	72	57	648	0.74				
12	238.47	479.96	183	86	67	763	1.20 4				
13	261.42	525.78	24	51	41	417		a NET< CL			
14	295.08	592.97	44	71	58	655		a NET< CL			
15	351.66	705.90	175	75	58	624	1.23 a				
16	508.28	1018.53	-3	35	29	210	0.72 a	a NET< CL			
								Wide Pk			
17	511.11	1024.17	1408	125	83	840	2.64 1	<b>D</b>			
18	537.99	1077.83	69	68	54	455	1.87 a	1			
19	558.44	1118.65	156	63	47	388	1.54 a	1			
20	569.80	1141.31	61	62	49	419	1.40 a				
		Page 001									

### 

### PEAK SEARCH RESULTS

### 

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN- CERTAINTY	C.L. Counts	BKG COUNTS	FWHM (keV)	FLAG
21	583.43	1168.53	128	95	76	657	2.88	a Wide Pk
22	596.33	1194.27	50	56	44	389	1.18	<b>A</b>
23	609.33	1220.22	141	59	45	409	1.32	<b>a</b>
24	768.70	1538.33	51	53	42	301	1.98	1
25	802.83	1606.46	65	43	33	221	1.32	8
26	911.38	1823.14	85	43	32	195	1.53	<b>A</b>
27	1121.02	2241.58	47	55	44	290	2.72	1
28	1461.11	2920.41	672	60	25	103	2.24	A
29	1764.75	3526.49	78	28	18	55	2.35	A

.

SEEKER BACKGROUND SUBTRACT RESULTS Vers. 2.2.1

ALS Laboratory Group - Fort Collins GammaScan

Background File:. . . . . DET010707.BKG (210707-1 LONGBKGCAL)

Bkg.File Detector #: 1

BACKGROUND SUBTRACT RESULTS

	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW	
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL FLA	G
2	66.45	104	59	46	-31	133	110 NET <c< td=""><td>L</td></c<>	L
4	74.94	95	60	47	-28	152	125 NET <c< td=""><td>L</td></c<>	L
6	92.59	172	102	81	25	181	149 NET <c< td=""><td>L</td></c<>	L
8	139.94	181	64	48	101	125	101 NET <c< td=""><td>L</td></c<>	L
9	154.18	62	83	67	20	131	107 NET <c< td=""><td>L</td></c<>	L
10	185.72	162	103	82	65	195	160 NET <c< td=""><td>L</td></c<>	L
11	198.32	119	72	57	-55	179	147 NET <c< td=""><td>L</td></c<>	L
12	238.47	183	86	67	90	161	132 NET <c< td=""><td>L</td></c<>	L
14	295.08	44	71	58	-0	165	135 NET <c< td=""><td>L</td></c<>	L
15	351.66	175	75	58	73	122	100 NET <c< td=""><td>L</td></c<>	L
17	511.11	1408	125	83	415	258	210	
19	558.44	156	63	47	-27	133	<b>110 NET<c< b=""></c<></b>	L
21	583.43	128	95	76	47	146	120 NET <c< td=""><td>L</td></c<>	L
23	609.33	141	59	45	16	151	124 NET <c< td=""><td>L</td></c<>	L
25	802.83	65	43	33	-53	93	77 NET <c< td=""><td>L</td></c<>	L
26	911.38	85	43	32	16	89	73 NET <c< td=""><td>L</td></c<>	L
27	1121.02	47	55	44	19	78	63 NET <c< td=""><td>L</td></c<>	L
28	1461.11	672	60	25	27	134	<b>110 NET<c< b=""></c<></b>	L
29	1764.75	78	28	18	13	81	66 NET <c< td=""><td>L</td></c<>	L

210799D01.SPC Analyzed by										
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		ALS La	boratory Gro	up - Fort (	Collins					
			Gamma							
***************************************										
Geo 13 / Solid										
Sample I	Sample ID: GS210619-1MB GS210619-1									
				-		07/11/2021 13:16				
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-						60000				
-						60110 210799D01.				
		-		-		ce Interval: 9				
		De	tector #: 1	(Detector	1)					
	-		.EFF (Geo 13	-						
	-		*L +-6.36E+0		-					
	-		•01 * En + 0.		-	300.00 keV				
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		ME	SURED or MDA	CONCENTRA	TIONS					
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		N								
		E Concer			Critical					
Nuclide	(keV)	T (pCi/g	)	MDA	Level	(hrs)				
Th-234	92.50	N 3.22E-02	+- 2.32E-01	3.85E-01	1.91E-01	3.92E+13				
Pb-212			+- 1.93E-02		1.58E-02	1.27E+14				
Pb-214	351.99	N 1.33E-02	+- 2.23E-02	3.68E-02	1.81E-02	1.40E+07				
<b>T1-208</b>	583.14	N 5.74E-03	+- 1.78E-02	2.95E-02	1.46E-02	1.27E+14				
Bi-214	609.32	N 3.83E-03	+- 3.50E-02	5.81E-02	2.87E-02	1.40E+07				
Ra-228			+- 5.19E-02		<b>4.26E-02</b>	5.04E+04				
K-40			+- 2.71E-01		2.22E-01	1.12E+13				
Pb-210			+- 6.78E+00		5.60E+00	1.95E+05				
U-235 Th-227			+- 3.35E-02 +- 5.36E-02		2.75E-02 4 40E-02	6.17E+12 1.90E+05				
Cs-137			+- 7.14E-03		4.40E-02 5.98E-03	2.64E+05				
Bi-212			+- 9.29E-02		7.19E-02	1.27E+14				
Pa-234m			+- 1.15E+00		9.09E-01	3.92E+13				

MEASURED TOTAL: 1.13E+00 +- 1.98E+00 pCi/g

## 

#### UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	53.86	111.47	69	109	89	1253	1.29	Deleted
2	66.45	136.61	-31	133	110	517	0.47	Deleted
3	69.37	142.43	13	56	46	517	0.50	Deleted
4	74.94	153.55	-28	152	125	547	0.49	Deleted
5	84.63	172.90	92	84	67	839	0.95	Unknown
7	97.05	197.68	55	61	49	524	0.66	Unknown
8	139.94	283.29	101	125	101	512	0.73	Deleted
9	154.18	311.72	20	131	107	829	1.06	Deleted
10	185.72	374.67	65	195	160	1059	1.35	Deleted
11	198.32	399.84	-55	179	147	648	0.74	Deleted
13	261.42	525.78	24	51	41	417	0.59	Deleted
14	295.08	592.97	-0	165	135	655	1.12	Deleted
16	508.28	1018.53	-3	35	29	210	0.72	Deleted
17	511.11	1024.17	415	258	210	840	2.64	Unknown
18	537.99	1077.83	69	68	54	455	1.87	Unknown
19	558.44	1118.65	-27	133	110	388	1.54	Deleted
20	569.80	1141.31	61	62	49	419	1.40	Unknown
22	596.33	1194.27	50	56	44	389	1.18	Unknown
24	768.70	1538.33	51	53	42	301	1.98	Unknown
25	802.83	1606.46	-53	93	77	221	1.32	Deleted
27	1121.02	2241.58	19	78	63	290	2.72	Deleted
29	1764.75	3526.49	13	81	66	55	2.35	Deleted

c:\SEEKER\BIN\210799d01.res Analysis Results Saved.

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	2	10799D01.S	SPC Analyze	d pr 3H /	I			
****	******	******	*******	*******	*******	*******	******	******
SEEF	ŒR	GAMM	A ANA	LYSIS	RESUI	TS P	S Versi	lon 1.8.4
		А	LS Laborat	ory Group ·	- Fort Coll	ins		
		-		GammaScal				
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				Geo 13 / So	oliđ			
Sampl	Le ID: GS	210619-1ME	GS210619-	-1				
-								
-	-			00:00   Con 00:00   Dec	-			
-	• •			00:00   Dec 0 Hrs   Liv	-			
	-			002 g   Real				60110 Sec
-				.0000   Sp				
			· · · · ·			· · · · · ·		
			Detecto	or #: 1 (De	etector 1)			
Energ	y(keV)=	-1.99 + 0	.501*Ch +	0.00E+00*C	$h^2 + 0.001$	S+00*Ch^3	07/11/	2021
FWHM	(keV) =	0.74 + 0	).020*En +	4.70E-04*E	$n^2 + 0.001$	C+00*En^3	08/22/	2020
			Where E	n = Sqrt(E	nergy in ke	€V)		
Searc	ch Sensit	ivity: 1.0	)0   Sigma	Multiplier	: 2.00   Se	earch Sta	rt/End:	80/4000
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				K SEARCH R				
====							======	
====: PK.	ENERGY	ADDRESS				BKG	===== FWHM	
			NET/MDA			BKG COUNTS	FWHM (keV)	FLAG
PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS C	UN- CERTAINTY	C.L. COUNTS	COUNTS	(keV)	
PK. # 	ENERGY (keV) 53.86	ADDRESS CHANNEL 111.47	NET/MDA COUNTS ( 69	UN- CERTAINTY 109	C.L. COUNTS 89	COUNTS 1253	(keV) 1.29	a NET< CL
РК. #  1 2	ENERGY (keV) 53.86 66.45	ADDRESS CHANNEL 111.47 136.61	NET/MDA COUNTS C 69 104	UN- CERTAINTY 109 59	C.L. COUNTS 89 46	COUNTS 1253 517	(keV) 1.29 0.47	a NET< CL a
PK. # 1 2 3	ENERGY (keV) 53.86 66.45 69.37	ADDRESS CHANNEL 111.47 136.61 142.43	NET/MDA COUNTS C 69 104 13	UN- CERTAINTY 109 59 56	C.L. COUNTS 89 46 46	COUNTS 1253 517 517	(keV) 1.29 0.47 0.50	a NET< CL a b NET< CL
PK. # 1 2 3 4	ENERGY (keV) 53.86 66.45 69.37 74.94	ADDRESS CHANNEL 111.47 136.61 142.43 153.55	NET/MDA COUNTS C 69 104 13 95	UN- CERTAINTY 109 59 56 60	C.L. COUNTS 89 46 46 46 47	COUNTS 1253 517 517 547	(keV) 1.29 0.47 0.50 0.49	a NET< CL a b NET< CL a
PK. #  1 2 3 4 5	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90	NET/MDA COUNTS ( 69 104 13 95 92	UN- CERTAINTY 109 59 56 60 84	C.L. COUNTS 89 46 46 46 47 67	COUNTS 1253 517 517 547 839	(keV) 1.29 0.47 0.50 0.49 0.95	a NET< CL a b NET< CL a a
PK. # 1 2 3 4 5 6	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59	ADDRESS CHANNEL 111.47 136.61 142.43 153.55	NET/MDA COUNTS C 69 104 13 95	UN- CERTAINTY 109 59 56 60	C.L. COUNTS 89 46 46 46 47	COUNTS 1253 517 517 547	(keV) 1.29 0.47 0.50 0.49	a NET< CL a b NET< CL a a a
PK. #  1 2 3 4 5	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79	NET/MDA COUNTS ( 69 104 13 95 92 172	UN- CERTAINTY 109 59 56 60 84 102	C.L. COUNTS 89 46 46 46 47 67 81	COUNTS 1253 517 517 547 839 1048	(keV) 1.29 0.47 0.50 0.49 0.95 1.37	a NET < CL a b NET < CL a a a b
PK. # 1 2 3 4 5 6 7	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68	NET/MDA COUNTS C 69 104 13 95 92 172 55	UN- CERTAINTY 109 59 56 60 84 102 61	C.L. COUNTS 89 46 46 46 47 67 81 49	COUNTS 1253 517 517 547 839 1048 524	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73	a NET < CL a b NET < CL a a a b
PK. # 1 2 3 4 5 6 7 8	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29	NET/MDA COUNTS C 69 104 13 95 92 172 55 181	UN- CERTAINTY 109 59 56 60 84 102 61 61 64	C.L. COUNTS 89 46 46 46 47 67 81 49 48	COUNTS 1253 517 517 547 839 1048 524 512	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73	a NET < CL a b NET < CL a a b a a NET < CL
PK. # 1 2 3 4 5 6 7 8 9	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72	NET/MDA COUNTS ( 69 104 13 95 92 172 55 181 62	UN- CERTAINTY 109 59 56 60 84 102 61 64 83	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67	COUNTS 1253 517 517 547 839 1048 524 512 829	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06	a NET < CL a b NET < CL a a b a a NET < CL a
PK. # 1 2 3 4 5 6 7 8 9 10	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82	COUNTS 1253 517 517 547 839 1048 524 512 829 1059	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35	a NET < CL a b NET < CL a a b a a NET < CL a a
PK. # 1 2 3 4 5 6 7 8 9 10 11	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 119	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103 72	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82 57	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20	a NET < CL a b NET < CL a a b a a NET < CL a a
PK. # 1 2 3 4 5 6 7 8 9 10 11 12	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 119 183	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82 57 67	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763	(keV) 1.29 0.47 0.50 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59	a NET < CL a b NET < CL a a b a a NET < CL a a a
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47 261.42	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96 525.78 592.97	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 162 119 183 24	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86 51	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82 57 67 41	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763 417	(keV) 1.29 0.47 0.50 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59	a NET < CL a b NET < CL a a b a a NET < CL a a NET < CL a NET < CL a NET < CL
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47 261.42 295.08	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96 525.78 592.97 705.90	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 162 119 183 24 44	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86 51 71	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82 57 67 41 58	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763 417 655	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59 1.12 1.23	a NET < CL a b NET < CL a a b a a NET < CL a a NET < CL a NET < CL a NET < CL
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47 261.42 295.08 351.66	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96 525.78 592.97 705.90	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 119 183 24 44 175	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86 51 71 71 75	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82 57 67 41 58 58	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763 417 655 624	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59 1.12 1.23	a NET < CL a b NET < CL a a b a a NET < CL a a NET < CL a NET < CL a NET < CL a
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47 261.42 295.08 351.66	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96 525.78 592.97 705.90 1018.53	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 119 183 24 44 175	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86 51 71 71 75	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82 57 67 41 58 58	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763 417 655 624	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59 1.12 1.23	a NET < CL a b NET < CL a a b a a NET < CL a NET < CL a NET < CL a a NET < CL a a NET < CL a u NET < CL a a NET < CL a
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47 261.42 295.08 351.66 508.28	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96 525.78 592.97 705.90 1018.53 1024.17	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 162 119 183 24 44 175 -3	UN- ERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86 51 71 75 35 125 68	C.L. COUNTS 89 46 46 47 67 81 49 48 67 82 57 67 41 58 58 58 29 83 54	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763 417 655 624 210 840 455	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59 1.12 1.23 0.72 2.64 1.87	a NET < CL a b NET < CL a a b a b a a NET < CL a a NET < CL a nET < CL a nET < CL a u nET < CL a a nET < CL a a a nET < CL a a a a a nET < CL a a a a a a a a a a a a a a a a a a a
PK. #  1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47 261.42 295.08 351.66 508.28 511.11 537.99 558.44	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96 525.78 592.97 705.90 1018.53 1024.17 1077.83 1118.65	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 162 162 119 183 24 44 175 -3 1408 69 156	UN- CERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86 51 71 71 75 35 125 68 63	C.L. COUNTS 89 46 46 46 47 67 81 49 48 67 82 57 67 41 58 57 67 41 58 58 29 83 54 47	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763 417 655 624 210 840 455 388	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59 1.12 1.23 0.72 2.64 1.87 1.54	a NET < CL a b NET < CL a a b a a NET < CL a a NET < CL a NET < CL a a NET < CL a u a NET < CL a a a NET < CL a a a NET < CL a a a NET < CL a a a a NET < CL a a a a a NET < CL a a a a a a a a a a a a a a a a a a a
PK. # 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18	ENERGY (keV) 53.86 66.45 69.37 74.94 84.63 92.59 97.05 139.94 154.18 185.72 198.32 238.47 261.42 295.08 351.66 508.28 511.11 537.99 558.44 569.80	ADDRESS CHANNEL 111.47 136.61 142.43 153.55 172.90 188.79 197.68 283.29 311.72 374.67 399.84 479.96 525.78 592.97 705.90 1018.53 1024.17 1077.83 1118.65	NET/MDA COUNTS C 69 104 13 95 92 172 55 181 62 162 162 119 183 24 44 175 -3 1408 69	UN- ERTAINTY 109 59 56 60 84 102 61 64 83 103 72 86 51 71 75 35 125 68	C.L. COUNTS 89 46 46 47 67 81 49 48 67 82 57 67 41 58 58 58 29 83 54	COUNTS 1253 517 517 547 839 1048 524 512 829 1059 648 763 417 655 624 210 840 455	(keV) 1.29 0.47 0.50 0.49 0.95 1.37 0.66 0.73 1.06 1.35 0.74 1.20 0.59 1.12 1.23 0.72 2.64 1.87	a NET < CL a b NET < CL a a b a a NET < CL a a NET < CL a NET < CL a a NET < CL a u a NET < CL a a a NET < CL a a a NET < CL a a a NET < CL a a a a NET < CL a a a a a NET < CL a a a a a a a a a a a a a a a a a a a

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## PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
21	583.43	1168.53	128	95	76	657	2.88	a Wide Pk
22	596.33	1194.27	50	56	44	389	1.18	a
23	609.33	1220.22	141	59	45	409	1.32	a
24	768.70	1538.33	51	53	42	301	1.98	a
25	802.83	1606.46	65	43	33	221	1.32	a
26	911.38	1823.14	85	43	32	195	1.53	a
27	1121.02	2241.58	47	55	44	290	2.72	a
28	1461.11	2920.41	672	60	25	103	2.24	a
29	1764.75	3526.49	78	28	18	55	2.35	a

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SEEKER BACKGROUND SUBTRACT RESULTS Vers. 2.2.1

### ALS Laboratory Group - Fort Collins

GammaScan

Background File:.... DET010707.BKG (210707-1 LONGBKGCAL)

Bkg.File Detector #: 1

BACKGROUND SUBTRACT RESULTS

	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL FLAG
2	66.45	104	59	46	-31	133	110 NET <cl< td=""></cl<>
4	74.94	95	60	47	-28	152	125 NET <cl< td=""></cl<>
6	92.59	172	102	81	25	181	149 NET <cl< td=""></cl<>
8	139.94	181	64	48	101	125	101 NET <cl< td=""></cl<>
9	154.18	62	83	67	20	131	107 NET <cl< td=""></cl<>
10	185.72	162	103	82	65	195	160 NET <cl< td=""></cl<>
11	198.32	119	72	57	-55	179	147 NET <cl< td=""></cl<>
12	238.47	183	86	67	90	161	132 NET <cl< td=""></cl<>
14	295.08	44	71	58	-0	165	135 NET <cl< td=""></cl<>
15	351.66	175	75	58	73	122	100 NET <cl< td=""></cl<>
17	511.11	1408	125	83	415	258	210
19	558.44	156	63	47	-27	133	110 NET <cl< td=""></cl<>
21	583.43	128	95	76	47	146	120 NET <cl< td=""></cl<>
23	609.33	141	59	45	16	151	124 NET <cl< td=""></cl<>
25	802.83	65	43	33	-53	93	77 NET <cl< td=""></cl<>
26	911.38	85	43	32	16	89	73 NET <cl< td=""></cl<>
27	1121.02	47	55	44	19	78	63 NET <cl< td=""></cl<>
28	1461.11	672	60	25	27	134	110 NET <cl< td=""></cl<>
29	1764.75	78	28	18	13	81	66 NET <cl< td=""></cl<>

****	******	210799D01.8	-		*******	******	*****	*****		
SEEK	SEEKER FINAL ACTIVITY REPORT Version 2.2.1									
****	ALS Laboratory Group - Fort Collins GammaScan									
				~						
				Geo 13	/ Solid					
Samp	le ID:	GS210619-11	0B GS2100	519-1						
Samp Buil Samp Coll	ling Sto dup Time le Size ection E	p: 07/1	L1/2021 : 0.00e- . 5.00	L3:00:00   +000 Hrs   De+002 g   1.0000   95 %	Decay Time Live Time Real Time Spectrum D Det. Limit	e  File t Confidend	2.   21 ce Inter	21 13:16:08 69e-001 Hrs 60000 Sec 60110 Sec 0799D01.SPC val: 95 %		
			Dete		(Detector					
Eff	=10^[-1.	ile: (D01) 10E+02 +1.4 97E-01 + -8	(Sh13).E 4E+02*L 3.38E-01	FF (Geo 13 +-6.36E+0 * En + 0.	Eff Cal) 1*L^2 +9.3	3E+00*L^3] n^2] Above	300.0			
Libr	-	• • • • •		-			• •			
		===================			CONCENTRA		======			
		=========								
	EN	n Ergy e (	loncentr	tion		Critical	Walflif			
Nucl		keV) T (p(				Level		5		
 Ra-2	26 35	1.92 N 3.00	5E-02 +-	1.36E-02		1.05E-02				
ME	ASURED T	OTAL: 3.00	5E-02 +-	1.36E-02	pCi/g					
====		============			ESCAPE PE					
====								= = = = = = = = = = = = =		
PK.	FREDCY	ADDEECC	NTEV/III	UN-	<b>C</b> T	PZO				
#	(keV)		NET COUNTS	CERTAINTY	C.L. COUNTS		FWHM (keV)	FLAG		
		172.90 197.68	92 55	84 61	67 49			Unknown Unknown		
3		1024.17	415	258				Unknown		
4		1077.83	69	68				Unknown		
5	569.80	1141.31	61	62	49	419	1.40	Unknown		
		1194.27	50	56				Unknown		
7	768.70	1538.33	51	53	42	301	1.98	Unknown		
<b>~</b> • • • •	ידי / משעים	N1 21 0799401	N	nalwaia Bo	aulta Como	a				

c:\SEEKER\BIN\210799d01A.res Analysis Results Saved.

