

ANALYTICAL REPORT

Job Number: 160-17842-1

Job Description: Hill AFB and Cabrera - Hill AFB WR111

For:

EA Engineering, Science, and Technology
7995 E. Prentice Ave, Suite 206E
Greenwood Village, CO 80111

Attention: Pamela J Moss



Approved for release.
Jessica H DeHerrera
Project Manager I
7/13/2016 5:16 PM

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07/13/2016

The test results in this report relate only to the samples in this report and meet all requirements of NELAP, with any exceptions noted. Pursuant to NELAP, this report shall not be reproduced except in full, without the written approval of the laboratory. All questions regarding this report should be directed to the TestAmerica Denver Project Manager.

The Lab Certification ID# is 4025.

Reporting limits are adjusted for sample size used, dilutions and moisture content if applicable.

TestAmerica Laboratories, Inc.

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Definitions/Glossary

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Qualifiers

Rad

Qualifier	Qualifier Description
U	Undetected at the Limit of Detection.

Glossary

Abbreviation	These commonly used abbreviations may or may not be present in this report.
α	Listed under the "D" column to designate that the result is reported on a dry weight basis
%R	Percent Recovery
CFL	Contains Free Liquid
CNF	Contains no Free Liquid
DER	Duplicate error ratio (normalized absolute difference)
Dil Fac	Dilution Factor
DL, RA, RE, IN	Indicates a Dilution, Re-analysis, Re-extraction, or additional Initial metals/anion analysis of the sample
DLC	Decision level concentration
MDA	Minimum detectable activity
EDL	Estimated Detection Limit
MDC	Minimum detectable concentration
MDL	Method Detection Limit
ML	Minimum Level (Dioxin)
NC	Not Calculated
ND	Not detected at the reporting limit (or MDL or EDL if shown)
PQL	Practical Quantitation Limit
QC	Quality Control
RER	Relative error ratio
RL	Reporting Limit or Requested Limit (Radiochemistry)
RPD	Relative Percent Difference, a measure of the relative difference between two points
TEF	Toxicity Equivalent Factor (Dioxin)
TEQ	Toxicity Equivalent Quotient (Dioxin)

CASE NARRATIVE
Client: EA Engineering, Science, and Technology
Project: Hill AFB and Cabrera - Hill AFB WR111
Report Number: 160-17842-1

With the exceptions noted as flags or footnotes, standard analytical protocols were followed in the analysis of the samples and no problems were encountered or anomalies observed. In addition all laboratory quality control samples were within established control limits, with any exceptions noted below. Each sample was analyzed to achieve the lowest possible reporting limit within the constraints of the method. In some cases, due to interference or analytes present at high concentrations, samples were diluted. For diluted samples, the reporting limits are adjusted relative to the dilution required.

Calculations are performed before rounding to avoid round-off errors in calculated results.

All holding times were met and proper preservation noted for the methods performed on these samples, unless otherwise detailed in the individual sections below.

RECEIPT

The samples were received on 06/17/2016; the samples arrived in good condition. The temperature of the cooler at receipt was 18.0° C. Thermal preservation is not required for the requested analyses. Corrective action is deemed unnecessary.

Custody seals were not present on the cooler at time of sample receipt. The cooler was received taped shut and the cooler did not appear to be tampered with. The client was notified on 6/20/16.

RADIUM-226 & OTHER GAMMA EMITTERS (GS)

Sample WR111-REF-018-SS-P-00 (160-17842-1) was analyzed for Radium-226 & Other Gamma Emitters (GS) in accordance with EPA 901.1. The samples were leached on 06/17/2016, prepared on 06/21/2016 and analyzed on 07/12/2016.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

DRY AND GRIND

Sample WR111-REF-018-SS-P-00 (160-17842-1) was analyzed for Dry and Grind in accordance with Dry and Grind. The samples were leached on 06/17/2016, prepared on 06/22/2016 and analyzed on 07/08/2016.

Thorium-230 was detected in method blank MB 160-257496/1-A at a level that was above the method detection limit but below the reporting limit. The value should be considered an estimate, and has been flagged "J". However, because the result concentration was less than ½ the reporting limit, no corrective action was necessary.

No additional analytical or quality issues were noted, other than those described above or in the Definitions/Glossary page.

Detection Summary

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Client Sample ID: WR111-REF-018-SS-P-00

Lab Sample ID: 160-17842-1

 No Detections.

This Detection Summary does not include radiochemical test results.

