

APPENDIX B

PRE-DESIGN STUDIES

APPENDIX B1

LABORATORY TEST REPORTS

APPENDIX B1.1

ANALYTICAL TEST RESULTS

ENERGY LABORATORIES

ANALYTICAL SUMMARY REPORT

December 05, 2013

Montgomery Watson Harza
1475 Pine Grove Rd Ste 109
Steamboat Springs, CO 80477

Workorder No.: C13110839

Project Name: NECR-PDS

Energy Laboratories, Inc. Casper WY received the following 2 samples for Montgomery Watson Harza on 11/20/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C13110839-001	TPH-01	11/12/13 16:08	11/20/13	Soil	Metals, TCLP Extractable Cyanide, Reactive Filterability Flashpoint pH corrosivity Digestion, Total Metals Corrosivity pH prep Reactivity preparation Sulfide, Reactive Mercury by CVAA, TCLP TCLP Extraction, Non-volatiles
C13110839-002	TPH-02	11/13/13 17:28	11/20/13	Soil	Same As Above

The results as reported relate only to the item(s) submitted for testing. The analyses presented in this report were performed at Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601, unless otherwise noted. Radiochemistry analyses were performed at Energy Laboratories, Inc., 2325 Kerzell Lane, Casper, WY 82601, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

If you have any questions regarding these test results, please call.

Report Approved By:



Report Proofing Specialist

Digitally signed by
Sheri M. Mead
Date: 2013.12.05 11:12:23 -07:00

CLIENT: Montgomery Watson Harza
Project: NECR-PDS
Sample Delivery Group: C13110839

Report Date: 12/05/13

CASE NARRATIVE

BRANCH LABORATORY SUBCONTRACT ANALYSIS

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

PREP COMMENTS

The prep hold time for reactive sulfide and cyanide was exceeded by up to 2.67 days.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Project: NECR-PDS
Lab ID: C13110839-001
Client Sample ID: TPH-01

Report Date: 12/05/13
Collection Date: 11/12/13 16:08
Date Received: 11/20/13
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Filterable	No					SW1311	11/21/13 08:48 / rw
PHYSICAL PROPERTIES							
Corrosivity - pH	7.74	s.u.		0.01		SW9045D	11/21/13 11:59 / rw
Flash Point (Ignitability)	> 140	°F		60	140	SW1010A	12/03/13 09:14 / bah
- Flashpoint has been corrected for barometric pressure.							
REACTIVITY							
Sulfide, Reactive	ND	mg/kg		20.0	500	SW846 Ch 7	11/22/13 13:49 / tmm
Cyanide, Reactive	ND	mg/kg		0.050	250	SW846 Ch 7	11/25/13 11:18 / eli-b
METALS - TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.2	5	SW6010B	11/25/13 17:45 / sf
Barium	ND	mg/L		1	100	SW6010B	11/25/13 17:45 / sf
Cadmium	ND	mg/L		0.1	1	SW6010B	11/25/13 17:45 / sf
Chromium	ND	mg/L		0.2	5	SW6010B	11/25/13 17:45 / sf
Lead	ND	mg/L		0.2	5	SW6010B	11/25/13 17:45 / sf
Mercury	ND	mg/L		0.02	0.2	SW7470A	11/21/13 16:42 / kja
Selenium	ND	mg/L		0.1	1	SW6010B	11/25/13 17:45 / sf
Silver	ND	mg/L		0.02	5	SW6010B	11/25/13 17:45 / sf

Report RL - Analyte reporting limit.
Definitions: QCL - Quality control limit.

MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Project: NECR-PDS
Lab ID: C13110839-002
Client Sample ID: TPH-02

Report Date: 12/05/13
Collection Date: 11/13/13 17:28
Date Received: 11/20/13
Matrix: Soil

Analyses	Result	Units	Qualifiers	RL	MCL/ QCL	Method	Analysis Date / By
PHYSICAL CHARACTERISTICS							
Filterable	No					SW1311	11/21/13 08:48 / rw
PHYSICAL PROPERTIES							
Corrosivity - pH	7.81	s.u.		0.01		SW9045D	11/21/13 11:59 / rw
Flash Point (Ignitability)	> 140	°F		60	140	SW1010A	12/03/13 10:50 / bah
- Flashpoint has been corrected for barometric pressure.							
REACTIVITY							
Sulfide, Reactive	ND	mg/kg		20.0	500	SW846 Ch 7	11/22/13 13:53 / tmm
Cyanide, Reactive	ND	mg/kg		0.050	250	SW846 Ch 7	11/25/13 11:21 / eli-b
METALS - TCLP EXTRACTABLE							
Arsenic	ND	mg/L		0.2	5	SW6010B	11/25/13 17:49 / sf
Barium	ND	mg/L		1	100	SW6010B	11/25/13 17:49 / sf
Cadmium	ND	mg/L		0.1	1	SW6010B	11/25/13 17:49 / sf
Chromium	ND	mg/L		0.2	5	SW6010B	11/25/13 17:49 / sf
Lead	ND	mg/L		0.2	5	SW6010B	11/25/13 17:49 / sf
Mercury	ND	mg/L		0.02	0.2	SW7470A	11/21/13 16:43 / kja
Selenium	ND	mg/L		0.1	1	SW6010B	11/25/13 17:49 / sf
Silver	ND	mg/L		0.02	5	SW6010B	11/25/13 17:49 / sf

Report RL - Analyte reporting limit.
Definitions: QCL - Quality control limit.

MCL - Maximum contaminant level.
ND - Not detected at the reporting limit.



QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 12/05/13

Project: NECR-PDS

Work Order: C13110839

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW1010A								Batch: 131203A-FLSHPNT-S		
Sample ID: MBLK1_131203A		Method Blank				Run: PM_FLASHPOINT A_131204A			12/03/13 13:50	
Flash Point (Ignitability)		> 140	°F	60						
- Flashpoint has been corrected for barometric pressure.										
Sample ID: LCS1_131203A		Laboratory Control Sample				Run: PM_FLASHPOINT A_131204A			12/03/13 07:54	
Flash Point (Ignitability)		90.4	°F	60	100	96	104			
- Flashpoint has been corrected for barometric pressure.										