****		10798D01.		ed by JH	******	*****	*****	****				
SEE	KER	GAMM	A ANZ	LYSIS	RESU	LTS P	S Versi	on 1.8.4				
****	ALS Laboratory Group - Fort Collins GammaScan ************************************											
				Geo 13 / 8	Solid							
Sam	ole ID: GS	210619-110	CS GS21061	.9-1								
Sam Buil Sam Coll	oling Stop dup Time. ole Size . .ection Ef	ficiency	11/2021 12 . 0.00E+C 5.00E	2:00:00   De 000 Hrs   L: 2+002 g   Re 1.0000   Sy	ive Time . Bal Time . Do. File .	• • • • • • • • • • • • • • • • • •	. 1.7   210	5E-001 Hrs 1800 Sec 1866 Sec 798D01.SPC				
Ener FWHM	rgy(keV)= I(keV) =	-1.99 + ( 0.74 + (	Detect 0.501*Ch + 0.020*En + Where	or #: 1 (1 0.00E+00*( 4.70E-04*) En = Sqrt() Multiplies	Detector 1) Ch^2 + 0.00 En^2 + 0.00 Energy in k	E+00*Ch^3 E+00*En^3 eV)	07/11/ 08/22/	2021 2020				
				ZAK SEARCH I								
===							======					
				UN- CERTAINTY		-		FLAG				
1	59.49	122.72	4753	179	94	 1792	0.86	a				
2	87.94	179.50	7147	204	94	1767		a HiResid				
3 4	122.07 136. <b>4</b> 7	247.63 276.36	2092 223	146 117	93 93	1610 1606	0.98					
5	165.82	334.95	154	100	93 79	1273	0.91 0.81					
6	228.65	460.36	56	83	67	1000		a NET< CL				
7	279.88	562.63	62	69	56	759	0.60					
8	297.18	597.16	65	88	71	1066	1.02	a NET< CL				
9	479.19	960.47	35	58	46	532		A NET< CL				
10	661.66	1324.68	17530	276	64	753		A HiResid				
11 12	1173.23 1332.40	2345.79 2663.51	13915 12670	244 229	51 32	462 177		A HiResid				
13	1460.91	2920.01	23	19	32 13	177 32	2.35 1.94	a HiResid a				

## 210798D01.SPC Analyzed by SEEKER BACKGROUND SUBTRACT RESULTSVers. 2.2.1 ALS Laboratory Group - Fort Collins GammaScan Background File:.... DET010707.BKG (210707-1 LONGBKGCAL) Bkg.File Detector #: 1 BACKGROUND SUBTRACT RESULTS

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN- CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN- CERTAINTY	NEW CR.LEVEL	FLAG
3	122.07	2092	146	93	2092	146	93	
8	297.18	65	88	71	64	88	71 N	ET <cl< td=""></cl<>
13	1460.91	23	19	13	4	19	15 N	et <cl< td=""></cl<>

******	210798	D01.SPC Analy		********	* * * * * * * * * * * * *		*****
SEEKER	F	INAL A				Vers	ion 2.2.1
		ALS Labo:	ratory Gro Gamma	up - Fort (	Collins		
******	********	*********			******	******	*****
			Geo 13	/ Solid			
Sample ]	D: GS2106	19-1LCS GS21	0619-1				
		07/11/2021 07/11/2021					
	-	• • • • • • • • • • • • • • • • • • •					
		5.0					
		ncy		-			
Cr. Leve	el Confiden	ce Interval:	95 %	Det. Limi	t Confidence	ce Inter	<b>val:</b> 95 %
		Dete	ctor #: 1	(Detector	 1)		
Efficier	ncy File: ()	D01)(Sh13).E	FF (Geo 13	Eff Cal)			
	-	+1.44E+02*L			-		
		+ -8.38E-01			-		
		ANALYTICA					
-		=================		-			
		MEASU	RED or MDA	CONCENTRA	TIONS		
	:======= N	= = = = = = = = = = = = = = = = = = =		=======			= = = = = = = = = = = = = = = = = = =
		Concentra	ation		Critical	Halflif	A
Nuclide		(pCi/g		MDA	Level		-
Am-241	59.54	2.03E+02 +-		8.19E+00	4.04E+00	3.79E+0	
Cd-109 Co-57	88.02 122.07	5.13E+02 +- 3.95E+00 +-			6.72E+00 1.76E-01	1.11E+0 6.50E+0	
Ce-139		3.01E-01 +-			1.55E-01		
		1.34E-01 +-			1.20E-01		-
Cs-137	661.62	7.86E+01 +-		5.85E-01	2.86E-01	2.64E+0	5
Co-60	-	8.65E+01 +-			• • • •		
		8.59E+01 +- 8.71E+01 +-			3.15E-01		
Sn-113	391.68	MDA	1.5/6700		2.22E-01 3.08E-01		
Y-88	898.02	MDA	• • • •		4.00E-01		
			<b></b>	- • •			
		8.86E+02 +-					
				ESCAPE PE			
*******			•				============
		00	TTLT	<b>.</b>	BVA		
	ERGY ADDRE (ev) chann		UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
π (л						(78¥)	
4 13	36.47 276.	36 223	117	93	1606	0.91	Unknown
	Page	003					

## 

## UNKNOWN, SUM or ESCAPE PEAKS

PK. # 	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. Counts	BKG COUNTS	FWHM (keV)	FLAG
6	228.65	460.36	56	83	67	1000	0.57	Deleted
8	297.18	597.16	64	88	71	1066	1.02	Deleted
9	479.19	960.47	35	58	46	532	0.70	Deleted
13	1460.91	2920.01	4	19	15	32	1.94	Deleted

c:\SEEKER\BIN\210798d01.res Analysis Results Saved.

Gamma Spectrometer Run Log

Date: 7 10 707 7 11 207

Reviewed By/Date: TS 7/(z/z)

Sample ID       Verl       Dat. No.       Geo?       Count Dat.       Start Time       Analyst       File ID.SPC       Save?         210551)-29       7       76       30       13/25       91       710756.007.00       0         -30       10       1       1       210756.007.00       0       0       0       0         6527060127.m8       1       1       1       1       210745.007.00       0       0         1       1       1       1       1       1       210747.00       0       0         1       1       1       1       1       1       21074000       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0       0		T	1	1	1	<u> </u>			1	ר
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-19       -15       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       -1       <			Ŷ							10
-1\$       7       13'.17       Z10759007       TS         -16       10       N       Z16732010       TS         -17       7/12       N       Z16732010       TS         -16       10       N       Z16732010       TS         -17       7/12       N       Z16732010       TS         -17       7/12       N       Z16732010       TS         -17       -16       10       -16       -16         -17       -16       10       -16       -16       -16         -17       -16       10       -16       -17       -17       -17         -17       -16       -16       -17       -16       -17       -17       -17         -17       -16       -16       -16       -16       -17       -17         -17	_14		E			-				2
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Form 754r16b.doc (10/27/11)

## <u>Technical Comments Regarding Analysis using the Natural (SubRa228).LIB</u> <u>Gamma Spectroscopy Library</u>

Analysis using the **Natural (SubRa228).LIB** library is limited to the list of gamma emitting radionuclides specified by ALS Laboratory Group. ALS Laboratory Group specifies all values assigned to the nuclides in this library. In cases where multiple gamma emissions are used to quantify activity, the most abundant emission is used for quantification in the absence of any supporting gamma emissions. It should be noted that the current software program used for gamma spectroscopic analysis is limited to a +/- 2.0 keV photo-peak resolution tolerance. Thus, any gamma emissions occurring within the same +/- 2.0 keV range will suffer interference, consequently preventing accurate quantification. Nuclide specific information regarding analysis using the **Natural (SubRa228).LIB** library is as follows:

Nuclide: ²²⁸Ra

Energy: various

Photon Abundance: various

All activity values for ²²⁸Ra are calculated using the emissions of the ²²⁸Ac daughter. It is assumed that secular equilibrium is achieved between the ²²⁸Ra parent and the ²²⁸Ac progeny.

Nuclide: ²¹²Bi, ²¹²Pb, ²⁰⁸Tl

Energy: various

Photon Abundance: various

All activity values for ²¹²Bi, ²¹²Pb, and ²⁰⁸Tl are calculated using the half-life, t_{1/2}=1.45E+10 years, of the long-lived ²³²Th parent. It is assumed that secular equilibrium is achieved between the ²³²Th parent and the ²¹²Bi, ²¹²Pb, ²⁰⁸Tl progeny.

Nuclide: ²¹⁴Bi, ²¹⁴Pb

Energy: various

Photon Abundance: various

All activity values for ²¹⁴Bi and ²¹⁴Pb are calculated using the half-life, t_{1/2}=1600 years, of the long-lived ²²⁶Ra parent. It is assumed that secular equilibrium is achieved between the ²²⁶Ra parent and the ²¹⁴Bi and ²¹⁴Pb progeny.

Nuclide: ¹³⁷Cs Energy: 661.62 keV

Photon Abundance: 0.8512

¹³⁷Cs does not emit any gamma photons useful for quantification. However, it can be assumed to be in secular equilibrium with the short-lived ^{137m}Ba daughter product. Therefore, the activity for ¹³⁷Cs is determined from the 661.62 keV gamma emission of the ^{137m}Ba daughter product. The calculated gamma photon abundance used in the library is the product of the 0.8998 abundance of the 661.62 keV ^{137m}Ba photon and the 0.946 branching ratio between ¹³⁷Ba and ^{137m}Ba.

Nuclide:  40 K Energy: 1460.75 keV Photon Abundance: 0.1100 ( $\gamma$ /dis)

The only gamma emission useful for quantification of this nuclide suffers from possible resolution interference due to the ²²⁸Ac gamma emission occurring at 1459.2 keV (0.0104, abundance). Therefore, a possibility of a high bias to the ⁴⁰K results may occur in the presence of elevated ²²⁸Ac activity.

Nuclide: ²²⁶Ra

Energy: 186.21 Photon Abundance: 0.0359

Quantifying ²²⁶Ra activity using the 186.21 keV photo-peak is vulnerable to a significant high bias due to interference from gamma emissions from ²³⁵U occurring at 185.72 keV (0.5720,

abundance). Therefore this nuclide will be "SI" flagged, indicating that significant spectral interference prohibits accurate quantification.

Nuclide: ²³⁴Th & ^{234m}Pa

Energy: various

Photon Abundance: various

²³⁴Th and ^{234m}Pa are assumed to be in secular equilibrium with their parent, ²³⁸U. The activities for these nuclides are therefore calculated using the half-life of the parent, which is  $t_{1/2}$ =4.468E+9 years.

Nuclide: ²²⁷Th

Energy: 236.00

Photon Abundance: 0.1230

All activity values for ²²⁷Th are calculated using the half-life,  $t_{1/2}=21.7$  yrs, of the long-lived ²²⁷Ac parent. It is assumed that secular equilibrium is achieved between the ²²⁷Ac parent and the ²²⁷Th progeny.

Nuclide: ²³⁴Th

Energy: 92.50

Photon Abundance: 0.0553

- The 92.50 keV photo-peak used in this library for ²³⁴Th quantification is actually two separate photo-peaks, occurring at 92.4 keV and 92.8 keV. The current software used for gamma spectroscopic analysis cannot resolve two photo-peaks that occur within the 2-keV resolution tolerance. Therefore, these two photopeaks are observed as a single photo-peak. Therefore, the average of the two photo-peak energies is used in this library. Also, the sum of the two photo-peak abundances, 0.0553, is used in the activity calculations for this observed 'single' photo-peak.
- All activity values for  234 Th are calculated using the half-life,  $t_{1/2}$ =4.468E+09 yrs, of the longlived ²³⁸U parent. It is assumed that secular equilibrium is achieved between the ²³⁸U parent and the ²³⁴Th progeny.

Nuclide: ²³⁵U

Energy: 185.72

Photon Abundance: 0.5720

Quantifying ²³⁵U activity using the 185.72 keV photo-peak is vulnerable to a significant high bias due to interference from gamma emissions from ²²⁶Ra occurring at 186.21 keV (0.0328, abundance). Therefore, this emission will be used as an identifier only and not in the activity calculations for this nuclide.

Gamma Spectroscopist

Radiochemistry Instrumentation Laboratory

Radiochemistry Manager

## Library File: Natural(SUB RA228).LIB File I.D.: Natural.LIB

Pk.	Energy	Isotope	2ndary		Gamma	
#	(keV)	Name	Pk #	Туре	Fraction	Halflife
			=======			
19	727.17	Bi-212	0	NET	0.0658	1.4500E+10 yrs
17	609.32	Bi-214	24	NET	0.4609	1.6000E+03 yrs
24	1120.28	Bi-214	17	QUANT	0.1510	1.6000E+03 yrs
18	661.62	Cs-137	0	NET	0.8512	3.0104E+01 yrs
25	1460.75	K-40	0	NET	0.1100	1.2800E+09 yrs
23	1001.03	<b>Pa-234</b> m	0	NET	0.0059	4.4680E+09 yrs
1	46.50	Pb-210	0	NET	0.0405	2.2260E+01 yrs
4	115.18	Pb-212	10	QUANT	0.0059	1.4500E+10 yrs
10	238.63	Pb-212	13	net	0.4330	1.4500E+10 yrs
13	300.09	Pb-212	4	QUANT	0.0327	1.4500E+10 yrs
12	295.22	Pb-214	15	QUANT	0.1920	1.6000E+03 yrs
15	351.99	Pb-214	12	NET	0.3710	1.6000E+03 yrs
14	338.40	Ra-228	21	QUANT	0.1127	5.7500E+00 yrs
21	911.07	Ra-228	22	NET	0.2580	5.7500E+00 yrs
22	968.90	<b>Ra-228</b>	14	QUANT	0.1580	5.7500E+00 yrs
9	236.00	Th-227	0	NET	0.1230	2.1700E+01 yrs
2	63.29	Th-234	3	QUANT	0.0390	4.4680E+09 yrs
3	92.50	Th-234	2	NET	0.0553	4.4680E+09 yrs
11	277.36	<b>T1-208</b>	16	QUANT	0.0631	<b>1.4500E+10 yrs</b>
16	583.14	<b>T1-208</b>	20	NET	0.8450	<b>1.4500E+10 yrs</b>
20	860.47	<b>T1-208</b>	11	QUANT	0.1242	1.4500E+10 yrs
5	143.76	U-235	6	NET	0.1096	7.0379E+08 yrs
6	163.35	<b>U-235</b>	7	QUANT	0.0508	7.0379E+08 yrs
7	185.72	<b>U-235</b>	8	ID	0.5720	7.0379E+08 yrs
8	205.31	<b>U-235</b>	5	QUANT	0.0501	7.0379E+08 yrs

•

## **Technical Comments Regarding Gamma Spectroscopy Libraries**

Library File: Ra-226.LIB

Nuclide: **Ra-226** Energy: various

Photon Abundance: various

Samples analyzed by this library are sealed in a steel can and allowed to ingrow for a 21day period to ensure the capture and full ingrowth of the Rn-222 gas and associated progeny. The Bi-214 and Pb-214 daughters are assumed to be in secular equilibrium with their parent, Ra-226. Ra-226 is then quantified from the ingrown Pb-214 and Bi-214 daughters using the 1600 year half-life of the Ra-226 parent.

Gamma Spectroscopist Radiochemistry Instrumentation Laboratory

Date

Library File: Ra226.lib File I.D.: Ra-226 (215g steel can)

$\left( \begin{array}{c} \\ \end{array} \right)$	Energy (keV)	Isotope Name	2ndary Pk #	Type	Gamma Fraction	Halflife
1	295.21	Ra-226	2	QUANT	0.1920	1.6000E+03 yrs
2		Ra-226	3	NET	0.3710	1.6000E+03 yrs
4			_			1.6000E+03 yrs
2	609.31	Ra-226	4	QUANT	0.4609	T.0000F+02 Ars
3	003.27	Ka-110	-		••	
4	1120.29	Ra-226	1	QUANT	0.1510	1.6000E+03 yrs

OK 811 4/3/02

## **TECHNICAL BULLETIN ADDENDUM**

The library used for analysis defines the gamma emission(s) to be used for analysis of each nuclide. If multiple gamma emissions are used for quantification, then a 'NET' quantification emission (or peak) must be defined in the library. This designation provides for the calculation of nuclide activity concentrations and detection limits in the case of non-presence of the nuclide. When the nuclide is not present, or the software is unable to resolve a peak at the library defined 'NET' energy, the software evaluates the 'NET' region of interest ('NET' peak energy +/- 2 keV) by performing a summation of the net counts above the background level. This 'NET' quantification can result in net negative, zero, or positive activity results, and is highly dependent on the spectral distribution in the region of interest of the 'NET' peak. In cases where only the 'NET' peak is found, and the software performs a net quantification, the nuclide result will be flagged with an 'NQ' qualifier on the final reports. This indicates that the nuclide is not detected or supported at any level above the reported MDC. Results are submitted without further qualification.

All nuclides specified in the library of analysis for gamma spectroscopy are evaluated for positive <u>OR</u> tentative identification on the following criteria:

- The individual abundances for the gamma emissions specified for each nuclide are summed to obtain a total nuclide abundance.
- From the total nuclide abundance, a positive identification criterion is set as 75% of this total nuclide abundance.
- For all nuclide peaks that are not net quantified, those peak abundances are summed. The total non-net quantified peak sum is compared to the calculated 75% abundance criterion. If this sum is greater than the 75% criterion, the nuclide is considered to be positively identified at the reported concentration. If the sum is less than the 75% criterion, the nuclide is tentatively identified at the reported concentration. These results will be flagged with a 'TI' qualifier on the final reports to indicate that the 75% abundance criterion was not met.