TestAmerica St. Louis

Client Sample Results

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Client Sample ID: WR111-REF-018-SS-P-00

Lab Sample ID: 160-17842-1

Date Collected: 06/15/16 13:10

Matrix: Solid

Date Received: 06/17/16 10:50

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	1.49		0.269	0.310	0.500	0.243	pCi/g	06/21/16 13:11	07/12/16 12:20	1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Analyte	Result	Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-230	1.78		0.219	0.265	0.100	0.0370	pCi/g	06/22/16 10:40	07/08/16 12:38	1
Thorium-232	1.64		0.209	0.251	0.100	0.0200	pCi/g	06/22/16 10:40	07/08/16 12:38	1
Tracer	%Yield	Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	64.0		30 - 110					06/22/16 10:40	07/08/16 12:38	1

Tracer/Carrier Summary

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Matrix: Solid

Prep Type: Total/NA

		Percent Yield (Acceptance Limits)						
Lab Sample ID	Client Sample ID	Th-229 (30-110)						
160-17842-1	WR111-REF-018-SS-P-00	64.0						
LCS 160-257496/2-A	Lab Control Sample	80.5						
MB 160-257496/1-A	Method Blank	89.2						
Tracer/Carrier Legend								
Th-229 = Thorium-229								

QC Sample Results

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Method: 901.1 - Radium-226 & Other Gamma Emitters (GS)

Lab Sample ID: MB 160-257318/1-A
Matrix: Solid
Analysis Batch: 260174

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 257318

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Radium-226	0.009406	U	0.0172	0.0173	0.500	0.284	pCi/g	06/21/16 13:11	07/12/16 10:01	1

Lab Sample ID: LCS 160-257318/2-A
Matrix: Solid
Analysis Batch: 260175

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 257318

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	%Rec	%Rec. Limits
Americium-241	97.1	99.51		10.4		1.13	pCi/g	102	87 - 116
Cesium-137	29.6	29.46		3.14		0.226	pCi/g	100	87 - 120
Cobalt-60	16.9	16.65		1.72		0.0983	pCi/g	98	87 - 115

Method: A-01-R - Isotopic Thorium (Alpha Spectrometry)

Lab Sample ID: MB 160-257496/1-A
Matrix: Solid
Analysis Batch: 260076

Client Sample ID: Method Blank
Prep Type: Total/NA
Prep Batch: 257496

Analyte	MB Result	MB Qualifier	Count Uncert. (2σ+/-)	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	Prepared	Analyzed	Dil Fac
Thorium-230	0.06090		0.0366	0.0369	0.100	0.0289	pCi/g	06/22/16 10:40	07/11/16 19:29	1
Thorium-232	-0.001174	U	0.00319	0.00319	0.100	0.0253	pCi/g	06/22/16 10:40	07/11/16 19:29	1
Tracer	MB %Yield	MB Qualifier	Limits					Prepared	Analyzed	Dil Fac
Thorium-229	89.2		30 - 110					06/22/16 10:40	07/11/16 19:29	1

Lab Sample ID: LCS 160-257496/2-A
Matrix: Solid
Analysis Batch: 259861

Client Sample ID: Lab Control Sample
Prep Type: Total/NA
Prep Batch: 257496

Analyte	Spike Added	LCS Result	LCS Qual	Total Uncert. (2σ+/-)	LOQ	MDC	Unit	%Rec	%Rec. Limits
Thorium-230	24.5	28.50		2.63	0.100	0.0315	pCi/g	116	81 - 118
Tracer	LCS %Yield	LCS Qualifier	Limits						
Thorium-229	80.5		30 - 110						

QC Association Summary

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Rad

Leach Batch: 256923

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-17842-1	WR111-REF-018-SS-P-00	Total/NA	Solid	Dry and Grind	

Prep Batch: 257318

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-17842-1	WR111-REF-018-SS-P-00	Total/NA	Solid	Fill_Geo-21	256923
LCS 160-257318/2-A	Lab Control Sample	Total/NA	Solid	Fill_Geo-21	
MB 160-257318/1-A	Method Blank	Total/NA	Solid	Fill_Geo-21	

Prep Batch: 257496

Lab Sample ID	Client Sample ID	Prep Type	Matrix	Method	Prep Batch
160-17842-1	WR111-REF-018-SS-P-00	Total/NA	Solid	ExtChrom	256923
LCS 160-257496/2-A	Lab Control Sample	Total/NA	Solid	ExtChrom	
MB 160-257496/1-A	Method Blank	Total/NA	Solid	ExtChrom	

Lab Chronicle

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Client Sample ID: WR111-REF-018-SS-P-00