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 12/05/13

Project: NECR-PDS

Work Order: C13110839

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B								Analytical Run: ICP2-C_131125E		
Sample ID: ICV	7	Initial Calibration Verification Standard							11/25/13 13:45	
Arsenic		0.975	mg/L	0.10	98	90	110			
Barium		0.988	mg/L	0.10	99	90	110			
Cadmium		0.491	mg/L	0.010	98	90	110			
Chromium		0.991	mg/L	0.050	99	90	110			
Lead		0.997	mg/L	0.050	100	90	110			
Selenium		1.01	mg/L	0.10	101	90	110			
Silver		0.491	mg/L	0.010	98	90	110			
Sample ID: ICSA	7	Interference Check Sample A							11/25/13 14:32	
Arsenic		-0.00730	mg/L	0.10						
Barium		-0.000400	mg/L	0.10						
Cadmium		0.000900	mg/L	0.010						
Chromium		0.00110	mg/L	0.050						
Lead		-0.0348	mg/L	0.050						
Selenium		0.00100	mg/L	0.10						
Silver		-0.00200	mg/L	0.010						
Sample ID: ICSAB	7	Interference Check Sample AB							11/25/13 14:36	
Arsenic		-0.0202	mg/L	0.10						
Barium		0.517	mg/L	0.10	103	80	120			
Cadmium		0.982	mg/L	0.010	98	80	120			
Chromium		0.500	mg/L	0.050	100	80	120			
Lead		0.977	mg/L	0.050	98	80	120			
Selenium		-0.0154	mg/L	0.10						
Silver		1.08	mg/L	0.010	108	80	120			
Method: SW6010B								Batch: 39855		
Sample ID: MB-39855	7	Method Blank							Run: ICP2-C_131125E 11/25/13 17:29	
Arsenic		ND	mg/L	0.02						
Barium		0.01	mg/L	0.004						
Cadmium		ND	mg/L	0.0009						
Chromium		ND	mg/L	0.006						
Lead		ND	mg/L	0.01						
Selenium		ND	mg/L	0.03						
Silver		ND	mg/L	0.004						
Sample ID: LCS3-39855	7	Laboratory Control Sample							Run: ICP2-C_131125E 11/25/13 17:33	
Arsenic		0.50	mg/L	0.20	100	85	115			
Barium		0.50	mg/L	1.0	97	85	115			
Cadmium		0.25	mg/L	0.10	100	85	115			
Chromium		0.50	mg/L	0.20	100	85	115			
Lead		0.50	mg/L	0.25	100	85	115			
Selenium		0.49	mg/L	0.10	98	85	115			
Silver		0.047	mg/L	0.020	94	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 12/05/13

Project: NECR-PDS

Work Order: C13110839

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 39855
Sample ID: LCSD3-39855	7	Laboratory Control Sample Duplicate				Run: ICP2-C_131125E			11/25/13 17:37	
Arsenic		0.49	mg/L	0.20	98	85	115	2.0	20	
Barium		0.51	mg/L	1.0	99	85	115		20	
Cadmium		0.25	mg/L	0.10	100	85	115	0.5	20	
Chromium		0.50	mg/L	0.20	100	85	115	0.7	20	
Lead		0.51	mg/L	0.25	102	85	115	1.9	20	
Selenium		0.48	mg/L	0.10	96	85	115	2.1	20	
Silver		0.047	mg/L	0.020	94	85	115	0.9	20	
Sample ID: C13110839-002ADIL	7	Serial Dilution				Run: ICP2-C_131125E			11/25/13 17:53	
Arsenic		ND	mg/L	0.20					10	
Barium		0.079	mg/L	1.0					10	N
Cadmium		ND	mg/L	0.10					10	
Chromium		ND	mg/L	0.20					10	
Lead		ND	mg/L	0.25					10	
Selenium		ND	mg/L	0.14					10	
Silver		ND	mg/L	0.020					10	
Sample ID: C13110839-002AMS3	7	Sample Matrix Spike				Run: ICP2-C_131125E			11/25/13 17:57	
Arsenic		0.48	mg/L	0.20	96	75	125			
Barium		0.59	mg/L	1.0	101	75	125			
Cadmium		0.25	mg/L	0.10	101	75	125			
Chromium		0.50	mg/L	0.20	100	75	125			
Lead		0.51	mg/L	0.25	102	75	125			
Selenium		0.49	mg/L	0.10	98	75	125			
Silver		0.048	mg/L	0.020	96	75	125			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

N - The analyte concentration was not sufficiently high to calculate a RPD for the serial dilution test.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 12/05/13

Project: NECR-PDS

Work Order: C13110839

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7470A								Analytical Run: CVAA_C203_131121A		
Sample ID: ICV		Initial Calibration Verification Standard								11/21/13 15:18
Mercury		0.0050	mg/L	0.020	101	90	110			
Method: SW7470A								Batch: 39846		
Sample ID: MB-39846		Method Blank								11/21/13 16:36
Mercury		ND	mg/L	4E-06						
Sample ID: LCS-39846		Laboratory Control Sample								11/21/13 16:38
Mercury		0.0052	mg/L	0.020	104	85	115			
Sample ID: LCSD-39846		Laboratory Control Sample Duplicate								11/21/13 16:40
Mercury		0.0053	mg/L	0.0020	105	85	115	1.7	10	
Sample ID: C13110839-002ADIL		Serial Dilution								11/21/13 16:49
Mercury		ND	mg/L	0.020						20
Sample ID: C13110839-002AMS		Sample Matrix Spike								11/21/13 16:50
Mercury		0.0050	mg/L	0.020	101	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 12/05/13

Project: NECR-PDS

Work Order: C13110839

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW846 Ch 7										Batch: B_76178
Sample ID: C13110898-007C		Sample Matrix Spike				Run: SUB-B215652				11/25/13 10:51
Cyanide, Reactive		0.10	mg/kg	0.050	105	80	120			
Sample ID: C13110898-007C		Sample Matrix Spike Duplicate				Run: SUB-B215652				11/25/13 10:54
Cyanide, Reactive		0.11	mg/kg	0.050	105	80	120	0.7	10	
Sample ID: MB-76178		Method Blank				Run: SUB-B215652				11/25/13 12:39
Cyanide, Reactive		ND	mg/kg	0.05						
Method: SW846 Ch 7										Batch: 39872
Sample ID: MB-39872		Method Blank				Run: TITRATION_131122A				11/22/13 13:05
Sulfide, Reactive		2	mg/kg	1						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.



QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 12/05/13

Project: NECR-PDS

Work Order: C13110839

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW9045D										Batch: 39860
Sample ID: C13110839-002ADUP										
Sample Duplicate		Run: ORION 3 STAR PH_131121A								
Corrosivity - pH		7.79	s.u.	0.010				0.3	10	
Sample ID: LCS1-39860										
Laboratory Control Sample		Run: ORION 3 STAR PH_131121A								
Corrosivity - pH		7.19	s.u.	0.010	101	94.9	104			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

Workorder Receipt Checklist

Montgomery Watson Harza

C13110839

Login completed by: Debra Williams

Date Received: 11/20/2013

Reviewed by: BL2000\khelm

Received by: cav

Reviewed Date: 11/21/2013

Carrier NDA
name:

Shipping container/cooler in good condition?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Not Present <input type="checkbox"/>
Custody seals intact on all shipping container(s)/cooler(s)?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Not Present <input type="checkbox"/>
Custody seals intact on all sample bottles?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Present <input checked="" type="checkbox"/>
Chain of custody present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody signed when relinquished and received?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody agrees with sample labels?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Samples in proper container/bottle?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sample containers intact?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sufficient sample volume for indicated test?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>	Not Applicable <input type="checkbox"/>
Container/Temp Blank temperature:	9.2°C On Ice		
Water - VOA vials have zero headspace?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	No VOA vials submitted <input checked="" type="checkbox"/>
Water - pH acceptable upon receipt?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Applicable <input checked="" type="checkbox"/>

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None



Chain of Custody and Analytical Request Record

Page 1 of 1

PLEASE PRINT (Provide as much information as possible.)

Company Name: MWH		Project Name, PWS, Permit, Etc. WEAR - PDS		Sample Origin State: NM		EPA/State Compliance: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Report Mail Address (Required): topy.leeson@mwhglobal.com		Contact Name: Toby Leeson		Phone/Fax:		Sampler: (Please Print) K. Jensen	
<input type="checkbox"/> No Hard Copy Email:		Invoice Contact & Phone: Toby Leeson		Purchase Order: 970821-4301		Quote/Bottle Order: 41309	
Invoice Address (Required): MWH Broomfield, CO		ANALYSIS REQUESTED Toxicity (TLC Metals) Leachability (1010) Corrosivity (9045/9046) Reactivity (sulfide/cyanide)		Standard Turnaround (TAT) SEE ATTACHED		Contact ELI prior to RUSH sample submittal for charges and scheduling - See Instruction Page	
<input type="checkbox"/> No Hard Copy Email:		Special Report/Formats: <input type="checkbox"/> DW <input type="checkbox"/> POTW/WWTP <input type="checkbox"/> State: <input type="checkbox"/> Other:		Shipped by: USA		Cooler ID(s): C-3530	
SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)		Collection Date		Collection		Receipt Temp 9.2 °C	
1 TPH-01		11/12		11/12		On Ice: <input checked="" type="checkbox"/> N	
2 TPH-02		11/13		11/13		Custody Seal On Bottle <input checked="" type="checkbox"/> Y On Cooler <input checked="" type="checkbox"/> Y	
3						Intact <input checked="" type="checkbox"/> Y N	
4						Signature Match <input checked="" type="checkbox"/> Y N	
5							
6							
7							
8							
9							
10							
Custody Record MUST be Signed		Relinquished by (print): Toby Leeson		Date/Time: 11/13 0721		Signature: [Signature]	
		Relinquished by (print):		Date/Time:		Signature:	
Sample Disposal:		Return to Client:		Received by (print): [Signature]		Date/Time: 11/20/13 9:30	
				Received by (print):		Signature:	
				Received by Laboratory:		Date/Time: 11/20/13 9:30	
				Received by (print):		Signature:	

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.enervia.com for additional information. Downloadable for electronic forms and files.

ANALYTICAL SUMMARY REPORT

January 06, 2014

Montgomery Watson Harza
1475 Pine Grove Rd Ste 109
Steamboat Springs, CO 80477

Workorder No.: C13110898

Quote ID: C4005

Project Name: NECR

Energy Laboratories, Inc. Casper WY received the following 47 samples for Montgomery Watson Harza on 11/21/2013 for analysis.

Sample ID	Client Sample ID	Collect Date	Receive Date	Matrix	Test
C13110898-001	NECR2-CC05-004 [5-8]	10/29/13 17:02	11/21/13	Soil	Gamma Sample Preparation Gross Gamma
C13110898-002	ROAD-CC01-002 [5-10]	10/30/13 10:05	11/21/13	Soil	Same As Above
C13110898-003	ROAD-CC02-001 [0-5]	10/30/13 10:30	11/21/13	Soil	Same As Above
C13110898-004	ROAD-CC03-001 [0-5]	10/30/13 11:13	11/21/13	Soil	Same As Above
C13110898-005	P1-CC11-004 [7.5-10]	11/12/13 13:21	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-006	P1-CC13-002 [5-7.5]	11/12/13 15:56	11/21/13	Soil	Same As Above
C13110898-007	TPH-P1-CC11-005 [10-12.5]	11/12/13 13:42	11/21/13	Soil	Metals by ICP/ICPMS, Total Metals, TCLP Extractable Cyanide, Reactive Filterability Flashpoint pH corrosivity Percent Moisture Digestion, Total Metals Digestion, Total Metals Gamma Sample Preparation Corrosivity pH prep Reactivity preparation Gross Gamma Sulfide, Reactive Mercury by CVAA, TCLP TCLP Extraction, Non-volatiles
C13110898-008	P1-CC08-001 [0-2.5]	11/12/13 9:08	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-009	P1-CC04-002 [2.5-5]	11/11/13 13:46	11/21/13	Soil	Same As Above
C13110898-010	P1-CC07-002 [2.5-5]	11/12/13 8:10	11/21/13	Soil	Same As Above
C13110898-011	SP-CC04-004 [7.5-10]	11/01/13 11:16	11/21/13	Soil	Same As Above
C13110898-012	SP-CC08-001 [0-2.5]	11/04/13 11:00	11/21/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