Section 6

# QUALITY ASSURANCE SUMMARY REPORTS



## No NON-CONFORMANCE REPORTS or QUALITY ASSURANCE SUMMARY SHEETS are included in this data package.

Section 7

# LABORATORY BENCH SHEETS



ALS -- Fort Collins

**Radiochemistry Instrument Worksheet** 



							¢	-	4												
Prep	Prep Procedure:	nre:	ש	GAMMASCAN	<b>IAS(</b>	CAN	$\sum_{i=1}^{N}$		020	2					Analytic	Analytical QASS / NCR? Y /(N)	NCR? Y	Ň,	N (A		
Prep Num	Lab ID Collection Date	AC Type	Init Alq	Adj Alq %Moist	Units Geo.	Report Units	Cnt 1 File Cnt Dur (min)	Cnt 1 Inst/Det	Cnt 1 Count Date	Cnt 2 File Cnt Dur (min)	Cnt 2 Inst/Det	Cnt 2 Count Date	Cnt 3 File Cnt Dur (min)	Cnt 3 Inst/Det	Cnt 3 Count Date			Notes			
-	2106442-1 06/14/21 12:03	3 SMP	425.7	377.6 11.293	¤ ₽	pCi/g	aco	r	U light	1202	1000	$\eta L $	12020								
-	2106442-1 06/14/21 12:03	3 DUP	425.7	377.6 11.293	ۍ ت	pCi/g		NID	_			Z 71	11/2021								
-	2106442-2 06/14/21 12:14	4 SMP	443.8	405 8.7523		pCi/g	0001	5	191101	1 1202	0a 7	IL 2	1202 0								
-	GS210619-1 06/19/21 10:34	A MB	200	200	в (1	pCi/g		NIA				1	11 292		$\setminus$						
-	GS210619-1 06/19/21 10:34	4 LCS	200	500	9 13	pCi/g		~		• • •	<u>3</u>			$\bigvee$					102/51/L HC	2121	n
	<									<			4		Spike Solution	tion Inform	ation				
	Ţ	_		_	2	h	NI 4 / / Ka/ (C).		1. 21		S	Soln # Nuclide		SolnID	Exp Date F	Prep Conc	Units	Prep Date Aliquot Units	Aliquot		Pipet ID
	11 N &	561	Naysy F	•	20			י ג ו				S1 Am	Am-241 1	1098		444.544	DPM/g	06/19/21	500	6	AA
		• -			Č		(					S1 Cd-	Cd-109 1	1098		1,262.024	DPM/g	06/19/21	500	5	Ą
		_	1	~	2	2							Ce-139 1	1098		0.899	DPM/g	06/19/21	500	5	Ą
	Jh.	ダン	1	T,	Ľ	としん						S1 Co	Co-57 1	1098		8.934	DPM/g	06/19/21	500	0	A
		. 1 .	)										Co-60 1	1098		191.699	DPM/g	06/19/21	500	0	¥
													Cs-137 1	1098		169.591	DPM/g	06/19/21	500	ŋ	¥
													Hg-203 1	1098		0.000	DPM/g	06/19/21	500	0	¥
												S1 Sn-	Sn-113 1	1098		0.540	DPM/g	06/19/21	500	0	¥
												S1 Υ-	Y-88 1	1098		0.527	DPM/g	06/19/21	200	5	AA
Samn	Samnle Barcodes	sep																			
2	>>======	>>>>																			

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*GS210619-1PS3*	
2106442-2 GS210619-1PS3	
*GS210619-1PS2*	*GS210619-1PS6*
2106442-1DUP GS210619-1PS2	GS210619-1LCS GS210619-1PS6
*GS210619-1PS1*	*GS210619-1PS5*
2106442-1 GS210619-1PS1	GS210619-1MB GS210619-1PS5

**GAMMASCAN Instrument Sheet** 

14:27

6/23/2021

**Date Printed:** Page 1 of 2

ALS -- Fort Collins LIMS Version: 7.536

**ALS -- Fort Collins** 

**Radiochemistry Instrument Worksheet** 



	Analytical QASS / NCR? Y /(N) NIA	Cnt 3 Count Date					Splike Solution Information	ate Prep Conc Units Prep Date Aliquot Units Pipet ID	444.544 DPM/g 06/19/21 500 g NA	1,262.024 DPM/g 06/19/21 500 g NA	06/19/21 500 g	06/19/21 500 9	06/19/21 500 g	06/19/21 500 g	0.000 DPM/g 06/19/21 500 g NA	06/19/21 500 9	0.527 DPM/g 06/19/21 500 g NA
	•	Cnt 3 Inst/Det					10g	SolnID Exp Date	1098	1098	1098	1098	1098	1098	1098	1098	1098
		Cnt 2 Count Cnt 3 File Date Cnt Dur (min)						Soln # Nuclide	S1 Am-241	S1 Cd-109	S1 Ce-139	S1 Co-57			S1 Hg-203		
		Cnt 2 Inst/Det						<u> </u>	<u> </u>								
Para a second		Cnt 1 Count Cnt 2 File Date Cnt Dur (min)	n Xus														
		Cnt 1 Inst/Det	Cuma			Ĺ				1100	601						
		Cnt 1 File Cnt Dur (min)	a S						/		1/bb/(	× ×					
	8	Units Report Geo. Units	pCi/g	pCi/g	pCi/g	pCi/g		R	Ś	0 /		•					
	26/22		9 E	95	9 Ç				Ś	ς	2 )	)					
	Ra_226/228	lq Adj Alq Moist	SMP 425.7 377.6 11.293	425.7 377.6 11.293					Ž		1	۲ ن					
		QC Init Alq Type	1P 425.	DUP 425.	IP 443.8	B 500					1.0	2	-	_	7	, ,	
	dure:			2:03	2:14	9-1A MB	_		5	Ĺ		>	(	_	11	)	
	Prep Procedure:	Lab ID Collection Date	2106442-1 06/14/21 12:03	2106442-1 06/14/21 12:03	2106442-2 06/14/21 12:14	GS210619-1A 06/19/21 10:34			(10)	>			(-			7	
	Prep	Prep Num	]- ]	- ]	-	-											

V · S /

<u>а</u>									
Units	0	6	6	6	6	6	6	6	0
Aliquot	500	500	500	500	500	500	500	500	500
Prep Date	06/19/21 500 9	06/19/21	06/19/21	06/19/21	06/19/21	06/19/21	06/19/21	06/19/21	06/19/21
Units	DPM/g	DPM/g	DPM/g	DPM/g	DPM/g	DPM/g	DPM/g	DPM/g	DPM/g
Exp Date Prep Conc			0.899	8.934	191.699	169.591	0.000	0.540	0.527
Exp Date									
SolnID	1098	1098	1098	1098	1098	1098	1098	1098	1098
Nuclide	Am-241	Cd-109	Ce-139	Co-57	Co-60	Cs-137	Hg-203	Sn-113	Y-88
Soln #	S1	S1	S1	S1	S1	S1	S1	S1	S1

# Sample Barcodes

2106442-1 GS210619-1PS1	*GS210619-1PS1*	2106442-1DUP GS210619-1PS2	*GS210619-1PS2*	2106442-2 GS210619-1PS3	*GS210619-1PS3*
GS210619-1AMB GS210619-1PS4	*GS210619-1PS4*				
<b>Reporting Units</b>	0				

LablD:	TstGrpName:	RptUnits:
2106442-1	GAMMA_Ra226	pCi/g
2106442-1	Gamma_NP_Custom	pCi/g
2106442-2	GAMMA_Ra226	pCi/g
2106442-2	Gamma_NP_Custom	pCi/g

Date Printed:

- ALS -	ALS Fort Collins	llins				Å	adioche	mistry P	Radiochemistry Prep Worksheet	ksheet	Prep Batch: G\$210619-1	
						ſ						1-1-1
Prep F	Prep Procedure:		GAMMASCAN	ASCA	z				9		Reviewed By: jcp (M Review Date: 6/	119/202161
			$\downarrow$									
Non-Ro	Non-Routine Pre-Treatment? Y (N)	eatment?	z) > ~ ~	/ Batch: (	h: []		Ĩ	Re-Prep? Y (N	🗸 Batch: 🗕		Prep QASS / NCR? Y I/N / W	
Prep	Prep SOP: PAI 739	39 Rev: 13	13			Dron Ang	Dron Analyst: John C. Datrovic	Datrovic		Balance: 46	)	
Prep	Prep SOP: NONE					Dran D	Pren Date: 6/19/2021	1		Balance: NA		
Matrix	Matrix Class: solid					Prep D	Prep Dept: GM	-				
Samp Prep Num Num	Prep LablD Num	QC Dish Type No.		Init Alq Fin Alq 9 g		Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes	
-	1 2106442-1	-1 SMP	Ň	425.7	425.7 A	As Received	13	47.9	473.6			
2	1 2106442-1	-1 DUP	7	425.7	425.7 A	As Received	13	47.9	473.6		Count Duplicate	
£	1 2106442-2	-2 SMP		443.8 4	443.8 A	As Received	13	49.2	493			,
4	1 GS210619-1	9-1 MB		500	500 A	As Received	13					
ъ	1 GS210619-1	9-1 LCS		500	500 A	As Received	13			S1		
Com	Comments											
1												
Spi	Spiked By: <u>N/A</u>			Date	Date: N/A							
Witnes	Witnessed By: N/A			Date	Date: N/A							
											Spike Solution Information	

			Spike So	lution Inform	ation				
Soln #	Nuclide	SoinID	Exp Date	Prep Conc	Units	Prep Date Aliquot Units	Aliquot	Units	Pipet ID
S1	Am-241	1098		444.544	DPM/g	06/19/21	500	6	AN
S1	Cd-109	1098		1,262.024	DPM/g	06/19/21	500	5	AN
S1	Ce-139	1098		0.899	DPM/g	06/19/21	500	5	AN
S1	Co-57	1098		8.934	DPM/g	06/19/21	500	6	AN
S1	Co-60	1098		191.699	DPM/g	06/19/21	500	6	AN
S1	Cs-137	1098		169.591	DPM/g	06/19/21	500	5	AN
S1	Hg-203	1098		0.000	DPM/g	06/19/21	500	5	AN
S1	Sn-113	1098		0.540	DPM/g	06/19/21	500	D	AN
S1	Y-88	1098		0.527	DPM/g	06/19/21	500	6	NA

GAMMASCAN Bench Sheet 6/19/2021 11:25

ALS -- Fort Collins LIMS Version: 7.536

ALS Fort Collins	llins			₽ <b>∠</b>	adioche	emistry F	Radiochemistry Prep Worksheet	rksheet	Prep Batch: GS210619-1	
Prep Procedure:		Ra_226/228	, 28				(		Reviewed By: jcp	(0 19/2021 6/19/2021
Non-Routine Pre-Treatment? Y	atment? Y	Z	Batch:	*		Re-Prep? Y N)	N) Batch: _	<b>V</b>	Prep QASS / NCR? Y / N F	
Prep SOP: PAI 739 Rev: 13 Prep SOP: NONE Matrix Class: solid	9 <b>Rev:</b> 13	$\mathbf{)}$		Prep An Prep Prep	Prep Analyst: John C. Petrovic Prep Date: 6/19/2021 Prep Dept: GM	Petrovic		Balance: 46 Balance: NA		
Samp Prep LabID Num Num	QC Dish Type No.		Init Alq Fin Alq g g	Prep Basis	Geometry	Dish Weight (g)	Dry Weight + Dish Weight (g)	Standards	Prep Notes	
1 1 2106442-1	1 SMP	425.7	425.7	As Received	13	47.9	473.6			
2 1 2106442-1	1 DUP	425.7	425.7	As Received	13	47.9	473.6		Count Duplicate	
3 1 2106442-2	2 SMP	443.8	443.8	As Received	13	49.2	493			
4 1 GS210619-1A	1A MB	500	500	As Received	13					
Comments										
Spiked By: N/A			Date: N/A							
Witnessed By: N/A			Date: N/A							

			Spike So	lution Inform	ation	2			
Soln #	Nuclide	SolnID	Exp Date	Prep Conc	Units	Prep Date	Aliquot Units	Units	Pipet ID
S1	Am-241	1098		444.544	DPM/g	06/19/21	500	6	AN
S1	Cd-109	1098		1,262.024	DPM/g	06/19/21	500	6	٨A
S.	Ce-139	1098		0.899	DPM/g	06/19/21	500	5	٨A
S.	Co-57	1098		8.934	DPM/g	06/19/21	500	6	AN
S1	Co-60	1098		191.699	DPM/g	06/19/21	500	6	NA
S1	Cs-137	1098		169.591	DPM/g	06/19/21	500	6	٨A
S1	Hg-203	1098		0.000	DPM/g	06/19/21	500	6	٨N
S1	Sn-113	1098		0.540	DPM/g	06/19/21	500	6	AN
S	Y-88	1098		0.527	DPM/g	06/19/21	500	6	NA

Page 2 of 2 Ra_226/228 Bench Sheet Date Printed: 6/19/2021 11:25

ALS -- Fort Collins LIMS Version: 7.536

Supersedes:

~		Sample	Condit	ion Form (Solid)
Analyst:				
Analysis Date:	9/2021			Method: Spec
		Sample	Condition (Vi	sual Appearance of Analysis Aliquot at Time of Prep)
Work	Sample ID	Dry/Wet/ Moist	Texture	Remarks
Order 21()(24442			Súl)	Packed As Received
2100992	$\frac{1}{2}$		<i>J</i> ( <i>t</i> )	PACHER /TS RECEIVEN
J	6		7	√
<u></u>				*
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I:\Oprtns\RAD\FORMS\Tracking Sheets and Condition Forms and Pipette Sheet\Sample Condition Form (Solid)

Section 8

## STANDARDS TRACEABILITY DOCUMENTS



**Analytics** 

Eckert & Ziegler 🕉 🕨 🥵 Received 8/20/19 1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 40-4-352-8677 Fax 404.352.2837 www.ezaq.com

## CERTIFICATE OF CALIBRATION Standard Reference Source

SRS Number: 110301 Source Description: 500 Grams Sand in 16 Ounce PP MRP Jar Product Code: 8401-EG-SAN Customer: ALS Laboratory Group P.O. Number: FC001958, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

#### Reference Date: 01-July-2018 12:00 PM EST **MGS Mixture**

La chairte	Gamma-Ray				Uncertainty			Calibration
Isotope	Energy, keV	Half-Life, d	Activity, Bq	Flux, s⊐	uA, %	u ₈ , %	U, %*	Method**
Am-241	69.6	1.580E+05	3.723E+03	1.336E+03	0.1	1.8	3.6	4π LS
Cd-109	88.0	4.614E+02	5.231E+04	1.936E+03	0.5	2.0	4.1	HPGe
Co-57	122.1	2.717E+02	1.183E+03	1.012E+03	0.4	1.7	3.4	HPGe
Ce-139	165.9	1.376E+02	1.775E+03	1.420E+03	0.4	1.7	3.6	HPGe
Hg-203	279.2	4.659E+01	3.778E+03	3.082E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.081E+03	2.002E+03	0.4	1.9	3.9	HPGe
Cs-137	661.7	1.099E+04	1.514E+03	1.288E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.064E+03	4.745E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1		ANNUALS OF CARE	5.024E+03	0.7	1.7	3.7	nrue nrue
Co-60	1173.2	1.925E+03	2.362E+03	2.359E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	Contract Berger Market	A DE LE CALEGO DE LE CALE DE LE C	2.362E+03	0.7	1.8	3.9	nrge Nie nie wester gew

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. *Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." **Calibration Methods: 411 LS - 411 Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Veritied 09/01/2020. New From. > 191

EZA Certificate Program Rev. 0, 07-DEC-2015

**Corporate Office** 24937 Avenue Tibbitts Valencia, California 91355

#### SRS Number: 110301



## Comments:

500.00 grams of customer supplied sand. Approximate volume: 290 mL

Expiration Date: 17-August-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: An Mony 1. (Wallor A. Chirillo, Radiochemist

QC Approved by:

J. Lahr, Spectroscopist

_____ Date: <u>16-406-18</u>

Section 9

# ADDITIONAL SUPPORTING DOCUMENTATION



Gamma Spectroscopy

Initial Calibration Standards Traceability

ALS Laboratory Group - Fort Collins

GammaScan Geo 1 / Water Sample ID: 082220-1 FWHM Cal (1119) Sampling Start: 01/01/2020 10:00:00 | Counting Start: 08/22/2020 13:03:17 Sampling Stop: 01/01/2020 10:00:00 | Decay Time. . . . . 5.62E+003 Hrs Buildup Time. . . . . 0.00E+000 Hrs | Live Time . . . . . . . 7200 Sec Sample Size . . . . . . 1.00E+000 L | Real Time . . . . . . . 7441 Sec Detector #: 1 (Detector 1) Energy  $(\text{keV}) = -1.83 + 0.501 \text{*Ch} + 0.00\text{E} + 00 \text{*Ch}^2 + 0.00\text{E} + 00 \text{*Ch}^3 08/22/2020$  $FWHM(keV) = 0.68 + 0.018*En + 5.50E-04*En^2 + 0.00E+00*En^3 08/22/2019$ Where En = Sart(Energy in keV) _____ Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000 ______ PEAK SEARCH RESULTS PK. ENERGY ADDRESS NET/MDA UN-C.L. BKG FWHM COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG # (keV) CHANNEL 0.90 a HiResid 535 324 19398 59.44 122.21 32648 1 26469 0.92 a HiResid 178.99 138172 874 378 2 87.91 122.06 247.10 20235 1.07 a 3 89025 729 344 275.85 11614 441 317 17101 1.08 a 4 136.47 15640 1.12 a 334.41 75062 660 303 5 165.84 512.72 2070 293 229 9671 1.02 a 6 255.23 9829 1.19 a 11971 365 240 7 279.19 560.50 391.71 7682 1.29 a 8 784.94 48092 504 204 4915 1.22 a 509.78 1020.44 385 196 158 9 511.36 1023.60 1093 8426 1.93 b 298 239 10 5771 1.54 a 80243 608 182 11 661.70 1323.46 5025 1.56 a 813.95 1627.13 743 208 165 12 6170 1.77 a 898.10 1794.97 13 50727 505 187 2880 1.96 a HiResid 85525 604 125 14 1173.29 2343.85 15 1325.15 2646.76 1086 138 100 1585 2.59 a HiResid

570

348

85

44

78439

29550

1332.46 2661.34

1835.90 3665.49

16

17

1288 2.08 b HiResid

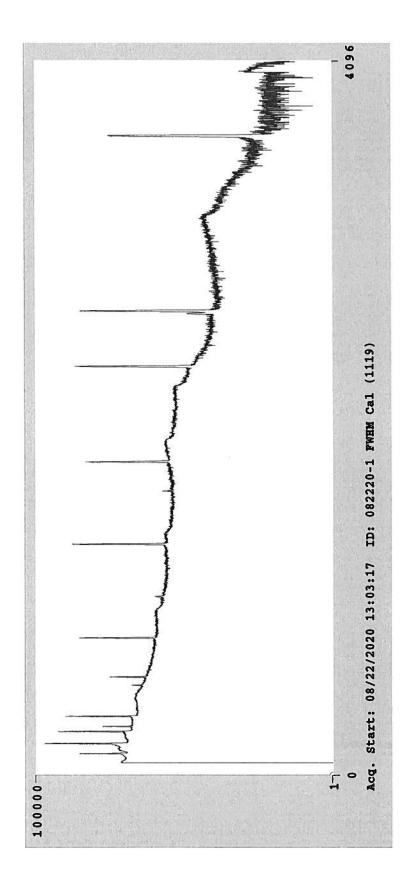
325 2.45 a HiResid

	201087	D01.SPC An	alyzed	by			
*****	******	*******	*****	******	********	***********	*****
SEEKEI	R	CALI	BRA	TION	RESUL	T S Version	2.0.4
*****	******	******	*****	*****	*******	*****	*****
Stds. 1	ID: 082220- Match Tolera	ance: 2.0	0 keV				
Detecto	or Number: 0	)1 Ca	librat	ion Date.	08/22/	2020 13:03:17	
	eV) = 0.74 (Where En =	+ 0.020 SQR(Energ	*En + y in k	4.70e-04*E eV))	m^2 + 0.00		
Pk.		leasured		Calculat		Prev.Calc.	