Lab Sample ID: 160-17842-1

Date Collected: 06/15/16 13:10

Matrix: Solid

Date Received: 06/17/16 10:50

Prep Type	Batch Type	Batch Method	Run	Dilution Factor	Batch Number	Prepared or Analyzed	Analyst	Lab
Total/NA	Leach	Dry and Grind			256923	06/17/16 15:02	DRO	TAL SL
Total/NA	Prep	Fill_Geo-21			257318	06/21/16 13:11	R1S	TAL SL
Total/NA	Analysis	901.1		1	260176	07/12/16 12:20	RTM	TAL SL
Total/NA	Leach	Dry and Grind			256923	06/17/16 15:02	DRO	TAL SL
Total/NA	Prep	ExtChrom			257496	06/22/16 10:40	SCB	TAL SL
Total/NA	Analysis	A-01-R		1	259885	07/08/16 12:38	ALD	TAL SL

Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Certification Summary

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Laboratory: TestAmerica St. Louis

All certifications held by this laboratory are listed. Not all certifications are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
Alaska	State Program	10	MO00054	06-30-17
California	State Program	9	2886	03-31-18
Connecticut	State Program	1	PH-0241	03-31-17
Florida	NELAP	4	E87689	06-30-17
Illinois	NELAP	5	003757	11-30-16
Iowa	State Program	7	373	12-01-16
Kansas	NELAP	7	E-10236	07-31-16 *
Kentucky (DW)	State Program	4	90125	12-31-16
L-A-B	DoD ELAP		L2305	04-06-19
Louisiana	NELAP	6	04080	06-30-17
Louisiana (DW)	NELAP	6	LA160008	12-31-16
Maryland	State Program	3	310	09-30-16 *
Missouri	State Program	7	780	06-30-17
Nevada	State Program	9	MO000542016-1	07-31-16 *
New Jersey	NELAP	2	MO002	06-30-17
New York	NELAP	2	11616	03-31-17
North Dakota	State Program	8	R207	06-30-16 *
NRC	NRC		24-24817-01	12-31-22
Oklahoma	State Program	6	9997	08-31-16 *
Pennsylvania	NELAP	3	68-00540	02-28-17 *
South Carolina	State Program	4	85002001	06-30-16 *
Texas	NELAP	6	T104704193-15-9	07-31-16 *
USDA	Federal		P330-07-00122	01-09-17
Utah	NELAP	8	MO000542015-7	07-31-16 *
Virginia	NELAP	3	460230	06-14-17
Washington	State Program	10	C592	08-30-16 *
West Virginia DEP	State Program	3	381	08-31-16 *

Laboratory: TestAmerica Denver

The certifications listed below are applicable to this report.

Authority	Program	EPA Region	Certification ID	Expiration Date
A2LA	DoD ELAP		2907.01	10-31-17
Utah	NELAP	8	CO00026	07-31-16

* Certification renewal pending - certification considered valid.

TestAmerica St. Louis

Method Summary

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Method	Method Description	Protocol	Laboratory
901.1	Radium-226 & Other Gamma Emitters (GS)	EPA	TAL SL
A-01-R	Isotopic Thorium (Alpha Spectrometry)	DOE	TAL SL

Protocol References:

DOE = U.S. Department of Energy

EPA = US Environmental Protection Agency

Laboratory References:

TAL SL = TestAmerica St. Louis, 13715 Rider Trail North, Earth City, MO 63045, TEL (314)298-8566

Sample Summary

Client: EA Engineering, Science, and Technology
Project/Site: Hill AFB and Cabrera - Hill AFB WR111

TestAmerica Job ID: 160-17842-1

Lab Sample ID	Client Sample ID	Matrix	Collected	Received
160-17842-1	WR111-REF-018-SS-P-00	Solid	06/15/16 13:10	06/17/16 10:50

REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica St. Louis Job No.: 160-17842-1