C13110898-013	TPH-P1-CC12-004 [12.5-15]	11/12/13 14:55	11/21/13	Soil	Metals by ICP/ICPMS, Total Metals, TCLP Extractable Cyanide, Reactive Filterability Flashpoint pH corrosivity Percent Moisture Digestion, Total Metals Digestion, Total Metals Gamma Sample Preparation Corrosivity pH prep Reactivity preparation Gross Gamma Sulfide, Reactive Mercury by CVAA, TCLP TCLP Extraction, Non-volatiles
C13110898-014	SP-CC08-002 [2.5-5]	11/04/13 11:05	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-015	NECR1-CC11-001 [3-5]	11/16/13 13:22	11/21/13	Soil	Gamma Sample Preparation Gross Gamma
C13110898-016	NECR1-CC12-002 [2.5-5]	11/06/13 14:18	11/21/13	Soil	Same As Above
C13110898-017	SP-CC01-001 [0-5]	11/01/13 8:41	11/21/13	Soil	Same As Above
C13110898-018	SP-CC07-002 [2.5-5]	11/04/13 10:17	11/21/13	Soil	Same As Above
C13110898-019	SP-CC11-002 [2.5-4.5]	11/04/13 15:13	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-020	NMSA-CC03-004 [5-7.5]	11/08/13 14:10	11/21/13	Soil	Gamma Sample Preparation Gross Gamma
C13110898-021	P1-CC07-003 [5-7.5]	11/12/13 8:30	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-022	NECR1-CC13-004 [10-12.5]	11/06/13 15:28	11/21/13	Soil	Gamma Sample Preparation Gross Gamma
C13110898-023	P1-CC08-002 [2.5-5]	11/12/13 9:08	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-024	SP-CC10-004 [11-15]	11/04/13 14:24	11/21/13	Soil	Gamma Sample Preparation Gross Gamma
C13110898-025	SP-CC10-005 [15-17.5]	11/04/13 14:35	11/21/13	Soil	Same As Above
C13110898-026	PND3-CC04-002 [5-10]	11/07/13 13:55	11/21/13	Soil	Same As Above
C13110898-027	P1-CC05-003 [5-7]	11/11/13 14:54	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma

ANALYTICAL SUMMARY REPORT

C13110898-028	NECR1-CC10-001 [9.5-15]	10/31/13 14:12	11/21/13	Soil	Gamma Sample Preparation Gross Gamma
C13110898-029	NECR2-CC3-005 [15-20]	10/29/13 14:53	11/21/13	Soil	Same As Above
C13110898-030	NECR1-CC09-001 [5-8.8]	10/31/13 13:26	11/21/13	Soil	Same As Above
C13110898-031	NECR1-CC02:06-BULK	10/31/13 10:25	11/21/13	Soil	Same As Above
C13110898-032	P1-CC01-002 [5-10]	11/06/13 10:40	11/21/13	Soil	Same As Above
C13110898-033	NECR1-CC15-001 [5-10]	11/07/13 9:00	11/21/13	Soil	Same As Above
C13110898-034	P1-CC04-003 [5-7.5]	11/11/13 14:00	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-035	P1-CC16-005 [12.5-15]	11/13/13 13:45	11/21/13	Soil	Gamma Sample Preparation Gross Gamma
C13110898-036	PND3-CC02-002 [5-10]	10/31/13 16:18	11/21/13	Soil	Same As Above
C13110898-037	PND3-CC03-002 [10-20]	10/31/13 17:27	11/21/13	Soil	Same As Above
C13110898-038	SP-CC03-002 [2.5-5]	11/01/13 10:21	11/21/13	Soil	Same As Above
C13110898-039	SP-CC06-002 [2.5-5]	11/04/13 9:32	11/21/13	Soil	Same As Above
C13110898-040	NECR1-CC14-003 [12-15]	11/06/13 16:40	11/21/13	Soil	Same As Above
C13110898-041	P2-CC02-002 [5-10]	11/06/13 9:17	11/21/13	Soil	Same As Above
C13110898-042	P2-CC03-001 [0-5]	11/06/13 9:45	11/21/13	Soil	Same As Above
C13110898-043	NMSA-CC01-002 [5.5-7.5]	11/08/13 10:58	11/21/13	Soil	Same As Above
C13110898-044	SP-CC10-203 [5-7.4]	11/04/13 14:05	11/21/13	Soil	Metals by ICP/ICPMS, Total Percent Moisture Digestion, Total Metals Gamma Sample Preparation Gross Gamma
C13110898-045	TPH-P1-CC11-004 [7.5-10]	11/12/13 13:21	11/21/13	Soil	Metals by ICP/ICPMS, Total Metals, TCLP Extractable Cyanide, Reactive Filterability Flashpoint pH corrosivity Percent Moisture Digestion, Total Metals Digestion, Total Metals Gamma Sample Preparation Corrosivity pH prep Reactivity preparation Gross Gamma Sulfide, Reactive Mercury by CVAA, TCLP TCLP Extraction, Non-volatiles
C13110898-046	TPH-P1-CC13-003 [7.5-10]	11/12/13 16:10	11/21/13	Soil	Same As Above
C13110898-047	TPH-P1-CC10-003 [5-7.5]	11/12/13 11:38	11/21/13	Soil	Same As Above

ANALYTICAL SUMMARY REPORT

The results as reported relate only to the item(s) submitted for testing. The analyses presented in this report were performed at Energy Laboratories, Inc., 2393 Salt Creek Hwy., Casper, WY 82601, unless otherwise noted. Radiochemistry analyses were performed at Energy Laboratories, Inc., 2325 Kerzell Lane, Casper, WY 82601, unless otherwise noted. Any exceptions or problems with the analyses are noted in the Laboratory Analytical Report, the QA/QC Summary Report, or the Case Narrative.

If you have any questions regarding these test results, please call.

Report Approved By:

Stephanie D Waldrop
Reporting Supervisor

Digitally signed by
Stephanie Waldrop
Date: 2014.01.06 11:10:56 -07:00

CLIENT: Montgomery Watson Harza
Project: NECR
Sample Delivery Group: C13110898

Report Date: 01/06/14

CASE NARRATIVE

LEVEL III COMMENTS

Included with the analysis reports are instrument data reports for all analysis associated with the instrument calibration, QC sample analysis, and sample analysis for Gamma results. All analytical data is within method QA/QC specifications except as noted on analyses and/or QC summary reports, or in this narrative. The analytical report identifies which QC batch ID and sequence QC is associated with each analysis result for a sample. The results of this Analytical Report relate only to the items submitted for analysis. Only the raw data associated with parameters listed on this report should be validated.

BRANCH LABORATORY SUBCONTRACT ANALYSIS

Tests associated with analyst identified as ELI-B were subcontracted to Energy Laboratories, 1120 S. 27th St., Billings, MT, EPA Number MT00005.

PREP COMMENTS

The prep hold time for Reactivity was exceeded by up to 2.86 days.