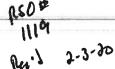
Pk.	Energy	Measured	%	Calculated	%	Prev.Calc.
#	(kev)	FWHM(keV)	Diff.	FWHM(keV)	Diff.	FWHM(kev)
		==============		================		=======================================
1	59.50	0.905	1.73	0.921	-8.74	0.847
2	88.04	0.916	5.28	0.967	-8.41	0.892
3	122.06	1.069	-5.27	1.015	-8.04	0.940
4	165.85	1.117	-4.19	1.072	-7.60	0.996
5	279.00	1.195	0.46	1.200	-6.59	1.126
6	391.68	1.294	1.52	1.314	-5.74	1.243
7	661.64	1.539	1.19	1.557	-4.11	1.496
8	898.02	1.768	-0.93	1.752	-2.99	1.701
9	1173.21	1.962	0.17	1.965	-1.94	1.928
10	1332.48	2.079	0.28	2.084	-1.42	2.055
11	1836.01	2.451	-0.23	2.446	-0.06	2.444

Calibration Results Saved.

DK Metzztow



**Eckert & Ziegler** 



1380 Seab oard Industrial Blvd. Atlanta, G eorgia 30318 Tel 404•3 52•8677 Fax 404•3 52•2837 www.ezag.com

## Analytics

## CERTIFICATE OF CALIBRATION Standard Reference Source

SRS Number: 114986 Source Description: 1.0 Liter Solid in 138G GA-MA Beaker Product Code: 8401-EG-SD Customer: ALS Laboratory Group (Paragon) P.O. Number: FC002657, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

Density of solid matrix:  $1.17 \text{ g/cm}^3 \pm 3 \%$ .

Reference Date: 01-January-2020 12:00 PM EST MGS Mixture

	Gamma-Ray		a ===		Uncertainty			Calibration
lsotope	Energy, keV	Half-Life, d	Activity, Bq	Flux, s ⁻¹	u _A , %	u _B , %	U, %*	Method**
Am-241	59.5	1.580E+05	3.812E+03	1.368E+03	0.1	1.8	3.7	4TT LS
Cd-109	88.0	4.614E+02	5.212E+04	1.928E+03	0.5	2.0	4.2	HPGe
Co-57	122.1	2.717E+02	1.173E+03	1.004E+03	0.4	1.7	3.5	HPGe
Ce-139	165.9	1.376E+02	1.778E+03	1.422E+03	0.4	1.8	3.7	HPGe
Hg-203	279.2	4.659E+01	3.695E+03	3.014E+03	0.3	1.7	3,5	HPGe
Sn-113	391.7	1.151E+02	3.068E+03	1.994E+03	0.4	2.0	4.1	HPGe
Cs-137	661.7	1.099E+04	1.502E+03	1,278E+03	0.7	1.9	4.1	HPGe
<b>Y-88</b>	898.0	1.066E+02	5.104E+03	4.783E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1			5.063E+03	0.7	1.7	3.7	
<b>Co-60</b>	1173.2	1.925E+03	2.383E+03	2.379E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	(		2.382E+03	0.7	1.8	3.9	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty,

k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:**  $4\pi$  LS -  $4\pi$  Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Page 1 of 2

**SRS Number:** 114986

Expiration Date: 31-January-2021

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by:

A. Herron, Radiochemist

QC Approved by:

ZECL

Date: 29 Jan 20

A. Chen, Spectroscopist

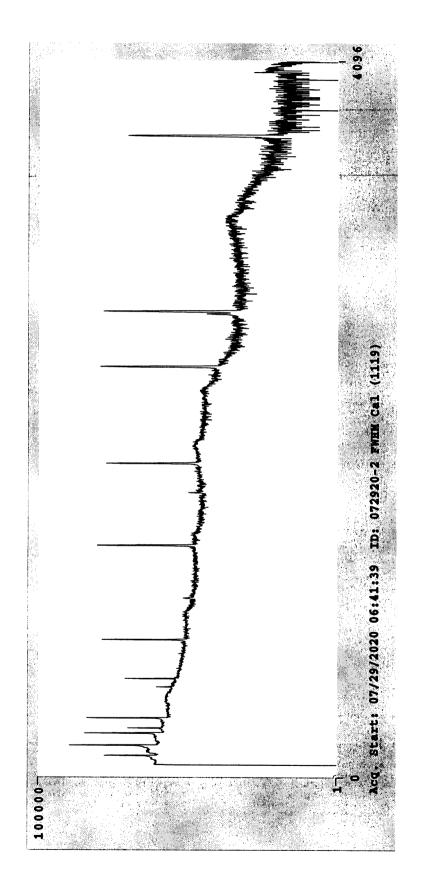
200210D02.SPC Analyzed by ********************************* ******** SEEKER GAMMA ANALYSIS RESULTS PS Version 1.8.4 ALS Laboratory Group - Fort Collins GammaScan Geo 1 / Water Sample ID: 072920-2 FWHM Cal (1119) _____ 01/01/2020 10:00:00 | Counting Start: 07/29/2020 06:41:39 Sampling Start: Sampling Stop: 01/01/2020 10:00:00 | Decay Time. . . . . . 5.04E+003 Hrs Buildup Time. . . . . 0.00E+000 Hrs | Live Time . . . . . . . 1800 Sec 1885 Sec Collection Efficiency . . . . Detector #: 2 (Detector 2) Energy  $(keV) = -1.33 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 07/29/2020$  $FWHM(keV) = 0.41 + 0.047*En + 0.00E+00*En^2 + 0.00E+00*En^3 07/16/2020$ Where En = Sqrt(Energy in keV) Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000 PEAK SEARCH RESULTS PK. ENERGY ADDRESS NET/MDA UN-C.L. BKG FWHM # CHANNEL COUNTS CERTAINTY COUNTS (keV) COUNTS (keV) FLAG 1 59.49 121.41 13558 315 174 6117 0.79 a HiResid 72.97 148.31 0.41 a 2 162 124 100 2771 87.97 178.25 52402 3 513 191 7358 0.81 a HiResid 155 4 122.07 246.34 32161 405 4812 0.83 a HiResid 136.55 275.23 5 3999 215 144 4152 0.76 a HiResid 3788 6 165.84 333.70 29005 379 137 0.90 a HiResid 7 255.19 512.06 854 174 134 3342 0.91 a 559.98 8 279.19 6172 212 117 2895 1.03 a 391.70 9 784.57 20627 317 110 2384 1.14 a HiResid 0.75 a NET< CL 10 509.01 1018.73 37 92 75 1289 Wide Pk 11 511.34 1023.39 449 215 173 3866 2.40 Ъ 12 661.65 1323.45 31087 372 97 1.36 a HiResid 1924 13 813.84 1627.26 376 118 92 1.55 a 1634 14 875.37 1750.08 80 65 64 1025 0.90 a 15 898.04 1795.32 23406 329 100 1936 1.53 a HiResid 16 1173.19 2344.59 34610 76 1.74 a HiResid 383 1103 17 1325.14 2647.92 583 118 89 1032 3.62 a HiResid Wide Pk 18 1332.35 2662.30 31921 363 52 516 1.84 b HiResid 19 1835.75 3667.20 14403 243 30 165 2.16 a HiResid

	2002	210D02.SPC A	nalyzed	by			
*****	*******	*******	******	********	******	**********	********
SEEKE	R	CALI	BRAT	ION RE	SULT	S Version	2.0.4
*****						* * * * * * * * * * * * * * *	
Sample	ID: 07292	20-2 FWHM Ca	1 (1119)				
Stds. I	Match Tole	rance: 2.	00 keV				
Detecto	or Number:			on Date			
FWHM(ke	eV) = 0.			 .08e-04*En^2			
	-	n = SQR(Ener					
Pk.	Energy	Measured	%	Calculated	%	Prev.Calc.	
#	(kev)	FWHM(keV)	Diff.	FWHM(keV)	Diff.	FWHM(kev)	
1	59.50	0.792	-3.37	0.766	0.77	0.772	
2	88.04	0.810	0.04	0.810	4.79	0.851	
3	122.06	0.831	2.93	0.856	7.87	0.929	

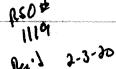
-				0.010			
3	122.06	0.831	2.93	0.856	7.87	0.929	
4	165.85	0.897	1.23	0.908	10.45	1.015	
5	279.00	1.027	0.05	1.028	13.92	1.194	
6	391.68	1.136	-0.32	1.133	15.38	1.339	
7	661.64	1.364	-0.59	1.356	16.12	1.617	
8	898.02	1.529	0.31	1.533	15.53	1.815	
9	1173.21	1.738	-0.61	1.728	14.32	2.016	
10	1332.48	1.836	-0.00	1.836	13.49	2.122	
11	1836.01	2.156	0.28	2.162	10.62	2.419	

Calibration Results Saved.

Oh JP-7/29/2020



**Eckert & Ziegler** 



1380 Seab oard Industrial Blvd. Atlanta, G eorgia 30318 Tel 404•3 52•8677 Fax 404•3 52•2837 www.ezag.com

### Analytics

#### CERTIFICATE OF CALIBRATION Standard Reference Source

SRS Number: 114986 Source Description: 1.0 Liter Solid in 138G GA-MA Beaker Product Code: 8401-EG-SD Customer: ALS Laboratory Group (Paragon) P.O. Number: FC002657, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

#### Density of solid matrix: $1.17 \text{ g/cm}^3 \pm 3 \%$ .

MG8 Mixture

Reference Date: 01-January-2020 12:00 PM EST

	Gamma-Ray				Ur	ncertair	Calibration	
Isotope	Energy, keV	Half-Life, d	Activity, Bq	Flux, s ⁻¹	u _A , %	u _B , %	U, %*	Method**
Am-241	59.5	1.580E+05	3.812E+03	1.368E+03	0.1	1.8	3.7	411 LS
Cd-109	88.0	4.614E+02	5.212E+04	1.928E+03	0.5	2.0	4.2	HPGe
(⊘(a):37/	122.1	2.717E+02	1.173E+03	1.004E+03	0.4	1.7	3.5	HPGe
Ce-139	165.9	1.376E+02	1.778E+03	1.422E+03	0.4	1.8	3.7	HPGe
162203	279.2	4.659E+01	3.695E+03	3.014E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.068E+03	1.994E+03	0.4	2.0	4.1	HPGe
-C-287.	661.7	1.099E+04	1.502E+03	1.278E+03	0.7	1.9	4.1	HPGe
<b>Y-88</b>	898.0	1.066E+02	5.104E+03	4.783E+03	0.7	1.7	3.7	HPGe
37-88	1836.1			5.063E+03	0.7	1.7	3.7	
<b>Co-60</b>	1173.2	1.925E+03	2.383E+03	2.379E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5		57 <u> </u>	2.382E+03	07	18	39.	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty,

k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:**  $4\pi$  LS -  $4\pi$  Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Page 1 of 2

#### **SRS Number:** 114986

Expiration Date: 31-January-2021

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: Pren

A. Herron, Radiochemist

QC Approved by:

A. Chen, Spectroscopist

Date: 29 Jan 20

210686D01.SPC Analyzed by ************ GAMMA ANALYSIS RESULTS SEEKER PS Version 1.8.4 ALS Laboratory Group - Fort Collins GammaScan Geo 13 / Solid Sample ID: 062521-1 Geo 13 Eff Cal (1130) 07/01/2020 10:00:00 | Counting Start: 06/25/2021 07:54:19 Sampling Start: Sampling Stop: 07/01/2020 10:00:00 | Decay Time. . . . . . 8.61E+003 Hrs Buildup Time. . . . . 0.00E+000 Hrs | Live Time . . . . . . . . 4500 Sec Sample Size . . . . . . 5.00E+002 g | Real Time . . . . . . . . 4592 Sec Collection Efficiency . . . . Detector #: 1 (Detector 1) Energy(keV) = -2.00 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 06/25/2021  $FWHM(keV) = 0.74 + 0.020*En + 4.70E-04*En^2 + 0.00E+00*En^3 08/22/2020$ Where En = Sqrt(Energy in keV) Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000 PEAK SEARCH RESULTS PK. ENERGY ADDRESS NET/MDA UN-C.L. BKG FWHM # (keV) CHANNEL COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG 59.47 122.66 1 11609 310 183 6771 0.78 a HiResid 2 87.98 179.54 10647 0.93 a 57666 562 240 3 122.11 247.64 33418 447 212 8266 0.97 a 136.54 4 276.43 4434 268 191 6739 1.05 a 165.88 5 334.98 20601 363 183 6188 0.98 a HiResid 6 255.19 513.18 741 228 182 6114 1.28 a 279.33 7 561.35 1181 220 172 5479 1.23 a 8 310.63 623.79 155 143 116 3063 0.79 a 9 391.89 785.92 12836 292 151 4234 1.30 a 10 511.35 1024.29 393 3486 177 142 **1.47** a 11 661.97 1324.82 45397 455 131 3189 1.64 a HiResid

234

282

449

424

176

191

140

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35

813.77 1627.70

898.48 1796.72

14 1173.80 2346.06

15 1333.06 2663.82

16 1836.73 3668.80

261

12630

46991

41650

7266

12

13

4793 3.00 a Wide Pk

1667 2.20 a HiResid

184 2.74 a HiResid

1.83 a HiResid

2.32 a HiResid

3465

1531

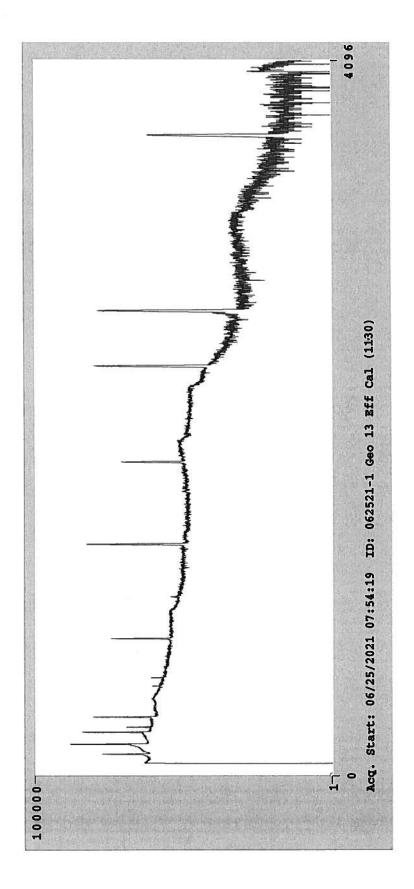
	210686D01.SPC Analyzed by										
*****	******	******	*******	******	******	*******	*******	****			
SEEK	ter b	ACKGR	OUND S	UBTRA	CT RE	SULTS	Version 1	.8.2			
			LS Laborato	GammaScan	4						
***************************************											
Background File: DET010623.BKG (062321-1 LONG BKG CAL)											
Bkg.F =====	ile Dete	ctor #: 1 =========									
				IND SUBTRAC	T RESULTS						
				:==========		8828222222	===========	88222			
	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW				
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY		FLAG			
10	511.35	393	177	142	283	178	144				

210686D01.SPC Analyzed by SEEKER CALIBRATION RESULTS Version 2.0.4 Sample ID: 062521-1 Geo 13 Eff Cal (1130) Stds. Match Tolerance: 2.00 keV Detector Number: 01 Calibration Date. . . 06/25/2021 07:54:19 Geometry File (D01)(Sh13).EFF ID. Geo 13 Eff Cal Amount of Std. in Calib. Source: 500.000000 gm Crossover: 300.00 keV Below Crossover Efficiency Fit: Eff = 10 ^ [-1.10e+02 + 1.44e+02*En +-6.36e+01*En^2 + 9.33e+00*En^3] (Where En = LOG(Energy in keV)) (Polynomial) Above Knee Efficiency Fit:  $Eff = exp \wedge [5.97e-01 + -8.38e-01*En + 0.00e+00*En^2]$ (Where En = Energy in keV) (Linear/Quad) - - - - - -_ = -----_ _

Pk.	Energy	Measured	%	Calculated	%	Prev.Calc.
#	(kev)	Efficiency	Difference	Efficiency	Difference	Efficiency
====						
1	59.50	<b>1.94e-03</b>	0.36	1.95e-03	10.05	2.16e-03
2	88.04	1.14e-02	-1.74	1.12e-02	1.36	1.14e-02
3	122.06	1.81e-02	2.68	1.86e-02	3.29	1.92e-02
4	165.85	<b>1.94e-02</b>	-1.57	1.91e-02	4.73	2.01e-02
5	279.00	<b>1.79e-02</b>	0.21	1.79e-02	-15.24	1.55e-02
6	391.68	1.20e-02	1.47	1.22e-02	-0.10	1.22e-02
7	661.64	8.00e-03	-1.84	7.86e-03	3.24	8.12e-03
8	898.02	6.02e-03	1.00	6.08e-03	4.88	6.40e-03
9	1173.21	<b>4.97e-03</b>	-2.14	<b>4.86e-03</b>	6.13	5.18e-03
10	1332.48	4.40e-03	-0.60	<b>4.37e-03</b>	6.67	<b>4.68e-03</b>
11	1836.01	3.27e-03	2.04	3.34e-03	7.89	3.63e-03

Calibration Results Saved.

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#### Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration 6/25/2021 Detector 1 Geometry 13 Crossover energy=300 keV

			MEETS ALS
	EFF @ CROSSOVER	<u>% DIFF*</u>	ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.014917	-2.20%	ОК
UPPER EFFICIENCY CURVE	0.015252	2.25%	ОК

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to <u>OR</u> within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

#### **Efficiency equations**

Polynomial	•	10^(A+B*(LOG(En))+C*(LOG(En))^	2+D*(LOG(En))^3)	
A	-1.104310E+02			
В	1.440889E+02			
С	-6.357339E+01	Calculated efficiency	0.014917	
D	9.327247E+00			
En is energy	in keV			
Crossover e	nergy	300		
Linear		e^(A+(B*(In(En)))+(C*(In(En))^2))		
A	5.971200E-01			
В	-8.380697E-01			
С		Calculated efficiency	0.015252	
<b></b> .				