SDG No.: _____

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
82232-334_00001	06/03/60	Eckert & Ziegler, Lot 82232-334			(Purchased Reagent)		Americium-241	7.281 Bq
							Pu-239	7.137 Bq
							Thorium-230	7.63 Bq
82233-334_00001	06/03/60	Eckert & Zigler, Lot 82233-334			(Purchased Reagent)		Americium-241	5.114 Bq
							Pu-239	6.064 Bq
							Thorium-230	4.95 Bq
82234-334_00001	06/02/60	Eckert & Zigler, Lot 82234-334			(Purchased Reagent)		Americium-241	5.652 Bq
							Pu-239	5.936 Bq
							Thorium-230	5.685 Bq
82237-334_00003						Pulser		
						U		
82242-334_00001						Pulser		
						U		
82245-334_00001	06/09/60	Eckert & Ziegler, Lot 82245-334			(Purchased Reagent)		Americium-241	5.528 Bq
							Pu-239	5.437 Bq
							Thorium-230	6.727 Bq
Source E_00001	04/01/59	02/23/11	water, Lot 79670-334	1.0205 g	Gamma Ampuole_00001	1.0205 g	Americium-241	9442.9 Bq
							Cd-109	132909 Bq
							Ce-139	4453.8 Bq
							Cesium-137	3729.6 Bq
							Co-57	2951.3 Bq
							Cobalt-60	6200.2 Bq
							Hg-203	9699.6 Bq
							Sn-113	7626.6 Bq
							Y-88	12712 Bq
.Gamma Ampuole_00001	04/07/59	Analytics, Lot 79670-334			(Purchased Reagent)		Americium-241	9442.9 Bq
							Cd-109	132909 Bq
							Ce-139	4453.8 Bq
							Cesium-137	3729.6 Bq
							Co-57	2951.3 Bq
							Cobalt-60	6200.2 Bq
							Hg-203	9699.6 Bq
							Sn-113	7626.6 Bq
							Y-88	12712 Bq
Source G_00001	01/01/61	01/01/11	water, Lot 83725-334	10 mL	Gamma Ampuole_00003	1.8639 g	Americium-241	1693.09 Bq
							Cd-109	24592.1 Bq
							Ce-139	816.481 Bq
							Cesium-137	681.815 Bq
							Co-57	532.386 Bq
							Cobalt-60	1120.87 Bq
							Hg-203	1766.08 Bq
							Sn-113	1445.98 Bq
							Y-88	2359.21 Bq
.Gamma Ampuole_00003	01/19/61	Analytics, Lot 83725-334			(Purchased Reagent)		Americium-241	9083.6 Bq
							Cd-109	131939 Bq

REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica St. Louis Job No.: 160-17842-1

SDG No.: _____

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
							Ce-139	4380.5 Bq
							Cesium-137	3658 Bq
							Co-57	2856.3 Bq
							Cobalt-60	6013.6 Bq
							Hg-203	9475.2 Bq
							Sn-113	7757.8 Bq
							Y-88	12657.4 Bq
Source H_00002	01/01/51	01/01/12	wataer, Lot 83725-334	10 mL	Gamma Ampuole_00003	2.1184 g	Americium-241	1924.27 Bq
							Cd-109	27950 Bq
							Ce-139	927.965 Bq
							Cesium-137	774.911 Bq
							Co-57	605.079 Bq
							Cobalt-60	1273.92 Bq
							Hg-203	2007.23 Bq
							Sn-113	1643.41 Bq
.Gamma Ampuole_00003	01/19/61		Analytics, Lot 83725-334		(Purchased Reagent)		Y-88	2681.34 Bq
							Americium-241	9083.6 Bq
							Cd-109	131939 Bq
							Ce-139	4380.5 Bq
							Cesium-137	3658 Bq
							Co-57	2856.3 Bq
							Cobalt-60	6013.6 Bq
							Hg-203	9475.2 Bq
Th-229_00020	08/05/16	07/16/15	0.1M HNO3, Lot n/a	500 mL	Th-229_00017	15 mL	Sn-113	7757.8 Bq
							Y-88	12657.4 Bq
							At-217	67.2296 dpm/mL
							Thorium-229	67.2296 dpm/mL
							At-217	2240.99 dpm/mL
							Thorium-229	2240.99 dpm/mL
							At-217	740.127 Bq/g
							Thorium-229	740.127 Bq/g
.Th-229_00017	08/05/16	08/20/14	0.1M HNO3, Lot n/a	100 mL	Th-229_00016	5.0464 g	At-217	2240.99 dpm/mL
							Thorium-229	2240.99 dpm/mL
							At-217	740.127 Bq/g
							Thorium-229	740.127 Bq/g
							At-217	740.127 Bq/g
							Thorium-229	740.127 Bq/g
							At-217	740.127 Bq/g
							Thorium-229	740.127 Bq/g
..Th-229_00016	08/06/64		Analytics, Lot 97790		(Purchased Reagent)		Pb-210	22.1 pCi/g
							Radium-226	25.4 pCi/g
							Thorium-230	24.5 pCi/g
							U-234	6.2 pCi/g
							U-238	6 pCi/g
							Americium-241	219 dpm/g
							Cesium-137	82.3 dpm/g
							Cobalt-60	136 dpm/g
TRM-2_00001	03/20/50		DOE, Lot TRM-2		(Purchased Reagent)		Americium-241	1164 Bq
							Cd-109	16063 Bq
							Ce-139	546 Bq
							Cesium-137	465 Bq
Tuna Can LCS_00005	10/29/16		Analytics, Lot 74139-334		(Purchased Reagent)		Americium-241	1164 Bq
							Cd-109	16063 Bq
							Ce-139	546 Bq
							Cesium-137	465 Bq
Tuna Can_00002	02/03/15		Eckert & Ziegler, Lot 81427-334		(Purchased Reagent)		Americium-241	1164 Bq
							Cd-109	16063 Bq
							Ce-139	546 Bq
							Cesium-137	465 Bq