Client: Montgomery Watson Harza
Client Sample ID NECR2-C005-004 [5-8]
Project: NECR
Matrix: Soil

Lab ID: C13110898-001
Collection Date: 10/29/13 17:02
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.7	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 3	39892
Radium 226 precision (±)	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 3	39892
Radium 226 MDC	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 3	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID ROAD-CC01-002 [5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-002
Collection Date: 10/30/13 10:05
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 4	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 4	39892
Radium 226 MDC	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 4	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



Client: Montgomery Watson Harza
Client Sample ID ROAD-CC02-001 [0-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-003
Collection Date: 10/30/13 10:30
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 5	39892
Radium 226 precision (±)	0.4	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 5	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 5	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



Client: Montgomery Watson Harza
Client Sample ID ROAD-CC03-001 [0-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-004
Collection Date: 10/30/13 11:13
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 6	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 6	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 6	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC11-004 [7.5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-005
Collection Date: 11/12/13 13:21
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	38.0	%		0.1		D2974	11/25/13 14:36 / dm			FORIUS CP3202_131126A : 1		131125A-MOIST
METALS - TOTAL												
Uranium	3190	mg/kg-dry		1.0		SW6020	12/03/13 01:51 / cfm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 219		39888
RADIONUCLIDES - GAMMA												
Radium 226	887	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 7		39892
Radium 226 precision (±)	11.9	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 7		39892
Radium 226 MDC	4.8	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 7		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC13-002 [5-7.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-006
Collection Date: 11/12/13 15:56
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	39.0	%		0.1		D2974	11/25/13 14:37 / dm			TORIUS CP3202_131126A : 2		131125A-MOIST
METALS - TOTAL												
Uranium	1330	mg/kg-dry		1.0		SW6020	12/03/13 02:07 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 224		39888
RADIONUCLIDES - GAMMA												
Radium 226	923	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 8		39892
Radium 226 precision (±)	11.7	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 8		39892
Radium 226 MDC	4.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 8		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID TPH-P1-CC11-005 [10-12.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-007
Collection Date: 11/12/13 13:42
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Filterable	No					SW1311	11/27/13 10:15 / rw			ANALYST_131127A : 1		R181268
Moisture	29.2	%		0.1		D2974	11/25/13 14:37 / dm			FORIUS CP3202_131126A : 3		131125A-MOIST
PHYSICAL PROPERTIES												
Corrosivity - pH	7.71	s.u.		0.01		SW9045D	11/26/13 11:07 / dm	11/26/13 08:59	ASA10-3.2 ION 3 STAR PH_131126A : 1			39903
Flash Point (Ignitability)	> 140	°F		60	140	SW1010A	12/03/13 12:16 / bah		FLASHPOINT A_131204A : 3			131203A-FLSHPNT-S
- Flashpoint has been corrected for barometric pressure.												
REACTIVITY												
Sulfide, Reactive	22.0	mg/kg		20.0	500	SW846 Ch 7	11/22/13 14:15 / tm	11/22/13 08:15	SW846 C	TITRATION_131122A : 19		39872
Cyanide, Reactive	ND	mg/kg		0.050	250	SW846 Ch 7	11/25/13 10:48 / eli-	11/25/13 06:38	SUB-B215652 : 16			B_76178
METALS - TOTAL												
Uranium	1310	mg/kg-dry		1.0		SW6020	12/03/13 02:10 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 225		39888
METALS - TCLP EXTRACTABLE												
Arsenic	ND	mg/L		0.2	5	SW6010B	12/03/13 14:17 / sf	12/02/13 08:58	SW3010A	ICP2-C_131203A : 31		39925
Barium	ND	mg/L		1	100	SW6010B	12/03/13 14:17 / sf	12/02/13 08:58	SW3010A	ICP2-C_131203A : 31		39925
Cadmium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:17 / sf	12/02/13 08:58	SW3010A	ICP2-C_131203A : 31		39925
Chromium	ND	mg/L		0.2	5	SW6010B	12/03/13 14:17 / sf	12/02/13 08:58	SW3010A	ICP2-C_131203A : 31		39925
Lead	ND	mg/L		0.2	5	SW6010B	12/03/13 14:17 / sf	12/02/13 08:58	SW3010A	ICP2-C_131203A : 31		39925
Mercury	ND	mg/L		0.02	0.2	SW7470A	12/03/13 14:30 / kja	11/26/13 11:26	SW1311	CVAA_C203_131203A : 30		39907
Selenium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:17 / sf	12/02/13 08:58	SW3010A	ICP2-C_131203A : 31		39925
Silver	ND	mg/L		0.02	5	SW6010B	12/03/13 14:17 / sf	12/02/13 08:58	SW3010A	ICP2-C_131203A : 31		39925
RADIONUCLIDES - GAMMA												
Radium 226	473	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 9		39892
Radium 226 precision (±)	7.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 9		39892
Radium 226 MDC	3.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 9		39892

Report RL - Analyte reporting limit.**Definitions:** MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC08-001 [0-2.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-008
Collection Date: 11/12/13 09:08
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	25.9	%		0.1		D2974	11/25/13 14:37 / dm			FORIUS CP3202_131126A : 4		131125A-MOIST
METALS - TOTAL												
Uranium	434	mg/kg-dry		1.0		SW6020	12/03/13 02:13 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 226		39888
RADIONUCLIDES - GAMMA												
Radium 226	492	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 10		39892
Radium 226 precision (±)	8.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 10		39892
Radium 226 MDC	3.4	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 10		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC04-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-009
Collection Date: 11/11/13 13:46
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	35.7	%		0.1		D2974	11/25/13 14:37 / dm			FORIUS CP3202_131126A : 5		131125A-MOIST
METALS - TOTAL												
Uranium	2110	mg/kg-dry		1.0		SW6020	12/03/13 02:17 / dlm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 227		39888
RADIONUCLIDES - GAMMA												
Radium 226	372	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 11		39892
Radium 226 precision (±)	6.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 11		39892
Radium 226 MDC	2.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 11		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC07-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-010
Collection Date: 11/12/13 08:10
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	19.8	%		0.1		D2974	11/25/13 14:37 / dm			ΓORIUS CP3202_131126A : 6		131125A-MOIST
METALS - TOTAL												
Uranium	209	mg/kg-dry		1.0		SW6020	12/03/13 02:20 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 228		39888
RADIONUCLIDES - GAMMA												
Radium 226	322	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 12		39892
Radium 226 precision (±)	6.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 12		39892
Radium 226 MDC	2.3	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 12		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC04-004 [7.5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-011
Collection Date: 11/01/13 11:16
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	9.2	%		0.1		D2974	11/25/13 14:37 / dm					
METALS - TOTAL												
Uranium	108	mg/kg-dry		1.0		SW6020	12/03/13 02:23 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A	: 229	131125A-MOIST
RADIONUCLIDES - GAMMA												
Radium 226	162	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 14	39892
Radium 226 precision (±)	3.8	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 14	39892
Radium 226 MDC	1.7	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 14	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC08-001 [0-2.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-012
Collection Date: 11/04/13 11:00
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	6.8	%		0.1		D2974	11/25/13 14:38 / dm			FORIUS CP3202_131126A : 8		131125A-MOIST
METALS - TOTAL												
Uranium	231	mg/kg-dry		1.0		SW6020	12/03/13 02:29 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 231		39888
RADIONUCLIDES - GAMMA												
Radium 226	150	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 15		39892
Radium 226 precision (±)	3.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 15		39892
Radium 226 MDC	1.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 15		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID TPH-P1-CC12-004 [12.5-15]
Project: NECR
Matrix: Soil