En is energy in keV Crossover energy

300

Ono clastace

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
	******				
1	Am-241	59.50	4.320E+02 y	rs 0.35900	7.43
2	Cd-109	88.04	4.626E+02 d	ys 0.03610	106.21
3	Co-57	122.06	2.718E+02 d	ys 0.85510	2.40
4	Ce-139	165.85	1.376E+02 d	ys 0.80350	3.58
5	Hg-203	279.00	4.661E+01 d	ув 0.77300	7.89
6	Sn-113	391.68	1.151E+02 d	ys 0.64900	6.35
7	Cs-137	661.64	3.007E+01 y	rs 0.85120	3.03
8	Y-88	898.02	1.066E+02 d	ys 0.93400	10.29
9	Co-60	1173.21	5.271E+00 y	rs 0.99980	4.78
10	Co-60	1332.48	5.271E+00 y	rs 0.99990	4.79
11	Y-88	1836.01	1.066E+02 d	lys 0.99380	10.24

Eckert & Ziegler

Analytics

### (250 th 1130 flecid 7-30-00

1380 SeabOard Industrial Bivd. Atlanta, Georgia 30318 Tel 404-352-8677 Fax 404-352-2837 www.ezag.com

#### CERTIFICATE OF CALIBRATION Standard Reference Source

SRS Number: 116626 Source Description: 500 Grams Sand in PP MRP Jar Product Code: 8401-EG-SAN Customer: ALS Laboratory Group P.O. Number: FC002882, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were addled gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.18, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

#### Reference Date: 01-July-2020 12:00 PM EST MGS Mixture

	Gamma-Ray				Ur	ncertair	nty	Calibration
isotope	Energy, keV	Half-Life, d	Activity, Bq	Flux, s ⁻¹	u _A , %	u ₈ , %	U, %*	Method**
Am-241	69.6	1.880E+05	3.714E+03	1.333E+03	0.1	1.8	3.7	4n LS
Cd-109	88.0	4.614E+02	5.180E+04	1.917E+03	0.8	2.0	4.2	HPGe
Co-87	122,1	2.717E+02	1.197E+03	1.025E+03	0.4	1.7	3.5	HPGe
Ce-139	165.9	1.376E+02	1.798E+03	1.438E+03	0.4	1.8	3.7	HPGe
Hg-203	279,2	4.659E+01	3.741E+03	3.051E+03	0.3	1.7	3.8	HPGe
Sn-113	391.7	1.151E+02	3.171E+03	2.060E+03	0.4	2.0	4.1	HPGe
Cs-137	661.7	1.099E+04	1.515E+03	1.289E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.127E+03	4.804E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1		CONTRACTOR OF ST	5.086E+03	0.7	1.7	- 3.7	**************************************
Co-60	1173.2	1.925E+03	2.396E+03	2.392E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	Section and the section of the secti	SECTOR FOR	2.398E+03	0.7	1.8	3.9	210.00

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty,

k = 2.5ee NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:**  $4\pi$  LS -  $4\pi$  Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

EZACertificate Program Rev. 1, 01-FEB-2019

115 of 173

**Corporate Office** 

Laboratory

#### SRS Number: 116626

#### Comments: 500.3 g of customer supplied sand. Approximate volume: 290 mL

Expiration Date: 28-July-2021

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

1. Source Prepared by:

M. Alfonso, Production Manager

QC Approved by:

J. Lahr, Spectroscopist

Date: 23-JI/L-20

Calibration verification

Geometry 13 Calibration Verification: Gamma Mixed Nuclide Source; Geometry 13 500-gram soil/solid geometry Detector 1

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		# of Half Lives	Expired	0.01	2.36	4.01	7.92	23.39	9.47	0.10	10.22	0.57	0.57	10.22
			Pass/Fail	Pass	Pass	Pass	>5 h-lives	>5 h-lives	>5 h-lives	Pass	>5 h-lives	Pass	Pass	>5 h-lives
Count Date: 6/25/2021			Recovery	105%	101%	96%	>5 h-lives	>5 h-lives	>5 h-lives	101%	>5 h-lives	101%	103%	>5 h-lives
int Date:		3	Activity	212	2850	61.6	76.9	S	S	83.0	S	129	132	NC
Cou			pCi/g	201.2	2813.1	64.0	95.5	215.5	166.7	81.8	274.6	127.5	127.7	273.3
	EXPECTED ACTIVITY		DPS	3721.4	52043.0	1183.5	1767.3	3987.1	3084.7	1513.2	5080.3	2359.5	2362.2	5055.3
	EXPECTE			J Am-241	Cd-109	Co-57	Ce-139	Hg-203	Sn-113	Cs-137	Y-88	Co-60	Co-60	Y-88
7/1/2018		Mass of	Standard	200										
<b>REF DATE : 7/1/2018</b>	FROM ANALYTICS.LIB		Gamma Fraction:	0.3590	0.0372	0.8551	0.8035	0.7730	0.6490	0.8512	0.9340	0.9998	0.9999	0.9938
	-ICATE		Gammas/Sec.	1336	1936	1012	1420	3082	2002	1288	4745	2359	2362	5024
1098	FROM CALIBRATION CERTIFICATE		KeV   Half Life(y)	432.0000	1.2666	0.7441	0.3768	0.1276	0.3151	30.0000	0.2919	5.2714	5.2714	0.2919
VERIF. SOURCE :	<b>VLIBRA</b>			59.5	88	122	166	279	392	662	898	1173	1332	1836
VERIF. S	FROM CA		Isotope	Am-241	Cd-109	Co-57	Ce-139	Hg-203	Sn-113	Cs-137	<u> Ү-88</u>	Co-60	Co-60	Y-88

NC = NOT CALCULATED DUE TO THE ACTIVITY BEING LESS THAN THE MDCa

reelsen non

210687D01.SPC Analyzed by GAMMA ANALYS'IS RESULTS PS Version 1.8.4 SEEKER ALS Laboratory Group - Fort Collins GammaScan Geo 13 / Solid Sample ID: 062521-1A Geo 13 Cal Ver (1098) 07/01/2018 10:00:00 | Counting Start: 06/25/2021 09:35:19 Sampling Start: Sampling Stop: 07/01/2018 10:00:00 | Decay Time. . . . . . 2.62E+004 Hrs Buildup Time. . . . . 0.00E+000 Hrs | Live Time . . . . . . . 1800 Sec 1822 Sec Sample Size . . . . . . 5.00E+002 g | Real Time . . . . . . . . Detector #: 1 (Detector 1) Energy  $(keV) = -2.00 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 06/25/2021$  $FWHM(keV) = 0.74 + 0.020*En + 4.70E-04*En^2 + 0.00E+00*En^3 08/22/2020$ Where En = Sqrt(Energy in keV) Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000 ______ PEAK SEARCH RESULTS UN-BKG FWHM NET/MDA C.L. PK. ENERGY ADDRESS COUNTS CERTAINTY COUNTS COUNTS (keV) FLAG # (keV) CHANNEL _ _ _ _ . 59.53 122.78 185 99 1811 0.93 a HiResid 4940 1 1792 0.95 a 88.00 179.59 7778 213 98 2 247.72 2005 143 92 1566 0.98 a 3 122.15 1819 1.08 a 310 130 103 4 136.48 276.32 165.91 335.04 163 99 79 1257 0.81 a 5 879 0.76 a 89 78 62 6 310.34 623.21 51 630 0.64 a NET< CL 7 349.73 701.81 50 63 974 1.43 a NET< CL 92 75 8 511.17 1023.92 60 17280 771 1.64 a HiResid 662.09 1325.06 274 65 9 51 462 2.19 a HiResid 10 1173.99 2346.44 14139 246 115 2.43 a HiResid 11 1333.24 2664.18 230 26 12972 12 1461.89 2920.87 30 17 10 23 1.52 a

	2:	L0687D01.S	PC Analyzed	by								
****	*******	*******	*******	*******	*******	********	*****					
SEEK	ER I	BACKG	ROUND	SUBTR	ACT R	ESULT	S Vers. 2.2.1					
		А	LS Laborato	ry Group -	Fort Col	lins						
	GammaScan											
***************************************												
Back	ground Fi	le:	DET010	623.BKG (	062321-1	LONG BKG CA	L)					
Bkg.	File Dete	ctor #: 1										
====							*************					
			BACKGROU	IND SUBTRAC	T RESULTS							
	ENERGY	OLD NET	OLD UN-	OLD	NEW NET	NEW UN-	NEW					
PK#	(keV)	COUNTS	CERTAINTY	CR.LEVEL	COUNTS	CERTAINTY	CR.LEVEL FLAG					
8	511.17	60	92	75	16	93	76 NET <cl< th=""></cl<>					
12	1461.89	30	17	10	11	17	13 NET <cl< th=""></cl<>					

* * * * * * * * *	210687D01.	SPC Analy	zed by	*******	******	******	* * * * * * * * * * *			
SEEKER	FIN	JAL A	СТІVІ	TY RE	PORT	Versi	on 2.2.1			
			-		- 11 4					
		ALS Labor	atory Grou Gammas	ıp - Fort C Scan	ollins					
*****	******	******			******	******	* * * * * * * * *			
			Geo 13 /	/ Solid						
Sample II	D: 062521-1A	Geo 13 Ca	<b>l Ver (10</b> 9	98)						
Sampling Buildup S Sample S Collection	Start: 07, Stop: 07, Fime ize on Efficiency L Confidence	/01/2018 1 . 0.00e+ 5.00	0:00:00   000 Hrs   e+002 g   1.0000	Decay Time Live Time Real Time Spectrum F	  	2.6   210	2e+004 Hrs 1800 Sec 1822 Sec 687D01.SPC			
Detector #: 1 (Detector 1) Efficiency File: (D01)(Sh13).EFF (Geo 13 Eff Cal) Eff=10^[-1.10E+02 +1.44E+02*L +-6.36E+01*L^2 +9.33E+00*L^3] 06/25/2021 Eff.= EXP[5.97E-01 + -8.38E-01 * En + 0.00E+00 * En^2] Above 300.00 keV										
Library 3	File:	ANALYTICAL	.LIB (An	alytical)						
= = = = = = = = = = = = = = = = = = = =				CONCENTRAJ						
						===========				
	N	<b>_</b>			Critical	****				
Nuclide	ENERGY E (kev) T (j	pCi/g	)	MDA	Level					
Am-241	59.54    2.	 12E+02 +-		8.63E+00	4.26E+00	3.79E+06	5			
Cd-109		85E+03 +-		7.30E+01	3.60E+01	1.11E+04	ł			
Co-57	122.07 6.	16E+01 +-	4.40E+00	5.74E+00		6.50E+03				
Ce-139		69E+01 +-		7.59E+01		3.30E+03				
Cs-137	•••••	30E+01 +-		6.33E-01		2.64E+05				
Co-60	Average:x 1.					4.62E+04				
		29E+02 +-			4.66E-01 2.69E-01	4.62E+04				
Um 203	1332.48 1. 279.18	32E+02 +- MDA		5.00E-UI 3.99E+06		<b>1.12E+0</b> 3				
Hg-203 Sn-113	391.68	MDA	• • • •	4.37E+02		2.76E+03				
Y-88	898.02	MDA		9.63E+02		2.56E+03				
MEASUR	ED TOTAL: 3.	<b>41E+03 +-</b>	1.40E+02	pCi/g						
*******							*========			
	# = = # = = = = = = = = = = = = = = = =		-	ESCAPE PE		:2222222	* 2 2 2 2 2 2 2 2 2 2 2 2 2 2			
PK. ENE	RGY ADDRESS	NET	UN-	C.L.	BKG	FWHM				
	eV) CHANNEL		CERTAINTY			(keV)	FLAG			
4 13	6.48 276.32 Page 003	310	130	103	1819	1.08	Unknown 120 of 173			

#### 210687D01.SPC Analyzed by

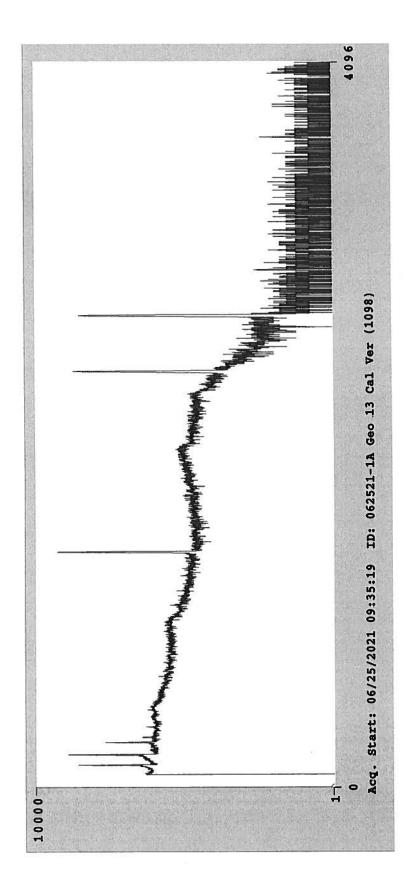
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#### UNKNOWN, SUM or ESCAPE PEAKS

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PK. #	ENERGY (kov)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
6	310.34	623.21	89	78	62	879	0.76	1333DEsc
7	349.73	701.81	50	63	51	630	0.64	Deleted
8	511.17	1023.92	16	93	76	974	1.43	Deleted
12	1461.89	2920.87	11	17	13	23	1.52	Deleted

c:\SEEKER\BIN\210687d01.res Analysis Results Saved.



Analytics

1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 404:352:8677 Fax 404:352:2837 www.ezag.com

CERTIFICATE OF CALIBRATION Standard Reference Source

Received 8/20/19.

K29

**SRB Number:** 110301 **Source Description:** 500 Grams Sand in 16 Ounce PP MRP Jar **Product Code:** 8401-EG-SAN **Customer:** ALS Laboratory Group P.O. Number: FC001958, Item 1

Eckert & Ziegler

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

#### Reference Date: 01-july-2018 12:00 PM EST MGB Mixture

W = 224	Gamma-Ray				Ur	certainty	Calibration
lectope	Energy, keV	Half-Life, d	Activity, Bq	Flux, s ⁻¹	u4. %	Hg. % U, %	
Am-241	1. A. C. BO.B. M.	1.680E+08	3.723E+03	1.338E+03	0.1	1.8 3.6	And the second se
Cd-109	88.0	4.614E+02	5.231E+04	1.936E+03	0.5	2.0 4.1	HPGe
Co-87	128.1	2.717E+02	1.183B+03	1.012E+03	0.4	1.7	
Ce-139	165.9	1.376E+02	1.778E+03	1.420E+03	0.4	1.7 3.6	
Hg-203	SEA. 101	4.6598+01	3.778E+03	3.082E+03	0.3	1.7 3.8	HPCe
Sn-113	391.7	1.181E+02	3.081E+03	2.002E+03	0.4	1.9 3.9	HPGa
Co-187	681.7	1.000 2404	1.814E+03	1.286E+03	0.7	1.9 4.1	HPCe
Y-88	898.0	1.066E+02	8.064E+03	4.745E+03	0.7	1.7 3.7	HPGe
Y 88	1030.1	A STATE AND A S		8.024E+03	0.7	1.7 3.7	CIP CE, Mr. C.
Co-80	1173.2	1.926E+03	2.362E+03	2.359E+03	0.7	1.8 3.9	
Co-80	1352.8	STREET BOOM	A PROPERTY I	2,382E+03	0.7	1.8 3.9	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-87, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. *Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." **Calibration Methods:  $4\pi$  LS -  $4\pi$  Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Verified 09/01/2020. New Exp. Date => 09/01 707, Bage 1 of 2

EZA Certificate Program Rev. 0, 07-DEC-2015

F-CA-12, Ray 0, 01 Nov

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24937 Avenue Tibbitts Valencia, California 91355

Laboratory 1380 Seaboard Industrial Blvd. Atlanta, Georgia, 30318

#### **SRS Number:** 110301

#### Comments:

500.00 grams of customer supplied sand. Approximate volume: 290 mL

Expiration Date: 17-August-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: A. Chirillo, Radiochemist

QC Approved by:

J. Lahr, Spectroscopist

Date: 16-404-18

EZA Certificate Program Rev. 0, 07-DEC-2015

Page 2 of 2

200484D02.SPC Analyzed by

****** SEEKER GAMMA ANALYSIS RESULTS PS Version 1.8.4

ALS Laboratory Group - Fort Collins

GammaScan

Geo 13 / Solid Sample ID: 101020-2 Geo 13 Eff Cal (1130) Sampling Start: 07/01/2020 10:00:00 | Counting Start: 10/10/2020 09:38:46 Sampling Stop: 07/01/2020 10:00:00 | Decay Time. . . . . . 2.42E+003 Hrs Buildup Time. . . . . 0.00E+000 Hrs | Live Time . . . . . . . 1800 Sec 1887 Sec _____ Detector #: 2 (Detector 2) Energy  $(keV) = -1.28 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 10/10/2020$  $FWHM(keV) = 0.59 + 0.019*En + 4.08E-04*En^2 + 0.00E+00*En^3 07/29/2020$ Where En = Sqrt(Energy in keV) _____ Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000 _____ PEAK SEARCH RESULTS ________________________ PK. ENERGY ADDRESS NET/MDA UN-C.L. BKG FWHM # CHANNEL COUNTS CERTAINTY (keV) COUNTS COUNTS (keV) FLAG 202 0.78 a HiResid 1 59.51 121.32 13278 337 8250 2 70.78 143.83 586 304 247 11241 0.91 a 147.90 72.82 3 1232 271 216 9368 0.75 b 82.46 4 167.13 1880 410 329 16041 1.53 a HiResid Wide Pk 2.41 b HiResid 5 84.86 171.92 5380 629 503 26735 87.97 178.13 58943 10694 0.91 c HiResid 6 567 241 7 109.25 220.59 175 0.42 a 156 142 4972 120.74 243.53 1.72 a Wide Pk 8 1577 445 360 16887 122.09 246.22 36643 7676 0.84 Ъ 9 450 195 136.51 275.00 0.89 a 10 4808 263 183 6785 0.90 a HiResid 11 165.84 333.54 40939 471 199 7314 12 255.12 511.73 1184 183 140 3937 0.84 a 559.73 13 279.17 25610 367 147 4017 1.02 a HiResid 14 391.72 784.34 32928 400 139 3303 1.14 a HiResid 15 509.98 1020.36 230 120 96 1934 0.98 a Wide Pk 16 511.50 1023.39 759 217 173 4191 2.16 b 17 540.32 1080.92 81 115 93 1829 0.93 a NET< CL 18 661.69 1323.14 26326 356 121 2721 1.37 a HiResid 19 814.00 1627.11 527 135 104 1887 1.55 a 20 898.07 1794.90 39813 424 119 2595 1.57 a HiResid

Page 001

#### 

### PEAK SEARCH RESULTS

РК. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
21	1173.23	2344.06	30450	366	92	1474	1.76 a	HiResid
22	1325.30	2647.56	1097	174	132	1786	4.19 a	HiResid Wide Pk
23	1332.42	2661.76	28087	346	70	824	1.89 b	HiResid
24	1658.26	3312.07	62	74	60	656	2.00 a	
25	1835.82	3666.44	25194	322	46	377	2.18 a	HiResid

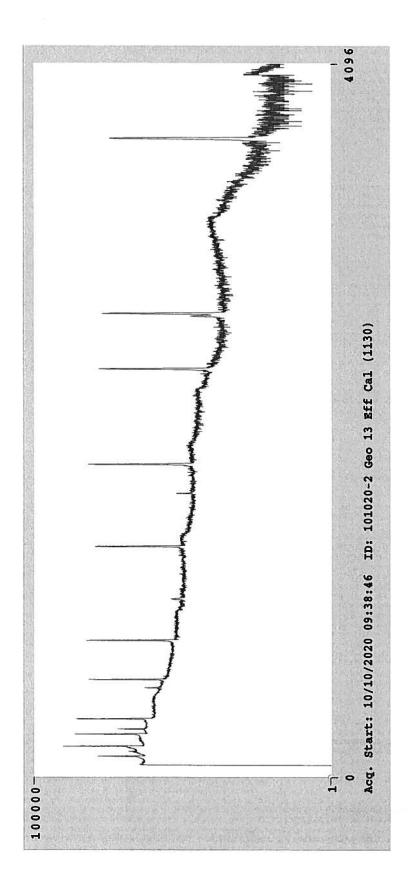
200484D02.SPC Analyzed by CALIBRATION RESULTS SEEKER Version 2.0.4 Sample ID: 101020-2 Geo 13 Eff Cal (1130) Stds. Match Tolerance: 2.00 keV _____ Detector Number: 02 Calibration Date. . . 10/10/2020 09:38:46 Geometry File (D02)(Sh13).EFF ID. Geo 13 Eff Cal Amount of Std. in Calib. Source: 500.000000 gm Crossover: 300.00 keV Below Crossover Efficiency Fit: Eff = 10 ^ [-8.02e+01 + 1.04e+02*En +-4.58e+01*En^2 + 6.67e+00*En^3] (Where En = LOG(Energy in keV)) (Polynomial) Above Knee Efficiency Fit:  $Eff = exp ^ [-2.35e-01 + -5.84e-01*En + -1.09e-02*En^2]$ (Where En = Energy in keV) (Linear/Quad) ------_____

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
====	****					* = = = = = = = = = = = = = = = = = = =
1	59.50	5.54e-03	0.53	5.57e-03	-228.36 🔼	<b>1.70e-03</b>
2	88.04	<b>1.99e-02</b>	-2.59	1.94e-02	-60.02	1.21e-02
3	122.06	2.57e-02	3.93	2.67e-02	-20.35	2.22e-02
4	165.85	2.63e-02	-2.33	2.57e-02	-9.34	2.35e-02
5	279.00	2.09e-02	0.31	2.10e-02	-8.89	1.93e-02
6	391.68	1.63e-02	0.41	1.64e-02	-7.36	1.53e-02
7	661.64	1.14e-02	-1.66	1.12e-02	-6.72	1.05e-02
8	898.02	8.88e-03	1.25	8.99e-03	-8.01	8.32e-03
9	1173.21	7.33e-03	0.70	7.39e-03	-9.01	6.77e-03
10	1332.48	6.76e-03	-0.52	6.72e-03	-9.21	6.15e-03
11	1836.01	5.31e-03	-0.20	5.30e-03	-8.21 🎙	<b>4.89e-03</b>

Calibration Results Saved.