REAGENT TRACEABILITY SUMMARY

Lab Name: TestAmerica St. Louis Job No.: 160-17842-1

SDG No.: _____

Reagent ID	Exp Date	Prep Date	Dilutant Used	Reagent Final Volume	Parent Reagent		Analyte	Concentration
					Reagent ID	Volume Added		
							Co-57	357 Bq
							Cobalt-60	742 Bq
							Hg-203	1208 Bq
							Pb-210	15186 Bq
							Sn-113	943 Bq
							Y-88	1571 Bq
Tuna Can_00003	02/09/17	Eckert & Ziegler, Lot 90099			(Purchased Reagent)		Americium-241	1164 Bq
							Cd-109	16373 Bq
							Ce-139	549 Bq
							Cesium-137	467 Bq
							Co-57	362 Bq
							Cobalt-60	735 Bq
							Hg-203	1171 Bq
							Pb-210	14936 Bq
							Sn-113	967 Bq
Tuna Can_00006	03/01/16	Eckert & Ziegler, Lot 83814-334			(Purchased Reagent)		Y-88	1590 Bq
							Americium-241	1195 Bq
							Cd-109	16353 Bq
							Ce-139	543 Bq
							Cesium-137	453 Bq
							Co-57	354 Bq
							Cobalt-60	745 Bq
							Hg-203	1175 Bq
							Pb-210	14606 Bq
							Sn-113	961 Bq
							Y-88	1568 Bq

ALPHA SPECTROSCOPY

Method A-01-R Th

Isotopic Thorium (Alpha
Spectrometry) by Method A-01-R

Prep Batch: 257496

Preparation, Extraction
Chromatography Resin Actinide
Separation

Alpha Spectroscopy Analysis Detail Report

Prep Batch: 257496

Lab ID: MB 160-257496/1-A
 Client ID:
 Sigma: 2

Analyzed: 07/11/16 19:29
 Detector: AV191
 Dil Fac: 1

Decay Corrected: No
 Yield Truncated: No
 Ts: 400

Analyte	MB Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	0.06090	0.0366	0.0369		pCi/g	0.100	0.0289	260076	
Thorium-232	-0.001174	0.00319	0.00319	U	pCi/g	0.100	0.0253	260076	
Tracer	MB Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	2.700	0.225	0.319		pCi/g	0.0254	3.03	89.2	30 - 110

Lab ID: LCS 160-257496/2-A
 Client ID:
 Sigma: 2

Analyzed: 07/08/16 12:38
 Detector: AV148
 Dil Fac: 1

Decay Corrected: No
 Yield Truncated: No
 Ts: 400

Analyte	LCS Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	28.50	1.09	2.63		pCi/g	0.100	0.0315	259861	
Tracer	LCS Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	4.865	0.406	0.576		pCi/g	0.0555	6.05	80.5	30 - 110

Lab ID: 160-17842-1
 Client ID: WR111-REF-018-SS-P-00
 Sigma: 2

Analyzed: 07/08/16 12:38
 Detector: AV175
 Dil Fac: 1

Decay Corrected: No
 Yield Truncated: No
 Ts: 400

Analyte	Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch	
Thorium-230	1.78	0.219	0.265		pCi/g	0.100	0.0370	259885	
Thorium-232	1.64	0.209	0.251		pCi/g	0.100	0.0200	259885	
Tracer	Result	Count Unc	Total Unc	Qualifier	Unit	MDC	Spike Added	% Rec	% Rec Limits
Thorium-229	1.94	0.183	0.245		pCi/g	0.0346	3.03	64.0	30 - 110

Quality Control Summary

Method Blank ID:	Analyte	Parent Result	Spike Added	MB Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
MB 160-257496/1-A	Thorium-230			0.06090		pCi/g							3.297107
MB 160-257496/1-A	Thorium-232			-0.001174	U	pCi/g							-.73545843
Lab Control Sample ID:	Analyte	Parent Result	Spike Added	LCS Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
LCS 160-257496/2-A	Thorium-230		24.5	28.50		pCi/g	116	81 - 118					2.3089291026

Glossary:
 Ts = Count Duration, Sample

ALPHA SPECTROSCOPY BATCH WORKSHEET

Lab Name: TestAmerica St. Louis Job No.: 160-17842-1

SDG No.: _____

Batch Number: 257496 Batch Start Date: 06/22/16 10:40 Batch Analyst: Bernsen, Sarah CBatch Method: ExtChrom Batch End Date: 07/07/16 08:53