Lab ID: C13110898-013
Collection Date: 11/12/13 14:55
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Filterable	No					SW1311	11/27/13 10:15 / rw			ANALYST_131127A : 2		R181268
Moisture	35.8	%		0.1		D2974	11/25/13 14:38 / dm			FORIUS CP3202_131126A : 9		131125A-MOIST
PHYSICAL PROPERTIES												
Corrosivity - pH	8.63	s.u.		0.01		SW9045D	11/26/13 11:07 / dm	11/26/13 08:59	ASA10-3.2 ION 3 STAR PH_131126A : 2			39903
Flash Point (Ignitability)	90	°F		60	140	SW1010A	12/03/13 13:39 / bah		FLASHPOINT A_131204A : 4			131203A-FLSHPNT-S
- Flashpoint has been corrected for barometric pressure.												
REACTIVITY												
Sulfide, Reactive	26.0	mg/kg		20.0	500	SW846 Ch 7	11/22/13 14:19 / tm	11/22/13 08:15	SW846 C	TITRATION_131122A : 20		39872
Cyanide, Reactive	ND	mg/kg		0.050	250	SW846 Ch 7	11/25/13 10:56 / eli-	11/25/13 06:38		SUB-B215652 : 17		B_76178
METALS - TOTAL												
Uranium	72.7	mg/kg-dry		1.0		SW6020	12/03/13 02:33 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 232		39888
METALS - TCLP EXTRACTABLE												
Arsenic	ND	mg/L		0.2	5	SW6010B	12/03/13 16:18 / sf	12/02/13 09:01	SW3010A	ICP2-C_131203A : 61		39927
Barium	2	mg/L		1	100	SW6010B	12/03/13 16:18 / sf	12/02/13 09:01	SW3010A	ICP2-C_131203A : 61		39927
Cadmium	ND	mg/L		0.1	1	SW6010B	12/03/13 16:18 / sf	12/02/13 09:01	SW3010A	ICP2-C_131203A : 61		39927
Chromium	ND	mg/L		0.2	5	SW6010B	12/03/13 16:18 / sf	12/02/13 09:01	SW3010A	ICP2-C_131203A : 61		39927
Lead	ND	mg/L		0.2	5	SW6010B	12/03/13 16:18 / sf	12/02/13 09:01	SW3010A	ICP2-C_131203A : 61		39927
Mercury	ND	mg/L		0.02	0.2	SW7470A	11/27/13 14:52 / kja	11/26/13 14:39	SW1311	CVAA_C203_131127A : 37		39912
Selenium	ND	mg/L		0.1	1	SW6010B	12/03/13 16:18 / sf	12/02/13 09:01	SW3010A	ICP2-C_131203A : 61		39927
Silver	ND	mg/L		0.02	5	SW6010B	12/03/13 16:18 / sf	12/02/13 09:01	SW3010A	ICP2-C_131203A : 61		39927
RADIONUCLIDES - GAMMA												
Radium 226	152	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 16		39892
Radium 226 precision (±)	4.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 16		39892
Radium 226 MDC	2.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 16		39892
Report Definitions: RL - Analyte reporting limit. MDC - Minimum detectable concentration												
MCL - Maximum contaminant level.												ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC08-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-014
Collection Date: 11/04/13 11:05
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	6.2	%		0.1		D2974	11/25/13 14:38 / dm			CRIUS CP3202_131126A : 10		131125A-MOIST
METALS - TOTAL												
Uranium	184	mg/kg-dry		1.0		SW6020	12/03/13 02:49 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 237		39888
RADIONUCLIDES - GAMMA												
Radium 226	119	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 17		39892
Radium 226 precision (±)	3.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 17		39892
Radium 226 MDC	1.3	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 17		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID NECR1-CC11-001 [3-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-015
Collection Date: 11/16/13 13:22
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	98.7	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	18	39892
Radium 226 precision (±)	2.9	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	18	39892
Radium 226 MDC	1.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	18	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID: NECR1-CC12-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-016
Collection Date: 11/06/13 14:18
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	147	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 19	39892
Radium 226 precision (±)	3.4	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 19	39892
Radium 226 MDC	1.3	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 19	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC01-001 [0-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-017
Collection Date: 11/01/13 08:41
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	98.9	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 20	39892
Radium 226 precision (±)	3.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 20	39892
Radium 226 MDC	1.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 20	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC07-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-018
Collection Date: 11/04/13 10:17
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	78.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 21	39892
Radium 226 precision (±)	2.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 21	39892
Radium 226 MDC	1.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 21	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC11-002 [2.5-4.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-019
Collection Date: 11/04/13 15:13
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	6.5	%		0.1		D2974	11/25/13 14:38 / dm			CRIUS CP3202_131126A : 11		131125A-MOIST
METALS - TOTAL												
Uranium	206	mg/kg-dry		1.0		SW6020	12/03/13 02:52 / clm	11/25/13 08:40	SW3050B	ICPMS2-C_131202A : 238		39888
RADIONUCLIDES - GAMMA												
Radium 226	118	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 22		39892
Radium 226 precision (±)	3.3	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 22		39892
Radium 226 MDC	1.3	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 22		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID NMSA-CC03-004 [5-7.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-020
Collection Date: 11/08/13 14:10
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	82.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 23	39892
Radium 226 precision (±)	2.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 23	39892
Radium 226 MDC	1.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 23	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC07-003 [5-7.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-021
Collection Date: 11/12/13 08:30
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	18.2	%		0.1		D2974	11/25/13 14:38 / dm			CRIUS CP3202_131126A : 12		131125A-MOIST
METALS - TOTAL												
Uranium	183	mg/kg-dry		1.0		SW6020	12/03/13 03:05 / clm	11/25/13 08:51	SW3050B	ICPMS2-C_131202A : 242		39888
RADIONUCLIDES - GAMMA												
Radium 226	87.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 25		39892
Radium 226 precision (±)	2.7	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 25		39892
Radium 226 MDC	1.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 25		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID NECR1-CC13-004 [10-12.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-022
Collection Date: 11/06/13 15:28
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	60.8	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 26	39892
Radium 226 precision (±)	2.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 26	39892
Radium 226 MDC	0.8	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 26	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC08-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-023
Collection Date: 11/12/13 09:08
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	26.7	%		0.1		D2974	11/25/13 14:38 / dm			CRIUS CP3202_131126A : 13		131125A-MOIST
METALS - TOTAL												
Uranium	70.7	mg/kg-dry		1.0		SW6020	12/03/13 03:08 / clm	11/25/13 08:51	SW3050B	ICPMS2-C_131202A : 243		39888
RADIONUCLIDES - GAMMA												
Radium 226	27.7	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 27		39892
Radium 226 precision (±)	1.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 27		39892
Radium 226 MDC	0.7	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 27		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC10-004 [11-15]
Project: NECR
Matrix: Soil