1 OK-1 New Delidar

) M (m 10/72/2020



#### Gamma Efficiency Calibration - Crossover energy efficiency difference

Calibration10/10/2020Detector2Geometry13Crossover energy=300 keV

			MEETS ALS
	EFF @ CROSSOVER	<u>% DIFF*</u>	ACCEPTANCE CRITERIA?
LOWER EFFICIENCY CURVE	0.019964	0.83%	ОК
UPPER EFFICIENCY CURVE	0.019800	-0.82%	OK

*When a single calibration curve does not meet ALS acceptance criteria, a split-fit efficiency calibration may be employed. This entails the use of two separate energy range calibrations, a low energy efficiency curve and a high energy efficiency curve. A crossover energy must be specified that marks where the software will use either the low energy efficiency curve or the high energy efficiency curve. It should be noted that if a nuclide is specified that has a gamma photon energy that is equal to <u>OR</u> within 15 keV of the crossover energy, the potential exists for the calculated efficiencies at the crossover energy to be significantly different than the true detection efficiency of the detector. At times by as much as 20%. This is an artifact of the non-equivalency of the calibration equations specified for each energy range. This may result in an effective high or low bias to the analytical results. This bias is reflected in the above calculated % difference. ALS Environmental will not accept any calibration with an effective % difference of greater than 5% without supervisory approval. Results are submitted without further qualification.

#### **Efficiency equations**

Polynomial	-	10^(A+B*(LOG(En))+C*(LOG(En))^	2+D*(LOG(En))^3)
A	-8.021020E+01		
В	1.041242E+02		
С	-4.576472E+01	Calculated efficiency	0.019964
D	6.671109E+00		
En is energy	∕ in keV		
Crossover e	nergy	300	
Linear		e^(A+(B*(In(En)))+(C*(In(En))^2))	
A	-2.352143E-01		
В	-5.844166E-01		
С	-1.086439E-02	Calculated efficiency	0.019800

En is energy in keV Crossover energy

300

ON MIDIZDOZU

Standards File. . . . . Gsstd13.std Assay Date . . . . . 07/01/2020 10:00 ID.: Geo 13 Std#1130 500-g. mixed gamma

Pk #	Nuclide	Energy	Halflife	Br.Ratio	dps/gm
====				=================	
1	Am-241	59.50	4.320E+02 yr:	s 0.35900	7.43
2	Cā-109	88.04	4.626E+02 dy	s 0.03610	106.21
3	Co-57	122.06	2.718E+02 dy	s 0.85510	2.40
4	Ce-139	165.85	1.376E+02 dy	s 0.80350	3.58
5	Hg-203	279.00	4.661E+01 dy	s 0.77300	7.89
6	Sn-113	391.68	1.151E+02 dy	s 0.64900	6.35
7	Cs-137	661.64	3.007E+01 yr	s 0.85120	3.03
8	Y-88	898.02	1.066E+02 dy	s 0.93400	10.29
9	Co-60	1173.21	5.271E+00 yr	s 0.99980	4.78
10	Co-60	1332.48	5.271E+00 yr	s 0.99990	4.79
11	Y-88	1836.01	1.066E+02 dy	s 0.99380	10.24

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1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 404·352·8677 Fax 404·352·2837 www.ezag.com

Analytics

#### CERTIFICATE OF CALIBRATION Standard Reference Source

SRS Number: 116626 Source Description: 500 Grams Sand in PP MRP Jar Product Code: 8401-EG-SAN Customer: ALS Laboratory Group P.O. Number: FC002882, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

#### Reference Date: 01-July-2020 12:00 PM EST

#### **MGS Mixture**

	Gamma-Ray				Ur	ncertair	nty	Calibratior
Isotope	Energy, keV	Half-Life, d	Activity, Bq	Flux, s⁻¹	u _A , %	u _B , %	U, %*	Method**
Am-241	59.5	1.580E+05	3.714E+03	1.333E+03	0.1	1.8	3.7	4π LS
Cd-109	88.0	4.614E+02	5.180E+04	1.917E+03	0.5	2.0	4.2	HPGe
Co-57	122.1	2.717E+02	1.197E+03	1.025E+03	0.4	1.7	3.5	HPGe
Ce-139	165.9	1.376E+02	1.798E+03	1.438E+03	0.4	1.8	3.7	HPGe
Hg-203	279.2	4.659E+01	3.741E+03	3.051E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.171E+03	2.060E+03	0.4	2.0	4.1	HPGe
Cs-137	661.7	1.099E+04	1.515E+03	1.289E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.127E+03	4.804E+03	0.7	1.7	3.7	HPGe
Y-88	1836.1		21	5.086E+03	0.7	1.7	3.7	
Co-60	1173.2	1.925E+03	2.396E+03	2.392E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5			2.395E+03	0.7	1.8	3.9	

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. ***Uncertainty:** U - Relative expanded uncertainty,

k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." ****Calibration Methods:**  $4\pi$  LS -  $4\pi$  Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

EZA Certificate Program Rev. 1, 01-FEB-2019

#### SRS Number: 116626

#### Comments:

500.3 g of customer supplied sand. Approximate volume: 290 mL

Expiration Date: 28-July-2021

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

_____

1. Ca _____ Source Prepared by: /

/ M. Alfonso, Production Manager

QC Approved by:

J. Lahr, Spectroscopist

Date: 23-JI/L-20

Calibration verification

Geometry 13 Calibration Verification: Gamma Mixed Nuclide Source; Geometry 13 500-gram soil/solid geometry Detector 2

		# of Half Lives	Expired	0.01	1.80	3.06	6.05							7.80
			Pass/Fail	Pass	Pass	Pass	Pass	>5 h-lives	Pass	Pass	>5 h-lives	Pass	Pass	>5 h-lives
Count Date: 10/10/2020			Recovery	102%	67%	67%	106%	>5 h-lives	91%	103%	>5 h-lives	100%	102%	>5 h-lives
int Date:			Activity	205	2740	61.9	101.0	S	151	83.9	S	128	130	NC
Cot			pCi/g	201.2	2813.1	64.0	95.5	215.5	166.7	81.8	274.6	127.5	127.7	273.3
	EXPECTED ACTIVITY		DPS	3721.4	52043.0	1183.5	1767.3	3987.1	3084.7	1513.2	5080.3	2359.5	2362.2	5055.3
	EXPECTE			j Am-241	Cd-109	Co-57	Ce-139	Hg-203	Sn-113	Cs-137	Y-88	Co-60	Co-60	Y-88
7/1/2018		Mass of	Standard	3 200										
<b>REF DATE : 7/1/2018</b>	FROM ANALYTICS.LIB		Gamma Fraction:	0.3590	0.0372	0.8551	0.8035	0.7730	0.6490	0.8512	0.9340	0.9998	0.9999	0.9938
	1													
				1336	1936	1012	1420	3082	2002	1288	4745	2359	2362	5024
1098				432.0000 1336	1.2666 1936	0.7441 1012	0.3768 1420				0.2919 4745		5.2714 2362	0.2919 5024
VERIF. SOURCE : 1098	FROM CALIBRATION CERTIFICATE		KeV   Half Life(y)   Gammas/Sec.					0.1276		30.0000				

NC = NOT CALCULATED DUE TO THE ACTIVITY BEING LESS THAN THE MDCa

ON OP Ididear

INOprins/RAD/INST/GAMMA/Calibration/Efficiency/GEO13_CAL VER_(1098)_Det2_10.10.12

200485D02.SPC Analyzed by

ALS Laboratory Group - Fort Collins

GammaScan

#### 

Geo 13 / Solid

Sample ID: 101020-2A Geo 13 Cal Ver (1098)

Sampling Start: 07/01/2018 10:00:00 | Counting Start: 10/10/2020 10:16:28 Sampling Stop: 07/01/2018 10:00:00 | Decay Time. . . . . . 2.00E+004 Hrs Buildup Time. . . . . 0.00E+000 Hrs | Live Time . . . . . . . . 1800 Sec 1839 Sec Collection Efficiency . . . . Detector #: 2 (Detector 2) Energy  $(keV) = -1.28 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 10/10/2020$  $FWHM(keV) = 0.59 + 0.019*En + 4.08E-04*En^2 + 0.00E+00*En^3 07/29/2020$ Where En = Sqrt(Energy in keV) ____ Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000 

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.51	121.33	13639	281	128	3306	0.77	a
2	87.96	178.11	18972	307	112	2535	0.82	a
3	122.07	246.18	5614	190	96	1865	0.85	a
4	136.50	274.99	725	123	91	1669	0.79	a
5	165.80	333.46	1056	125	88	1569	0.89	a
6	271.39	544.20	72	85	68	1031	0.65	a
7	391.67	784.24	356	106	81	1222	0.96	a
8	471.54	943.65	63	103	84	1389	1.20	a NET< CL
9	507.53	1015.47	44	61	49	599	0.62	a NET< CL
10	534.10	1068.50	56	84	68	907	1.15	a NET< CL
11	661.59	1322.94	25369	330	71	940	1.32	a HiResid
12	774.27	1547.83	58	71	57	649	1.09	a
13	897.94	1794.65	375	120	93	1460	1.93	a
14	1173.09	2343.78	23326	313	57	569	1.75	a
15	1332.26	2661.45	21500	296	34	202	1.85	a HiResid
16	1835.74	3666.28	197	34	15	40	2.25	a

	20	0485D02.5	PC Analyzed	by						
****	********	*******	*******	*******	*******	*****	******	****		
SEEKI	ER I	BACKG	ROUND	SUBTR	ACTR	ESULT	S Vers. 2	.2.1		
	ALS Laboratory Group - Fort Collins GammaScan									
****	** *** *** *** *** *** *** ************									
Backg	Background File: DET020930.BKG (093020-2 LONG BKG CAL)									
Bkg.H	File Detec	tor #: 2								
			BACKGROU	ND SUBTRAC	T RESULTS	;				
			# 6 8 8 8 8 8 8 8 8 <b>8</b> 8				==========	====		
PK#			OLD UN- CERTAINTY			NEW UN- CERTAINTY	NEW CR.LEVEL	FLAG		
2		18972	307	112		307	112			

200485D02.SPC Analyzed by											
SEEKER FINAL ACT	IVITY RE	PORT	Version 2.2.1								
ALS Laborator	y Group - Fort	Collins									
	GammaScan										
** ** * * * * * * * * * * * * * * * * *	***********	*******	*****								
Ge	o 13 / Solid										
Sample ID: 101020-2A Geo 13 Cal Ve	er (1098)										
Sampling Start: 07/01/2018 10:00	•										
Sampling Stop: 07/01/2018 10:00			2.00e+004 Hrs								
Buildup Time.       .       0.00e+000 Hrs       Live Time       1800 Sec         Sample Size       .       .       5.00e+002 g       Real Time       1839 Sec											
Collection Efficiency 1.0000   Spectrum File											
Cr. Level Confidence Interval: 95 %   Det. Limit Confidence Interval: 95 %											
	#: 2 (Detector										
Efficiency File: (D02)(Sh13).EFF ((											
Eff=10^[-8.02E+01 +1.04E+02*L +-4. Eff.= EXP[-2.35E-01 + -5.84E-01 * P		—									
Library File: ANALYTICAL.LI	· •										
EESESSEESESSEESESSEESESSEESESESESESESE	r MDA CONCENTRA		============								
			===========								
N ENERGY E Concentration			<b>Walflife</b>								
Nuclide (keV) T (pCi/g											
Am-24159.542.05E+02+-4.22Cd-10988.022.74E+03+-4.44			3.79E+06 1.11E+04								
Cd-109 88.02 2.74E+03 +- 4.44 Co-57 122.07 6.19E+01 +- 2.10			6.50E+03								
Ce-139 165.85 1.01E+02 +- 1.20			3.30E+03								
Sn-113 391.68 1.51E+02 +- 4.48			2.76E+03								
Cs-137661.628.39E+01 +- 1.09Y-88Average:x 2.60E+02 +- 3.93			2.64E+05 2.56E+03								
898.02 3.00E+02 +- 9.5			2.56E+03								
1836.01 2.52E+02 +- 4.24			2.56E+03								
Co-60 Average:x 1.29E+02 +- 1.24 1173.21 1.28E+02 +- 1.72			4.62E+04 4.62E+04								
1332.48  1.30E+02  +-  1.79			4.62E+04								
	7.99E+04		1.12E+03								

MEASURED TOTAL: 3.73E+03 +- 1.49E+02 pCi/g

#### 200485D02.SPC Analyzed by

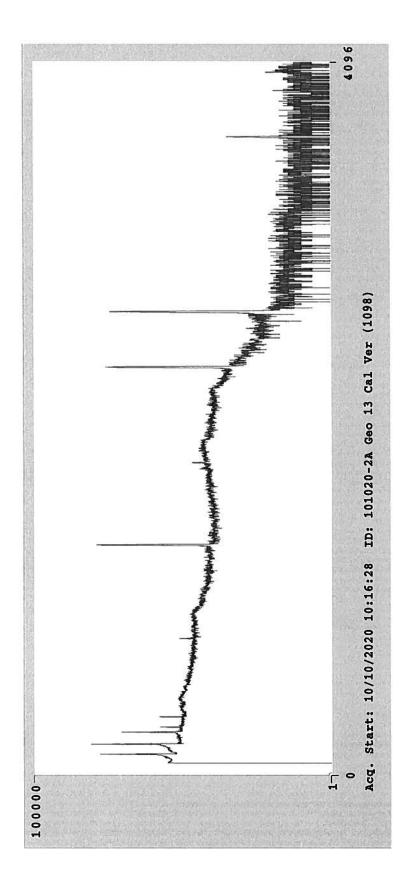
#### 

#### UNKNOWN, SUM or ESCAPE PEAKS

#### 

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
4	136.50	274.99	725	123	91	1669	0.79	Unknown
6	271.39	544.20	72	85	68	1031	0.65	Unknown
8	471.54	943.65	63	103	84	1389	1.20	Deleted
9	507.53	1015.47	44	61	49	599	0.62	Deleted
10	534.10	1068.50	56	84	68	907	1.15	Deleted
12	774.27	1547.83	58	71	57	649	1.09	Unknown

c:\SEEKER\BIN\200485d02.res Analysis Results Saved.



## 💽 Eckert & Ziegler 🕉 🕨 🕈 Received 8/20/19

1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 40-4-352-8677 Fax 404+352+2837 www.ezag.com

**Analytics** 

**CERTIFICATE OF CALIBRATION** Standard Reference Source

SRS Number: 110301 Source Description: 500 Grams Sand in 16 Ounce PP MRP Jar Product Code: 8401-EG-SAN Customer: ALS Laboratory Group P.O. Number: FC001958, Item 1

This standard radionuclide source was prepared from an aliquot measured gravimetrically from a master radionuclide solution calibrated with a germanium gamma-ray spectrometer system. Additional radionuclides were added gravimetrically from solutions calibrated by gamma-ray spectrometry, ionization chamber, or liquid scintillation counting. Calibration and purity were checked using germanium gamma-ray spectrometry. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology (NIST) through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST."

#### Reference Date: 01-July-2018 12:00 PM EST MGS Mixture

	Gamma-Ray	Half-Life, d	Activity, Bq	Flux, s ⁻¹	Uncertainty			Calibration
Isotope	Energy, keV				uA, %	ug, %	U, %*	Method**
Am-241	89.5	1.580E+05	3.723E+03	1.336E+03	0.1	1.8	3.6	411 LS
Cd-109	88.0	4.614E+02	5.231E+04	1.936E+03	0.5	2.0	4.1	HPGe
<b>Co-87</b>	122.1	2.717E+02	1.183E+03	1.012E+03	0.4	1.7	3.4	HPGe
<b>Ce-139</b>	165.9	1.376E+02	1.775E+03	1.420E+03	0.4	1.7	3.6	HPGe
Hg-203	<u>279.2</u>	4.659E+01	3.778E+03	3.082E+03	0.3	1.7	3.5	HPGe
Sn-113	391.7	1.151E+02	3.081E+03	2.002E+03	0.4	1.9	3.9	HPGe
<b>Cs-137</b>	661.7	1.099E+04	1.514E+03	1.288E+03	0.7	1.9	4.1	HPGe
Y-88	898.0	1.066E+02	5.064E+03	4.745E+03	0.7	1.7	3.7	HPGe
<b>Y-88</b>	1836.1			5.024E+03	0.7	1.7	3.7	STATISTICS ST
<b>Co-60</b>	1173.2	1.925E+03	2.362E+03	2.359E+03	0.7	1.8	3.9	HPGe
Co-60	1332.5	A CONTRACTOR OF A CONTRACT	A DESCRIPTION OF A DESC	2.362E+03	0.7	1.8	3.9	NAME OF THE PARTY

Mixed Gamma (MGS) master solution is EZA's eight isotope mixture which is calibrated quarterly and consists of Cd-109, Co-57, Ce-139, Hg-203, Sn-113, Cs-137, Y-88, and Co-60. "Uncertainty: U - Relative expanded uncertainty. k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results." **Calibration Methods: 411 LS - 411 Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber.

(Certificate continued on reverse side)

Standard Re-Veritied 09/01/2020. > 09/01 10 4 202 Bage 1 of 2 Laboratory

F-CR-32, Rev 0, 01 Nov z

EZA Certificate Program Rev. 0, 07-DEC-2015

1380 Seaboard Industrial Blvd. Atlanta, Georgia 아래 173

SRS Number: 110301

#### Comments:

500.00 grams of customer supplied sand. Approximate volume: 290 mL

Expiration Date: 17-August-2019

This source was wipe tested in its inactive areas with leak test results < 185 Bq (5 nCi) of removable activity per ISO 9978:1992.