Lab Sample ID	Client Sample ID	Method Chain	Basis	InitialAmount	Th-229 00020	TRM-2 00001	AnalysisComment		
MB 160-257496/1		ExtChrom, A-01-R		1.0 g	0.1 mL				
LCS 160-257496/2		ExtChrom, A-01-R		0.5009 g	0.1 mL	0.5009 g	TRM		
160-17842-A-1-A	WR111-REF-018-SS -P-00	ExtChrom, A-01-R	T	0.9982 g	0.1 mL				

Batch Notes	
Balance ID	27050421
Analyst ID - Column	nmn
Column Date	7/5/16
Analyst ID - CoPrecipitation	nmn
CoPrecipitation Date	7/7/16
Pipette ID	rad097
Analyst ID - Reagent Drop Witness	rjs per nmn
Analyst ID - Reagent Drop	sek
SOP Number	st rc 0003 st rc 0004 st rc0100 st rc 0242

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

Run Logs

Alpha Spectroscopy Run Log

Detector: AV148

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/16/15 16:27	140	IC 160-223445/1		223445			PS
10/26/15 19:10	60	ICV 160-223563/1		223563			PS
06/24/16 16:15	960	ICB 160-258037/1		258037			PS
06/27/16 10:48	60	CCV 160-258276/1		258276			PS
07/08/16 08:48	1	PULSER 160-259861/1		259861			ALD
07/08/16 12:38	400	LCS 160-257496/2-A		259861	257496	A-01-R	ALD

Detector: AV175

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/17/15 14:48	140	IC 160-223472/1		223472			PS
10/31/15 14:14	60	ICV 160-223590/1		223590			
10/31/15 17:26	60	ICV 160-223590/2		223590			PS
06/24/16 16:15	960	ICB 160-258064/1		258064			PS
06/27/16 13:55	60	CCV 160-258301/1		258301			PS
07/08/16 08:47	1	PULSER 160-259885/1		259885			ALD
07/08/16 12:38	400	160-17842-1	WR111-REF-018-SS-P-01	259885	257496	A-01-R	ALD

Detector: AV191

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/17/15 18:13	140	IC 160-223488/1		223488			PS
11/01/15 14:23	60	ICV 160-223606/1		223606			
11/01/15 18:11	60	ICV 160-223606/2		223606			PS
06/26/16 17:10	960	ICB 160-258139/1		258139			PS
06/28/16 09:29	60	CCV 160-258354/1		258354			PS
07/11/16 09:24	1	PULSER 160-260076/1		260076			ALD
07/11/16 11:38	240	ZZZZZ		260076			
07/11/16 19:29	400	MB 160-257496/1-A		260076	257496	A-01-R	ALD

Detector: AV194

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/17/15 18:13	140	IC 160-223491/1		223491			PS
11/01/15 14:24	60	ICV 160-223609/1		223609			PS
06/24/16 16:15	960	ICB 160-258075/1		258075			PS
06/27/16 13:49	60	CCV 160-258306/1		258306			PS
07/11/16 09:24	1	PULSER 160-260077/1		260077			ALD
07/11/16 11:38	240	ZZZZZ		260077			
07/11/16 19:29	400	ZZZZZ		260077			

GAMMA SPECTROSCOPY

Method 901.1

Ra-226

Radium-226 & Other Gamma Emitters
(GS) by Method 901.1

Prep Batch: 257318

Fill Geometry, 21-Day In-Growth

Gamma Spectroscopy Analysis Detail Report

Prep Batch: 257318

Lab ID: MB 160-257318/1-A Analyzed: 07/12/16 10:01 Ts: 30 Sigma: 2
Client ID: Detector: GV12 Decay Corrected: No

Analyte	MB Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch
Radium-226	0.009406	0.0172	0.0173	U	pCi/g	0.500	0.284	260174

Lab ID: LCS 160-257318/2-A Analyzed: 07/12/16 09:59 Ts: 30 Sigma: 2
Client ID: Detector: GV16 Decay Corrected: No

Analyte	LCS Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch
Americium-241	99.51	1.56	10.4		pCi/g		1.13	260175
Cesium-137	29.46	0.673	3.14		pCi/g		0.226	260175
Cobalt-60	16.65	0.409	1.72		pCi/g		0.0983	260175

Lab ID: 160-17842-1 Analyzed: 07/12/16 12:20 Ts: 30 Sigma: 2
Client ID: WR111-REF-018-SS-P-00 Detector: GV14 Decay Corrected: No

Analyte	Result	Count Unc	Total Unc	Qualifier	Unit	LOQ	MDC	Anly Batch
Radium-226	1.49	0.269	0.310		pCi/g	0.500	0.243	260176