Source Prepared by: Theallort

A. Chirillo, Radiochemist

QC Approved by:

hr, Spectroscopist

Date: 16-404-18

Gamma Spectroscopy

# **Quality Control Data**

# Weekly Background Calibrations

## Gamma Spectrometer Calibration Log

Date:  $\frac{7}{7}$ 

Reviewed By/Date: TS 7/7/2L

		Backg	round	Source Check			Repeat Source Check					
Det. No.	Out Of Service	Started	ОК	Started	OK	Failed Parameter(s)	ОК	Failed Parameter(s)	Corrective Action Taken **	Removed from Service		
1.		TS	TS	TS	73							
2.		75	TS	TS	TS							
3.		TS	TS	TS	TS							
4.		TS	TSA	ts	TS							
5.		75	TS	TS	TS							
6.	TS		2	/	/							
7.		TS	TS	TS	TS							
8.	T3	/	1	/								
9.	TS		/	//	/							
10.		TS	TS	TJ	75							

.** Corrective Action:

A RE- FAN BKG

*** Due to detector ______ failing two different QC parameters on the first and second daily check, a the daily check was performed. All QC parameters passed for the third daily check. Detector ______ is only for the date of ______



Form 754r16a.doc (10/42000

				m									
	2	10770D01.S	PC Analyze	d by									
SEEP	KER	GAMM	A ANA	LYSIS	RESUI	LTS P	S Versio	on 1.8.4					
		А	LS Laborat	ory Group ·	- Fort Coll	lins							
	GammaScan												
****	***************************************												
	Long Background Calibration												
Sampl	le ID: 21	0707-1 LON	GBKGCAL										
Sampl	ling Star	t: 07/0	7/2021 13:	:00:00   Cor	unting Star	rt: 07	/07/202	1 13:53:06					
				:00:00 De									
	-			)0 Hrs   Liv									
				000 L   Re									
Colle	action Ef	ficiency .	1	L.0000   Sp	c. File .		210	770D01.SPC					
¥8		1 00 - 0		or $#: 1 (D)$	•	₽⊥∩∩≠ぺ⊾ょっ	07/07/	2021					
				0.00E+00*C									
FWHM	(Kev) =	0.74 + 0		$a.70E=0a^{\circ}E$ En = Sgrt(E			00/22/	2020					
See		 ivitv, 1 0	0   Sime	Multiplier	 2.00   ga	earch Ste	rt/End:	80/4000					
							========						
			PE	AK SEARCH R	esults								
	=========				=============			*********					
PK.	The day	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM						
#	(keV)		•	011-	<b>U</b> • <b>H</b> •		* ******						
	(1101)	CHANNEL	COUNTS (	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG					
1		CHANNEL	COUNTS (	CERTAINTY	COUNTS		(keV)	FLAG					
	66.40	136.54	COUNTS ( 135	CERTAINTY  60	COUNTS 								
2	66.40 74.97	136.54	135 123	60 70	45 54	COUNTS 504 657	0.53	a.					
3	7 <b>4.97</b> 77.25	136.54 153.64 158.19	135 123 45	60 70 90	45 54 73	COUNTS 504 657 986	0.53	a a b NET< CL					
3 4	74.97 77.25 92.59	136.54 153.64 158.19 188.82	135 123 45 147	60 70 90 75	45 54 73 58	COUNTS 504 657 986 679	0.53 0.66 0.97 0.76	a a b NET< CL a					
3 4 5	74.97 77.25 92.59 122.29	136.54 153.64 158.19 188.82 248.11	135 123 45 147 22	60 70 90 75 50	45 54 73 58 40	COUNTS 504 657 986 679 403	0.53 0.66 0.97 0.76 0.51	a b NET< CL a a NET< CL					
3 4 5 6	74.97 77.25 92.59 122.29 139.96	136.54 153.64 158.19 188.82 248.11 283.39	135 123 45 147 22 80	60 70 90 75 50 53	45 54 73 58 40 41	COUNTS 504 657 986 679 403 424	0.53 0.66 0.97 0.76 0.51 0.51	a a b NET < CL a a NET < CL a					
3 4 5 6 7	74.97 77.25 92.59 122.29 139.96 154.62	136.54 153.64 158.19 188.82 248.11 283.39 312.65	135 123 45 147 22 80 42	60 70 90 75 50 53 51	45 54 73 58 40 41 40	COUNTS 504 657 986 679 403 424 400	0.53 0.66 0.97 0.76 0.51 0.56 0.53	a a b NET < CL a a NET < CL a a a					
3 4 5 6 7 8	74.97 77.25 92.59 122.29 139.96 154.62 185.70	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70	135 123 45 147 22 80 42 98	60 70 90 75 50 53 51 83	45 54 73 58 40 41 40 66	COUNTS 504 657 986 679 403 424 400 806	0.53 0.66 0.97 0.76 0.51 0.55 0.53 0.99	a a b NET < CL a a NET < CL a a a a					
3 4 5 6 7 8 9	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26	135 123 45 147 22 80 42 98 173	60 70 90 75 50 53 51 83 83 82	45 54 73 58 40 41 40 66 64	COUNTS 504 657 986 679 403 424 400 806 747	0.53 0.66 0.97 0.76 0.51 0.55 0.53 0.99 1.03	a a b NET < CL a a NET < CL a a a a					
3 4 5 6 7 8 9 10	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96	135 123 45 147 22 80 42 98 173 58	60 70 90 75 50 53 51 83 82 66	45 54 73 58 40 41 40 66 64 53	COUNTS 504 657 986 679 403 424 400 806 747 559	0.53 0.66 0.97 0.76 0.51 0.56 0.53 0.99 1.03 0.76	a a b NET < CL a a NET < CL a a a a a					
3 4 5 7 8 9 10 11	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71	135 123 45 147 22 80 42 98 173	60 70 90 75 50 53 51 83 83 82	45 54 73 58 40 41 40 66 64	COUNTS 504 657 986 679 403 424 400 806 747	0.53 0.66 0.97 0.76 0.51 0.56 0.53 0.99 1.03 0.76 0.88	a a b NET < CL a a NET < CL a a a a a					
3 4 5 6 7 8 9 10	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96	135 123 45 147 22 80 42 98 173 58 93	60 70 90 75 50 53 51 83 83 82 66 68	45 54 73 58 40 41 40 66 64 53 54	COUNTS 504 657 986 679 403 424 400 806 747 559 583	0.53 0.66 0.97 0.76 0.51 0.56 0.53 0.99 1.03 0.76 0.88	a b NET < CL a a NET < CL a a a a a a a a a a a a a a a a a a					
3 4 5 6 7 8 9 10 11 12	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31	135 123 45 147 22 80 42 98 173 58 93 44	60 70 90 75 50 53 51 83 82 66 68 74	45 54 73 58 40 41 40 66 64 53 54 60	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710	0.53 0.66 0.97 0.76 0.51 0.56 0.53 0.99 1.03 0.76 0.88 1.15 0.74	a b NET < CL a a NET < CL a a a a a a a a a a a a a a a a a a					
3 4 5 6 7 8 9 10 11 12 13	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21 352.02	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31 706.72 785.77	135 123 45 147 22 80 42 98 173 58 93 44 102	60 70 90 75 50 53 51 83 82 66 68 74 48	45 54 73 58 40 41 40 66 64 53 54 60 36	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710 319	0.53 0.66 0.97 0.76 0.51 0.56 0.53 0.99 1.03 0.76 0.88 1.15 0.74 1.18	a a b NET < CL a a NET < CL a a a a a a a a a a a a a a a a a a a					
3 4 5 6 7 8 9 10 11 12 13 14	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21 352.02 391.62	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31 706.72 785.77 1023.01	135 123 45 147 22 80 42 98 173 58 93 44 102 34	60 70 90 75 50 53 51 83 82 66 68 74 48 59	45 54 73 58 40 41 40 66 64 53 54 60 36 48	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710 319 452	0.53 0.66 0.97 0.76 0.51 0.56 0.53 0.99 1.03 0.76 0.88 1.15 0.74 1.18	a b NET < CL a a NET < CL a a a a a a a a a a a a a a a a a a a					
3 4 5 6 7 8 9 10 11 12 13 14 15	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21 352.02 391.62 510.46	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31 706.72 785.77 1023.01 1025.32	135 123 45 147 22 80 42 98 173 58 93 44 102 34 407	60 70 90 75 50 53 51 83 82 66 68 74 48 59 88	45 54 73 58 40 41 40 66 64 53 54 60 36 48 64 77 43	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710 319 452 609 761 340	0.53 0.66 0.97 0.76 0.51 0.56 0.53 0.99 1.03 0.76 0.88 1.15 0.74 1.18 1.98 2.52 1.38	a a b NET < CL a a NET < CL a a a a a a a a a a a a a a a a a a a					
3 4 5 6 7 8 9 10 11 12 13 14 15 16	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21 352.02 391.62 510.46 511.62	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31 706.72 785.77 1023.01 1025.32 1118.98 1168.00	135 123 45 147 22 80 42 98 173 58 93 44 102 34 407 992 183 81	60 70 90 75 50 53 51 83 82 66 68 74 48 59 88 113 59 88 113 59 55	45 54 73 58 40 41 40 66 64 53 54 60 36 48 64 77 43 43	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710 319 452 609 761 340 345	0.53 0.66 0.97 0.76 0.51 0.55 0.53 0.99 1.03 0.76 0.88 1.15 0.74 1.18 1.98 2.52 1.38 1.37	a a b NET < CL a n NET < CL a a a a a a a a a n NET < CL a a NET < CL a a Wide Pk b a a					
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21 352.02 391.62 510.46 511.62 558.53 583.09 609.70	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31 706.72 785.77 1023.01 1025.32 1118.98 1168.00 1221.11	135 123 45 147 22 80 42 98 173 58 93 44 102 34 407 992 183 81 125	60 70 90 75 50 53 51 83 82 66 68 74 48 59 88 113 59 88 113 59 55 69	45 54 73 58 40 41 40 66 64 53 54 60 36 48 64 77 43 43 54	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710 319 452 609 761 340 345 538	0.53 0.66 0.97 0.76 0.51 0.53 0.99 1.03 0.76 0.88 1.15 0.74 1.18 1.98 2.52 1.38 1.37 1.61	a a b NET < CL a n NET < CL a a a a a a a a a a a a a a nET < CL a a NET < CL a a Wide Pk b a a a					
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21 352.02 391.62 510.46 511.62 558.53 583.09 609.70 693.46	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31 706.72 785.77 1023.01 1025.32 1118.98 1168.00 1221.11 1388.33	135 123 45 147 22 80 42 98 173 58 93 44 102 34 407 992 183 81 125 70	60 70 90 75 53 51 83 82 66 68 74 48 59 88 113 59 88 113 59 55 69 74	45 54 73 58 40 41 40 66 64 53 54 60 36 48 64 77 43 43 54 59	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710 319 452 609 761 340 345 538 538 559	0.53 0.66 0.97 0.76 0.51 0.55 0.53 0.99 1.03 0.76 0.88 1.15 0.74 1.18 1.98 2.52 1.38 1.37 1.61 2.12	a a b NET < CL a a NET < CL a a a a a a a a a a a a a a a a a a a					
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19	74.97 77.25 92.59 122.29 139.96 154.62 185.70 198.51 222.40 238.81 295.21 352.02 391.62 510.46 511.62 558.53 583.09 609.70 693.46 803.34	136.54 153.64 158.19 188.82 248.11 283.39 312.65 374.70 400.26 447.96 480.71 593.31 706.72 785.77 1023.01 1025.32 1118.98 1168.00 1221.11 1388.33	135 123 45 147 22 80 42 98 173 58 93 44 102 34 407 992 183 81 125	60 70 90 75 50 53 51 83 82 66 68 74 48 59 88 113 59 88 113 59 55 69	45 54 73 58 40 41 40 66 64 53 54 60 36 48 64 77 43 43 54	COUNTS 504 657 986 679 403 424 400 806 747 559 583 710 319 452 609 761 340 345 538	0.53 0.66 0.97 0.76 0.51 0.53 0.99 1.03 0.76 0.88 1.15 0.74 1.18 1.98 2.52 1.38 1.37 1.61	a a b NET < CL a a NET < CL a a a a a a a a a a a a a a a a a a a					

210770D01.SPC Analyzed by

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# PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN- CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	898.82	1798.29	51	51	41	276	1.96 a	2
23	911.78	1824.16	69	39	29	176	1.26 a	<b>1</b>
24	969.96	1940.31	41	47	38	236	1.89 8	<b>a</b> .
25	1120.69	2241.21	27	27	21	108	0.97 a	A
26	1238.59	2476.57	38	40	31	171	2.12	a
27	1461.29	2921.14	646	60	26	114	2.30	a
28	1764.53	3526.49	65	38	28	114	3.07	a

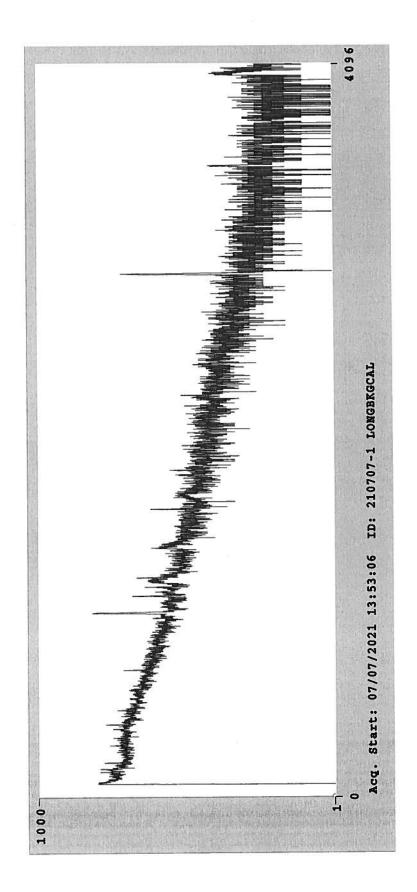
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*****	**	*1	* * :	* *	***	k *	**	**	**	**	***	***	* * *	*****	**	* * :	**:	**:	**:	**	**	**	**1	*****	***	****	***	*
SEEKER ***********	_	_	-	-		-		-	-			-												Vers:				*

#### ID: 210707-1 LONGBKGCAL

Detector # 1 Background Q.C. Analysis for 07/07/2021 13:53:06

			n Sigma	Bounds	т-
#	Parameter	Value	Test	Test	Test
10	40-> 50 keV Bkg	3.810	N.A.	Pass	N.A.
11	50-> 150 keV Bkg	29.460	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	36.901	N.A.	Pass	N.A.
13	500->1000 keV Bkg	34.652	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	19.162	N.A.	Pass	N.A.
15	150-> 250 keV Bkg	25.232	N.A.	Pass	N.A.

Q.C. Results Saved.



	210776D02.SPC Analyzed by												
****	SEEKER GAMMA ANALYSIS RESULTS PS Version 1.8.4												
SEEI	KER	GAMM	A ANA	LYSIS	RESUL	TS P	S Versic	on 1.8.4					
	ALS Laboratory Group - Fort Collins GammaScan												
****	Gammascan ************************************												
					- 14 1								
			Long Ba	ckground Ca	alibration								
Samp:	le ID: 21	0707-2 LON	GBKGCAL										
				00:00   Cou									
				00:00   Dec									
				0 Hrs   Liv				60000 Sec					
-				•000 L   Rea									
Colle	ection Ef	ficiency .	1	0000   Spo	c. File	• • • •	210	76D02.SPC					
_		1 40 - 0		or #: 2 (De 0.00E+00*Cl	· · · · ·	+00±05×3	07/07/	2021					
FWHM	(Kev) =	0.59 + 0		4.08E-04*En En = Sgrt(En			0//23/2	6020					
		 initar. 1 0		Multiplier	• 2.00   Se	arch Sta	 rt/End:	80/4000					
Sear	SII Sensic												
====													
			PE	K SEARCH RI	esults								
====							=======						
PK.	ENERGY	ADDRESS	NET/MDA	UN-	C.L.	BKG	FWHM						
#	(keV)	CHANNEL	COUNTS (	CERTAINTY	COUNTS	COUNTS	(keV)	FLAG					
	46.69	96.05	89	57	45	490	0.54	A					
2	63.25	129.10	179	92	72	967	0.95	a HiResid					
3	66.53	135.64	262	94	72	967	0.92 1	b HiResid					
4	69.24	141.05	22	42	34	322	0.39	C NET< CL					
								HiResid					
5	75.02	152.60	123	70	55	662	0.65						
6	77.18	156.92	125	81	64	828	0.78						
7	84.41	171.35	92	82	66	801	1.02						
8	87.17		37	71	58	668		b NET< CL					
9	92.74	187.97	421	87	63	731		a HiResid					
10	94.64	191.76	65	69	55	609		b HiResid					
11	98.43	199.33	39	96	78	975	1.24	C NET< CL					
						~~~	A A 4	HiResid					
12	140.00	282.31	181	73	56	632	0.84						
13	144.11	290.53	55	50	39	379	0.45						
14				67	54	598	0.81 a	a NET< CL					
	163.52	329.27	35										
15	185.88	373.91	272	74	54	598	0.77	a .					
15 16	185.88 19 4 .79	373.91 391.69	272 47	74 47	54 37	338	0.77 a 0.47 a	a.					
15 16 17	185.88 194.79 198.46	373.91 391.69 399.03	272 47 317	74 47 73	54 37 53	338 563	0.77 0.47 0.78	a a b					
15 16 17 18	185.88 194.79 198.46 205.96	373.91 391.69 399.03 414.00	272 47 317 14	74 47 73 47	54 37 53 38	338 563 352	0.77 0.47 0.78 0.48	a a b a NET< CL					
15 16 17	185.88 194.79 198.46 205.96 229.71	373.91 391.69 399.03 414.00	272 47 317	74 47 73	54 37 53	338 563	0.77 0.47 0.78	a a b a NET< CL					

210776D02.SPC Analyzed by

PEAK SEARCH RESULTS

РК. # 	ENERGY (keV)		COUNTS	UN- CERTAINTY	-	BKG COUNTS	FWHM (keV)	FLAG
20	238.68	479.31	252	62	44	425	0.70 a	L
21	242.21	486.36	97	57	44	425	0.70 E	•
22	295.24	592.23	64	61	48	472	0.88 a	L
23	351.84	705.22	195	73	55	524	1.14 a	L
24	365.31	732.10	57	79	64	600	1.47 a	NET< CL
25	507.58	1016.12	2	129	106	1150	3.51 a	NET< CL
								Wide Pk
26	511.10	1023.15	2106	138	84	876	2.68 E	
27	558.62	1118.02	320	59	38	291	1.20 a	L
28	569.93	1140.59	74	44	34	256	0.86 a	L
29	583.30	1167.29	101	44	32	239	0.88 a	L
30	596.43	1193.49	22	39	31	240	0.66 a	NET< CL
31	598.08	1196.80	128	77	60	600	1.67 E	
32	609.37	1219.33	169	70	54	533	1.32 a	L
33	669.79	1339.95	45	41	32	219	0.90 a	L
34	803.31	1606.49	163	55	40	281	1.45 a	L
35	843.76	1687.24	36	42	33	230	1.00 a	L
36	881.02	1761.63	22	28	22	117	0.77 a	L
37	898.63	1796.78	59	54	42	300	1.90 a	L
38	911.46	1822.39	87	55	43	293	2.10 a	L
39	962.07	1923.43	66	46	35	218	1.82 a	L
40	1120.47	2239.64	43	28	21	107	0.85 a	L
41	1378.19	2754.14	30	28	21	93	1.54 a	L
42	1461.01	2919.47	242	43	24	114	1.88 a	L
43	1765.01	3526.34	49	28	20	77	1.80 a	L

210776D02.SPC Analyzed by

********	********	******	**********************************	
SEEKER	BACKG	ROUND Q.C	C. ANALYSIS Version 2.2.2	

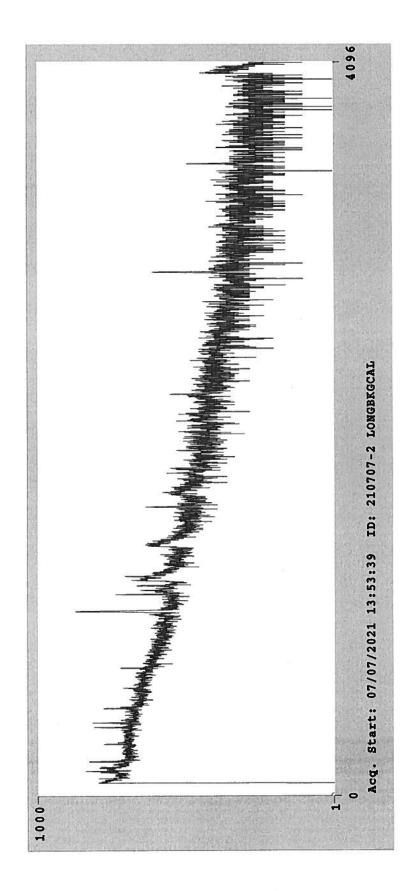
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ID: 210707-2 LONGBKGCAL

Detector # 2 Background Q.C. Analysis for 07/07/2021 13:53:39

			n Sigma	Bounds	Т-
#	Parameter	Value	Test	Test	Test
10	50-> 150 keV Bkg	28.039	N.A.	Pass	 N.A.
11	150-> 250 keV Bkg	23.354	N.A.	Pass	N.A.
12	250-> 500 keV Bkg	35.311	N.A.	Pass	N.A.
13	500->1000 keV Bkg	38.858	N.A.	Pass	N.A.
14	1000->2000 keV Bkg	22.571	N.A.	Pass	N.A.
15	40-> 50 keV Bkg	3.633	N.A.	Pass	N.A.