Quality Control Summary

Method Blank ID:	Analyte	Parent Result	Spike Added	MB Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
MB 160-257318/1-A	Radium-226			0.009406	U	pCi/g							1.089641 66
Lab Control Sample ID:	Analyte	Parent Result	Spike Added	LCS Result	Qualifier	Unit	% Rec	% Rec Limits	RPD	RER	DER	RER Limit	Z Factor
LCS 160-257318/2-A	Americium-241		97.1	99.51		pCi/g	102	87 - 116					.3286939 377
LCS 160-257318/2-A	Cesium-137		29.6	29.46		pCi/g	100	87 - 120					-.0594747 997
LCS 160-257318/2-A	Cobalt-60		16.9	16.65		pCi/g	98	87 - 115					-.2306063 569

Glossary:

Ts = Count Duration, Sample

GAMMA SPECTROSCOPY BATCH WORKSHEET

Lab Name: TestAmerica St. Louis Job No.: 160-17842-1

SDG No.: _____

Batch Number: 257318 Batch Start Date: 06/21/16 13:11 Batch Analyst: Sloan, Robert 1Batch Method: Fill_Geo-21 Batch End Date: 06/21/16 15:00

Lab Sample ID	Client Sample ID	Method Chain	Basis	TareWeight	GrossWeight	InitialAmount	IngDecDate1	IngDecDate3	Geometry
MB 160-257318/1		Fill_Geo-21, 901.1				291.18 g	6/21/2016	7/12/2016	Tuna Can
LCS 160-257318/2		Fill_Geo-21, 901.1				341.9 g	6/21/2016	7/12/2016	Tuna Can
160-17842-A-1-A	WR111-REF-018-SS -P-00	Fill_Geo-21, 901.1	T	46.6 g	302.6 g	256 g	6/21/2016	7/12/2016	Tuna Can

Lab Sample ID	Client Sample ID	Method Chain	Basis	Tuna Can LCS 00005					
MB 160-257318/1		Fill_Geo-21, 901.1							
LCS 160-257318/2		Fill_Geo-21, 901.1		# g					
160-17842-A-1-A	WR111-REF-018-SS -P-00	Fill_Geo-21, 901.1	T						

Batch Notes	
Balance ID	1121432711
SOP Number	ST-RC-0003 ST-RC-0025

Basis	Basis Description
T	Total/NA

The pound sign (#) in the amount added field denotes that the reagent was used undiluted. All calculations are performed using the stated concentration for this reagent.

Run Logs

Gamma Spectroscopy Run Log

Detector: GV12

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
10/02/12 10:16		IC 160-13156/1		13156			JLW
10/04/12 09:10		ICV 160-13156/2		13156			JLW
01/28/16 13:28		ACVTOP 160-235885/1		235885			PS
07/09/16 18:02		ICB 160-259826/1		259826			RTM
07/12/16 01:06		CCV 160-260174/1		260174			
07/12/16 01:32		CCV 160-260174/2		260174			RTM
07/12/16 02:06		CCB 160-260174/3		260174			RTM
07/12/16 08:13	30	ZZZZZ		260174			
07/12/16 08:50	30	ZZZZZ		260174			
07/12/16 09:28	30	ZZZZZ		260174			
07/12/16 10:01	30	MB 160-257318/1-A		260174	257318	901.1	RTM
07/12/16 10:43	30	ZZZZZ		260174			
07/12/16 11:32	30	ZZZZZ		260174			
07/12/16 12:21	30	ZZZZZ		260174			
07/12/16 12:55		ZZZZZ		260174			
07/12/16 13:34	30	ZZZZZ		260174			
07/12/16 14:13	30	ZZZZZ		260174			
07/12/16 14:54	30	ZZZZZ		260174			
07/12/16 15:28	30	ZZZZZ		260174			
07/12/16 16:07	30	ZZZZZ		260174			
07/12/16 17:11	30	ZZZZZ		260174			
07/12/16 17:56	30	ZZZZZ		260174			
07/12/16 18:56	30	ZZZZZ		260174			
07/12/16 20:04	30	ZZZZZ		260174			
07/12/16 21:30	30	ZZZZZ		260174			
07/12/16 22:08	30	ZZZZZ		260174			
07/12/16 22:45	30	ZZZZZ		260174			
07/12/16 23:17	120	ZZZZZ		260174			