Q.C. Results Saved.



Gamma Spectroscopy

Quality Control Data

Daily Instrument Performance Checks

New Gamma Standards RSO 967-976 Detectors 1-10

	RSO#	Am241 Act Bq	Eu152 Act Bq	Am241 Act DPS	Eu152 Act DPS
	967	36860	30240	36860	30240
	968	36490	29930	36490	29930
	969	36500	29940	36500	29940
	970	36590	30010	36590	30010
	971	36670	30080	36670	30080
	972	36430	29890	36430	29890
	973	36570	30000	36570	30000
	974	37470	30740	37470	30740
	975	37280	30580	37280	30580
	976	37230	30540	37230	30540
Average		36809	30195	36809	30195

Standards File. GSSTD99.STD Assay Date 06/22/2012 12:00 ID.: Daily Check Sources Det 1-10

	Nuclide	Energy	Halflife	Br.Ratio	d ps/g m
1	Am-241	59.54	4.331E+02 yrs	3 0.35900	13214.43
2	Eu-152	778.90	1.333E+01 yrs	3 0.12940	3907.23
3	Eu-152	1408.08	1.333E+01 yr:	s 0.21000	6340.95

Rec 6-26-12 RSO# 967

1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 404.352.8677 Fax 404.352.2837 www.analyticsinc.com

Analytics

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

91091

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: **ALS** Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4,15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

				`			
Isotope	Half-Life, Days	Activity (Bq)	<u>1</u> 9 1	Ty u _A	pe u _B	υ	Calibration Method*
Eu-152	4.938E+03	3.024E+04		0.1	1.7	3.5	IC
Am-241	1.580E+05	3.686E+04		0.1	1.7	3.5	4n LS

Calibration Methods: 411 LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC -Ionization Chamber. Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by:

chemist

QA Approved:

ANA Form005 Rev. ---

J.D. McCorvey, Counting Room Manager

Date:



Multi-Isotope Certificate, Rev 2 04-08-2010

Analytics

Rec 6-26-12 2 RSO # ~

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CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91092

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

	Uncertainty*, %								
Isotope	Half-Life, Davs	Activity (Bq)	Ту	-	77	Calibration Method*			
			u _A	uB	0	Metilod.			
Eu-152	4.938E+03	2.993E+04	0.1	1.7	3.5	IC			
Am-241	1.580E+05	3.649E+04	0.1	1.7	3.5	4π LS			

Calibration Methods: 4 II LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC -Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1207, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by:

QA Approved:

ANA Form005 Rev.

ardley, Radiochemist J.D. McCorvey, Counting Room Manager

18 JUN 12 Date:

OUNCE CALIBRATON LABORATON

Multi-Isotope Certificate, Rev 2 04-08-2010

Eckert & Ziegler

Rec 6-24-12

RYO# 969

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Analytics

CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91093

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date:	6/22/2012	12:00 PM EST					
Isotope	Half-L Day		Activity (Bq)	Unce Ty u _A	rtainty pe u _B	v*,% U	Calibration Method*
Eu-152 Am-241	4.938E 1.580E		994E+04 650E+04	0.1 0.1	1.7 1.7	3.5 3.5	IC 4π LS

Calibration Methods: 4π LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

ANA Form005 Rev.

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by: K. Eardley, Radiochemist QA Approved: J.D. McCorvey, Counting Room Manager Date: 18 JUN IL



Multi-Isotope Certificate, Rev 2 04-08-2010

Rec le-26-13

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Atlanta, Georgia 30318 Tel 404•352•8677 Fax 404•352•2837

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Analytics

CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91094

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer:	ALS Laboratory Group
P.O. No.:	CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

	Uncertainty* , %								
Isotope	Half-Life, Days	Activity (Bq)	Ty u _A	pe u _B	U	Calibration Method*			
Eu-152	4.938E+03	3.001E+04	0.1	1.7	3.5	IC	×		
Am-241	1.580E+05	3.659E+04	0.1	1.7	3.5	4π LS			

Calibration Methods: 411 LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC -Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

ANA Form005 Rev.

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by: K Eardley, Radiochemist QA Approved: J.D. McCorvey, Counting Room Manager Date: <u>18 JUN 12</u>



Multi-Isotope Certificate, Rev 2 04-08-2010

Rec 6-26-12

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Analytics

CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91095

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

Isotope	Half-Life, Days	Activity (Bq)	Ty u _A	pe u _B	U	Calibration Method*
Eu-152	4.938E+03	3.008E+04	0.1	1.7	3.5	IC
Am-241	1.580E+05	3.667E+04	0.1	1.7	3.5	4π LS

Calibration Methods: 4n LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC -Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by:

dley, Radiochemist

QA Approved:

J.D. McCorvey, Counting Room Manager

Date: 18 JUN 12

CONCECTION

Multi-Isotope Certificate, Rev 2 04-08-2010

fre la-26-12

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Analytics

CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91096

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

	Uncertainty*, %							
	Half-Life,	Activity	Туре			Calibration		
Isotope	Days	(Bq)	u _A	uB	U	Method*		
Eu-152	4.938E+03	2.989E+04	0.1	1.7	3.5	IC		
Am-241	1.580E+05	3.643E+04	0.1	1.7	3.5	4π LS		

Calibration Methods: 4π LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

ANA Form005 Rev

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by: ardley, Radiochemist JUNIO QA Approved: Date: J.D. McCorvey, Counting Room Manager



Multi-Isotope Certificate, Rev 2 04-08-2010

Rec 6-26-12 RUO# 973

1380 Seaboard Industrial Blvd.

Atlanta, Georgia 30318

www.analyticsinc.com

Tel 404·352·8677 Fax 404·352·2837

Analytics

CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91097

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

	Half-Life.	*,%	Calibration			
Isotope	Days	Activity (Bq)	Tyj u _A	uB	U	Method*
Eu-152	4.938E+03	3.000E+04	0.1	1.7	3.5	IC
Am-241	1.580E+05	3.657E+04	0.1	1.7	3.5	4π LS

Calibration Methods: 4π IS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC - Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by:

QA Approved:

ANA Form005 Rev.

J.D. McCorvey, Counting Room Manager

Date: 18JUN17



Multi-Isotope Certificate, Rev 2 04-08-2010



Rec 6-26-12 Rue 974

1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 404•352•8677 Fax 404•352•2837 www.analyticsinc.com

Analytics

CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91098

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

	Uncertainty* , %								
Isotope	Half-Life, Days	Activity (Bq)	Ty u _A	pe u _B	U	Calibration Method*			
Eu-152	4.938E+03	3.074E+04	0.1	1.7	3.5	IC			
Am-241	1.580E+05	3.747E+04	0.1	1.7	3.5	4π LS			

Calibration Methods: 4π LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC -Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by:

K. Eardley, Radiochemist

Date:



Multi-Isotope Certificate, Rev 2 04-08-2010

QA Approved:

1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 404•352•8677 Fax 404•352•2837 www.analyticsinc.com

Analytics

CERTIFICATE OF CALIBRATION

Rec 6-26-12

R50# 975

Standard Radionuclide Source

91099

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

	Half-Life,	Activity	Unce: Ty	rtainty pe	*,%	Calibration	
Isotope	Days	(Bq)	u _A	uB	U	Method*	
Eu-152	4.938E+03	3.058E+04	0.1	1.7	3.5	IC	
Am-241	1.580E+05	3.728E+04	0.1	1.7	3.5	4π LS	

Calibration Methods: 4n LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC -Ionization Chamber. **Uncertainty:** U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1207, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities< 0.1%. Diameter of active area: 5 mm.

Source Prepared by:

QA Approved:

ardley, Radiochemist J.D. McCorvey, Counting Room Manager

Date:



Multi-Isotope Certificate, Rev 2 04-08-2010

JUNIZ

Rec 6-26-12

Analytics

R50# 976

1380 Seaboard Industrial Blvd. Atlanta, Georgia 30318 Tel 404-352-8677 Fax 404.352.2837 www.analyticsinc.com

CERTIFICATE OF CALIBRATION Standard Radionuclide Source

91100

Eu-152 + Am-241 25.4 mm Diameter x 6 mm Thick Button

Customer: ALS Laboratory Group P.O. No.: CEP12NAALS339, Item1

This standard radionuclide source was prepared gravimetrically from calibrated master solutions. Radionuclide calibration and purity were checked by germanium gamma-ray spectrometry, liquid scintillation counting, and/or alpha spectrometry, as applicable. The nuclear decay rate and reference date for this source are given below. Eckert & Ziegler Analytics (EZA) maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Revision 2, July 2007, and compliance with ANSI N42.22-1995, "Traceability of Radioactive Sources to NIST." EZA is accredited by the Health Physics Society (HPS) for the production of NIST-traceable sources, and this source was produced in accordance with the HPS accreditation requirements. Customers may report any concerns with the accreditation program to the HPS Secretariat, 1313 Dolley Madison Blvd., Ste. 402, McLean, VA 22101.

Reference Date: 6/22/2012 12:00 PM EST

	Half-Life,	Activity	Unce Ty	-	*,%	Calibration
Isotope	Days	(Bq)	uA	uB	U	Method*
Eu-152	4.938E+03	3.054E+04	0.1	1.7	3.5	IC
Am-241	1.580E+05	3.723E+04	0.1	1.7	3.5	4π LS

Calibration Methods: 411 LS - 4 pi Liquid Scintillation Counting, HPGe - High Purity Germanium Gamma-Ray Spectrometer, IC -Ionization Chamber. Uncertainty: U - Relative expanded uncertainty, k = 2. See NIST Technical Note 1297, "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results."

Comments:

Impurities: γ -impurities < 0.1%. Diameter of active area: 5 mm.

Source Prepared by:

dlev. Radiochemist

QA Approved:

J.D. McCorvey, Counting Room Manager

18 JUN17 Date:



Multi-Isotope Certificate, Rev 2 04-08-2010

Gamma Spectrometer Calibration Log

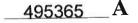
Date: 710200

Reviewed By/Date:

		Backg	round		Source (Check	Repeat Source Check			
Det. No.	Out Of Service	Started	ОК	Started	OK	Failed Parameter(s)	ОК	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				(\mathcal{M})	(n)	,				
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3.				(n)	\mathcal{D}					
4.				10-		1408Cart	()		Can top	
5.				()	TP					
6.	R			1						
7.	U.			100	TR					
8.	m									
9.	1 Ch	1								
10.				P	T					

.** Corrective Action:

*** Due to detector ______ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ______ is online for the date of ______



Form 754r16a.doc (10/27/11)

ID: DAILY CHECK

Detector # 1 Detector Q.C. Analysis for 07/10/2021 08:01:27 Standards File #: 99 (Daily Check Sources Det 1-10)

		n	Sigma	Bounds	T -
#	Parameter	Value	Test	Test	Test
1	60 keV Centroid	122.798	N.A.	Pass	N.A.
2	60 kev FWHM	9.344E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.921E-03	N.A.	Pass	N.A.
16	779 keV Centroid	1558.562	N.A.	Pass	N.A.
17	779 kev FWHM	1.687	N.A.	Pass	N.A.
18 -	779 keV Efficiency	1.696E-02	N.A.	Pass	N.A.
19	1408 keV Centroid	2813.982	N.A.	Pass	N.A.
20	1408 keV FWHM	2.342	N.A.	Pass	N.A.
21	1408 keV Efficiency	7.058E-03	N.A.	Pass	N.A.

210791D02.SPC Analyzed by

ID: DAILY CHECK

Detector # 2 Detector Q.C. Analysis for 07/10/2021 08:01:37 Standards File #: 99 (Daily Check Sources Det 1-10)

#	Parameter	n Value	Sigma Test	Bounds Test	T- Test
1	60 keV Centroid	121.667	N.A.	Pass	N.A.
2	60 kev FWHM	7.588E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	4.304E-03	N.A.	Pass	N.A.
17	779 keV Centroid	1556.963	N.A.	Pass	N.A.
19	779 kev FWHM	1.457	N.A.	Pass	N.A.
20	779 keV Efficiency	2.701E-02	N.A.	Pass	N.A.
21	1408 keV Centroid	2811.987	N.A.	<fail></fail>	N.A.
22	1408 keV FWHM	1.980	N.A.	Pass	N.A.
23	1408 keV Efficiency	1.156E-02	N.A.	Pass	N.A.

21	2D02.SPC Analyzed by	
SEEKER	DETECTOR Q.C. ANALYSIS Version 2.2.2	
*******	***************************************	****

ID: DAILY CHECK

Detector # 2 Detector Q.C. Analysis for 07/10/2021 08:10:22 Standards File #: 99 (Daily Check Sources Det 1-10)

#	Parameter	n Value	Sigma Test	Bounds Test	T- Test	
1	60 keV Centroid	121.692	N.A.	Pass	 N.A.	
2	60 kev FWHM	7.578E-01	N.A.	Pass	N.A.	
3	60 keV Efficiency	4.350E-03	N.A.	Pass	N.A.	
17	779 keV Centroid	1557.658	N.A.	Pass	N.A.	
19	779 kev FWHM	1.401	N.A.	Pass	N.A.	
20	779 keV Efficiency	2.592E-02	N.A.	Pass	N.A.	
21	1408 keV Centroid	2813.363	N.A.	Pass	N.A.	
22	1408 kev FWHM	1.940	N.A.	Pass	N.A.	
23	1408 keV Efficiency	1.076E-02	N.A.	Pass	N.A.	

Gamma Spectrometer Calibration Log

Date: 711 M

Reviewed By/Date: P7111201

		Background		Source Check		Repeat Source Check				
Det. No.	Out Of Service	Started	ок	Started	ОК	Failed Parameter(s)	ОК	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				\Box	(p)			1		
2.	* .	2		D	M					
3.		- A			VI					
4.	н т., 1			R	2	1408 Cent	(\mathcal{D})		Cannola,	
5.		-		Uh	JP					
6.				6	0					
7.				K/h	K					
8.		2		\square					· ·	
9.			,	\square						
10.	۵.	4		M						

.** Corrective Action:

*** Due to detector ______ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector ______ is online for the date of ______



Form 754r16a.doc (10/27/11)

210797D01.SPC Analyzed by SEEKER DETECTOR Q.C. ANALYSIS Version 2.2.2

ID: DAILY CHECK

Detector # 1 Detector Q.C. Analysis for 07/11/2021 12:01:59 Standards File #: 99 (Daily Check Sources Det 1-10)

		n	Sigma	Bounds	Т-
#	Parameter	Value	Test	Test	Test
1	60 keV Centroid	122.759	N.A.	Pass	N.A.
2	60 kev FWHM	8.159E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.895E-03	N.A.	Pass	N.A.
16	779 keV Centroid	1558.813	N.A.	Pass	N.A.
17	779 kev FWHM	1.798	N.A.	Pass	N.A.
18	779 keV Efficiency	1.846E-02	N.A.	Pass	N.A.
19	1408 keV Centroid	2814.500	N.A.	Pass	N.A.
20	1408 keV FWHM	2.459	N.A.	Pass	N.A.
21	1408 keV Efficiency	7.078E-03	N.A.	Pass	N.A.

210803D02.SPC Analyzed by

ID: DAILY CHECK

Detector # 2 Detector Q.C. Analysis for 07/11/2021 12:08:06 Standards File #: 99 (Daily Check Sources Det 1-10)

#	Parameter	n Value	Sigma Test	Bounds Test	T- Test
1	60 keV Centroid	121.756	N.A.	Pass	N.A.
2	60 keV FWHM	7.289E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	4.307E-03	N.A.	Pass	N.A.
17	779 keV Centroid	1558.200	N.A.	Pass	N.A.
19	779 kev FWHM	1.433	N.A.	Pass	N.A.
20	779 keV Efficiency	2.662E-02	N.A.	Pass	N.A.
21	1408 keV Centroid	2814.362	N.A.	Pass	N.A.
22	1408 keV FWHM	1.946	N.A.	Pass	N.A.
23	1408 keV Efficiency	1.118E-02	N.A.	Pass	N.A.

Gamma Spectrometer Calibration Log

Date: 7/12/2(

Reviewed By/Date: TS 7/12/21

		Backg	round	Source Check			Repeat Source Check			
Det. No.	Out Of Service	Started	ОК	Started	ок	Failed Parameter(s)	ОК	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
. 1.				13	TS					
2.				TS	15					
3.	Y	1		TS	TS	-				
4.				15	/	1908 Cent	TS		Gain Adi	
5.				15	TS					
6.	-15				/					
7.				TS	TS					
8.	TS			/						
9.	73			1	/					
10.	л. — "Д			TS		-				1

.** Corrective Action:

*** Due to detector _____ failing two different QC parameters on the first and second daily check, a third daily check was performed. All QC parameters passed for the third daily check. Detector _____ is only for the date of ______

495368 A

Form 754r16a.doc (10/2//11)

171 of 173

210800D01.SPC Analyzed by

ID: DAILY CHECK

Detector # 1 Detector Q.C. Analysis for 07/12/2021 07:28:46 Standards File #: 99 (Daily Check Sources Det 1-10)

#	Parameter	n Value	Sigma Test	Bounds Test	T- Test
1	60 keV Centroid	122.669	N.A.	Pass	N.A.
2	60 keV FWHM	8.789E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	1.911E-03	N.A.	Pass	N.A.
16	779 keV Centroid	1558.729	N.A.	Pass	N.A.
17	779 kev FWHM	1.733	N.A.	Pass	N.A.
18	779 keV Efficiency	1.733E-02	N.A.	Pass	N.A.
19	1408 keV Centroid	2814.337	N.A.	Pass	N.A.
20	1408 kev FWHM	2.474	N.A.	Pass	N.A.
21	1408 keV Efficiency	7.310E-03	N.A.	Pass	N.A.

Q.C. Results Saved.

210806D02.SPC Analyzed by

ID: DAILY CHECK

Detector # 2 Detector Q.C. Analysis for 07/12/2021 07:28:54 Standards File #: 99 (Daily Check Sources Det 1-10)

#	Parameter	n Value	Sigma Test	Bounds Test	T- Test
1	60 keV Centroid	121.626	N.A.	Pass	N.A.
2	60 kev FWHM	7.749E-01	N.A.	Pass	N.A.
3	60 keV Efficiency	4.407E-03	N.A.	Pass	N.A.
17	779 keV Centroid	1558.178	N.A.	Pass	N.A.
19	779 kev FWHM	1.437	N.A.	Pass	N.A.
20	779 keV Efficiency	2.676E-02	N.A.	Pass	N.A.
21	1408 keV Centroid	2814.270	N.A.	Pass	N.A.
22	1408 keV FWHM	1.988	N.A.	Pass	N.A.
23	1408 keV Efficiency	1.129E-02	N.A.	Pass	N.A.

Q.C. Results Saved.