Detector: GV14

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
04/23/12 09:56		IC 160-12359/1		12359			JLW
04/24/12 08:12		ICV 160-12359/2		12359			JLW
01/25/16 12:29		ACVTOP 160-235877/1		235877			PS
07/09/16 18:21		ICB 160-259830/1		259830			RTM
07/12/16 01:04		CCB 160-260176/1		260176			RTM
07/12/16 02:04		CCV 160-260176/2		260176			
07/12/16 02:26		CCV 160-260176/3		260176			RTM
07/12/16 08:09	30	ZZZZZ		260176			
07/12/16 08:42	30	ZZZZZ		260176			
07/12/16 09:24	30	ZZZZZ		260176			
07/12/16 10:00	30	ZZZZZ		260176			
07/12/16 10:40	30	ZZZZZ		260176			
07/12/16 11:32	30	ZZZZZ		260176			
07/12/16 12:20	30	160-17842-1	WR111-REF-018-SS-P-01	260176	257318	901.1	RTM
07/12/16 12:56	30	ZZZZZ		260176			
07/12/16 13:35	30	ZZZZZ		260176			
07/12/16 14:15	30	ZZZZZ		260176			
07/12/16 14:55	30	ZZZZZ		260176			
07/12/16 15:29	30	ZZZZZ		260176			
07/12/16 16:06	30	ZZZZZ		260176			
07/12/16 17:05	30	ZZZZZ		260176			

Gamma Spectroscopy Run Log

Detector: GV14 (Continued)

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
07/12/16 17:51	30	ZZZZZ		260176			
07/12/16 18:43	30	ZZZZZ		260176			
07/12/16 19:52	30	ZZZZZ		260176			
07/12/16 21:29	30	ZZZZZ		260176			
07/12/16 22:09	30	ZZZZZ		260176			
07/12/16 22:43	30	ZZZZZ		260176			
07/12/16 23:18	120	ZZZZZ		260176			

Detector: GV16

Analysis Date	Count Minutes	Lab Sample ID	Client Sample ID	Analysis Batch	Prep Batch	Method	Analyst Initials
07/10/12 10:35		IC 160-12382/1		12382			JLW
07/17/12 11:27		ICV 160-12382/2		12382			JLW
01/22/16 10:56		ACVTOP 160-235879/1		235879			PS
07/09/16 18:23		ICB 160-259831/1		259831			RTM
07/12/16 01:05		CCB 160-260175/1		260175			RTM
07/12/16 02:06		CCV 160-260175/2		260175			
07/12/16 02:28		CCV 160-260175/3		260175			RTM
07/12/16 08:10	30	ZZZZZ		260175			
07/12/16 08:41	30	ZZZZZ		260175			
07/12/16 09:25	30	ZZZZZ		260175			
07/12/16 09:59	30	LCS 160-257318/2-A		260175	257318	901.1	RTM
07/12/16 10:41		ZZZZZ		260175			
07/12/16 12:20	30	ZZZZZ		260175			
07/12/16 12:56	30	ZZZZZ		260175			
07/12/16 13:35	30	ZZZZZ		260175			
07/12/16 14:14	30	ZZZZZ		260175			
07/12/16 14:56	30	ZZZZZ		260175			
07/12/16 15:30	30	ZZZZZ		260175			
07/12/16 16:05	30	ZZZZZ		260175			
07/12/16 17:06	30	ZZZZZ		260175			
07/12/16 17:50	30	ZZZZZ		260175			
07/12/16 18:44	30	ZZZZZ		260175			
07/12/16 21:34	30	ZZZZZ		260175			
07/12/16 22:10	30	ZZZZZ		260175			
07/12/16 22:45	30	ZZZZZ		260175			
07/12/16 23:19	30	ZZZZZ		260175			
07/12/16 23:55	30	ZZZZZ		260175			

Shipping and Receiving Documents

Login Sample Receipt Checklist

Client: EA Engineering, Science, and Technology

Job Number: 160-17842-1

Login Number: 17842

List Source: TestAmerica St. Louis

List Number: 1

Creator: Daniels, Brian J

Question	Answer	Comment
Radioactivity wasn't checked or is \leq background as measured by a survey meter.	True	
The cooler's custody seal, if present, is intact.	N/A	
Sample custody seals, if present, are intact.	N/A	
The cooler or samples do not appear to have been compromised or tampered with.	True	
Samples were received on ice.	False	
Cooler Temperature is acceptable.	True	
Cooler Temperature is recorded.	True	
COC is present.	True	
COC is filled out in ink and legible.	True	
COC is filled out with all pertinent information.	True	
Is the Field Sampler's name present on COC?	False	
There are no discrepancies between the containers received and the COC.	True	
Samples are received within Holding Time (excluding tests with immediate HTs)	True	
Sample containers have legible labels.	True	
Containers are not broken or leaking.	True	
Sample collection date/times are provided.	True	
Appropriate sample containers are used.	True	
Sample bottles are completely filled.	True	
Sample Preservation Verified.	True	
There is sufficient vol. for all requested analyses, incl. any requested MS/MSDs	True	
Containers requiring zero headspace have no headspace or bubble is $<6\text{mm}$ (1/4").	N/A	
Multiphasic samples are not present.	True	
Samples do not require splitting or compositing.	True	
Residual Chlorine Checked.	N/A	