Lab ID: C13110898-024
Collection Date: 11/04/13 14:24
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	3.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 28	39892
Radium 226 precision (±)	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 28	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 28	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC10-005 [15-17.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-025
Collection Date: 11/04/13 14:35
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 29	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 29	39892
Radium 226 MDC	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 29	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID PND3-CC04-002 [5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-026
Collection Date: 11/07/13 13:55
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	21.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 30	39892
Radium 226 precision (\pm)	1.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 30	39892
Radium 226 MDC	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 30	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC05-003 [5-7]
Project: NECR
Matrix: Soil

Lab ID: C13110898-027
Collection Date: 11/11/13 14:54
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	28.1	%		0.1		D2974	11/25/13 14:39 / dm			CRIUS CP3202_131126A : 14		131125A-MOIST
METALS - TOTAL												
Uranium	174	mg/kg-dry		1.0		SW6020	12/03/13 03:12 / clm	11/25/13 08:51	SW3050B	ICPMS2-C_131202A : 244		39888
RADIONUCLIDES - GAMMA												
Radium 226	23.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 31		39892
Radium 226 precision (±)	1.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 31		39892
Radium 226 MDC	0.9	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 31		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



Client: Montgomery Watson Harza
Client Sample ID NECR1-CC10-001 [9.5-15]
Project: NECR
Matrix: Soil

Lab ID: C13110898-028
Collection Date: 10/31/13 14:12
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	70.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 32	39892
Radium 226 precision (±)	2.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 32	39892
Radium 226 MDC	0.9	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 32	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID NECR2-CC3-005 [15-20]
Project: NECR
Matrix: Soil

Lab ID: C13110898-029
Collection Date: 10/29/13 14:53
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	13.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 33	39892
Radium 226 precision (±)	1.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 33	39892
Radium 226 MDC	0.9	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 33	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID NECR1-CC09-001 [5-8.8]
Project: NECR
Matrix: Soil

Lab ID: C13110898-030
Collection Date: 10/31/13 13:26
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	2.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 34	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 34	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 34	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

Client: Montgomery Watson Harza
Client Sample ID NECR1-CC02:06-BULK
Project: NECR
Matrix: Soil

Lab ID: C13110898-031
Collection Date: 10/31/13 10:25
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	3.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 36	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 36	39892
Radium 226 MDC	0.4	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 36	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC01-002 [5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-032
Collection Date: 11/06/13 10:40
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 37	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 37	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 37	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

Client: Montgomery Watson Harza
Client Sample ID NECR1-CC15-001 [5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-033
Collection Date: 11/07/13 09:00
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	2.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 38	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 38	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 38	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC04-003 [5-7.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-034
Collection Date: 11/11/13 14:00
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	16.2	%		0.1		D2974	11/25/13 14:39 / dm			CRIUS CP3202_131126A : 15		131125A-MOIST
METALS - TOTAL												
Uranium	176	mg/kg-dry		1.0		SW6020	12/03/13 03:15 / clm	11/25/13 08:51	SW3050B	ICPMS2-C_131202A : 245		39888
RADIONUCLIDES - GAMMA												
Radium 226	1.3	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 39		39892
Radium 226 precision (±)	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 39		39892
Radium 226 MDC	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 39		39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P1-CC16-005 [12.5-15]
Project: NECR
Matrix: Soil

Lab ID: C13110898-035
Collection Date: 11/13/13 13:45
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	2.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 40	39892
Radium 226 precision (\pm)	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 40	39892
Radium 226 MDC	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 40	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



Client: Montgomery Watson Harza
Client Sample ID PND3-CC02-002 [5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-036
Collection Date: 10/31/13 16:18
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 41	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 41	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 41	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

Client: Montgomery Watson Harza
Client Sample ID PND3-CC03-002 [10-20]
Project: NECR
Matrix: Soil

Lab ID: C13110898-037
Collection Date: 10/31/13 17:27
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.4	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 42	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 42	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 42	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC03-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-038
Collection Date: 11/01/13 10:21
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	2.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 43	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 43	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 43	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC06-002 [2.5-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-039
Collection Date: 11/04/13 09:32
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	2.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 44	39892
Radium 226 precision (±)	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 44	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 44	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



Client: Montgomery Watson Harza
Client Sample ID NECR1-CC14-003 [12-15]
Project: NECR
Matrix: Soil

Lab ID: C13110898-040
Collection Date: 11/06/13 16:40
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.2	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 45	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 45	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 45	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P2-CC02-002 [5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-041
Collection Date: 11/06/13 09:17
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 47	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 47	39892
Radium 226 MDC	0.6	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	: 47	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.



LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID P2-CC03-001 [0-5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-042
Collection Date: 11/06/13 09:45
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	2.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	48	39892
Radium 226 precision (±)	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	48	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	48	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

Client: Montgomery Watson Harza
Client Sample ID NMSA-CC01-002 [5.5-7.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-043
Collection Date: 11/08/13 10:58
Date Received: 11/21/13
Report Date: 01/06/14

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
RADIONUCLIDES - GAMMA												
Radium 226	1.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	49	39892
Radium 226 precision (±)	0.4	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	49	39892
Radium 226 MDC	0.5	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	49	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID SP-CC10-203 [5-7.4]
Project: NECR
Matrix: Soil

Lab ID: C13110898-044
Collection Date: 11/04/13 14:05
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Moisture	8.7	%		0.1		D2974	11/25/13 14:39 / dm			CRIUS CP3202_131126A	16	131125A-MOIST
METALS - TOTAL												
Uranium	104	mg/kg-dry		1.0		SW6020	11/28/13 05:35 / clm	11/26/13 09:56	SW3050B	ICPMS2-C_131127A	310	39905
RADIONUCLIDES - GAMMA												
Radium 226	144	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	50	39892
Radium 226 precision (±)	3.0	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	50	39892
Radium 226 MDC	1.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A	50	39892

Report Definitions: RL - Analyte reporting limit.
MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID TPH-P1-CC11-004 [7.5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-045
Collection Date: 11/12/13 13:21
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Filterable	No					SW1311	11/27/13 10:15 / rw			ANALYST_131127A : 3		R181268
Moisture	37.3	%		0.1		D2974	11/25/13 14:39 / dm			CRUIUS CP3202_131126A : 17		131125A-MOIST
PHYSICAL PROPERTIES												
Corrosivity - pH	8.02	s.u.	D	0.02		SW9045D	11/26/13 11:07 / dm	11/26/13 08:59	ASA10-3.2 ION 3 STAR PH_131126A : 3			39903
Flash Point (Ignitability)	> 140	°F		60	140	SW1010A	12/04/13 12:04 / dm		FLASHPOINT A_131205A : 3			131204A-FLSHPNT-S
- Flashpoint has been corrected for barometric pressure.												
REACTIVITY												
Sulfide, Reactive	ND	mg/kg		20.0	500	SW846 Ch 7	11/22/13 14:22 / tm	11/22/13 08:15	SW846 C	TITRATION_131122A : 21		39872
Cyanide, Reactive	ND	mg/kg		0.050	250	SW846 Ch 7	11/25/13 10:59 / eli-	11/25/13 06:38	SUB-B215652 : 18			B_76178
METALS - TOTAL												
Uranium	2940	mg/kg-dry		1.0		SW6020	11/28/13 05:38 / clm	11/26/13 09:56	SW3050B	ICPMS2-C_131127A : 311		39905
METALS - TCLP EXTRACTABLE												
Arsenic	ND	mg/L		0.2	5	SW6010B	12/03/13 14:21 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 32		39925
Barium	ND	mg/L		1	100	SW6010B	12/03/13 14:21 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 32		39925
Cadmium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:21 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 32		39925
Chromium	ND	mg/L		0.2	5	SW6010B	12/03/13 14:21 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 32		39925
Lead	ND	mg/L		0.2	5	SW6010B	12/03/13 14:21 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 32		39925
Mercury	ND	mg/L		0.02	0.2	SW7470A	11/27/13 15:06 / kja	11/26/13 11:26	SW1311	CVAA_C203_131127A : 45		39907
Selenium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:21 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 32		39925
Silver	ND	mg/L		0.02	5	SW6010B	12/03/13 14:21 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 32		39925
RADIONUCLIDES - GAMMA												
Radium 226	895	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 51		39892
Radium 226 precision (±)	10.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 51		39892
Radium 226 MDC	4.1	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 51		39892

Report RL - Analyte reporting limit.**Definitions:** MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

D - RL increased due to sample matrix.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID TPH-P1-CC13-003 [7.5-10]
Project: NECR
Matrix: Soil

Lab ID: C13110898-046
Collection Date: 11/12/13 16:10
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Filterable	No					SW1311	11/27/13 10:15 / rw			ANALYST_131127A : 4		R181268
Moisture	29.5	%		0.1		D2974	11/25/13 14:39 / dm			CRUIUS CP3202_131126A : 18		131125A-MOIST
PHYSICAL PROPERTIES												
Corrosivity - pH	7.47	s.u.		0.01		SW9045D	11/26/13 11:07 / dm	11/26/13 08:59	ASA10-3.2 ION 3 STAR PH_131126A : 4			39903
Flash Point (Ignitability)	> 140	°F		60	140	SW1010A	12/04/13 13:30 / dm		FLASHPOINT A_131205A : 4			131204A-FLSHPNT-S
- Flashpoint has been corrected for barometric pressure.												
REACTIVITY												
Sulfide, Reactive	30.0	mg/kg		20.0	500	SW846 Ch 7	11/22/13 14:25 / tm	11/22/13 08:15	SW846 C	TITRATION_131122A : 22		39872
Cyanide, Reactive	ND	mg/kg		0.050	250	SW846 Ch 7	11/25/13 11:12 / eli-	11/25/13 06:38	SUB-B215652 : 19			B_76178
METALS - TOTAL												
Uranium	1090	mg/kg-dry		1.0		SW6020	11/28/13 05:44 / clm	11/26/13 09:56	SW3050B	ICPMS2-C_131127A : 313		39905
METALS - TCLP EXTRACTABLE												
Arsenic	ND	mg/L		0.2	5	SW6010B	12/03/13 14:25 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 33		39925
Barium	ND	mg/L		1	100	SW6010B	12/03/13 14:25 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 33		39925
Cadmium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:25 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 33		39925
Chromium	ND	mg/L		0.2	5	SW6010B	12/03/13 14:25 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 33		39925
Lead	ND	mg/L		0.2	5	SW6010B	12/03/13 14:25 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 33		39925
Mercury	ND	mg/L		0.02	0.2	SW7470A	11/27/13 15:12 / kja	11/26/13 11:26	SW1311	CVAA_C203_131127A : 48		39907
Selenium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:25 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 33		39925
Silver	ND	mg/L		0.02	5	SW6010B	12/03/13 14:25 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 33		39925
RADIONUCLIDES - GAMMA												
Radium 226	592	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 52		39892
Radium 226 precision (±)	7.4	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 52		39892
Radium 226 MDC	2.9	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 52		39892

Report RL - Analyte reporting limit.**Definitions:** MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

LABORATORY ANALYTICAL REPORT

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza
Client Sample ID TPH-P1-CC10-003 [5-7.5]
Project: NECR
Matrix: Soil

Lab ID: C13110898-047
Collection Date: 11/12/13 11:38
Date Received: 11/21/13
Report Date: 01/06/14

Analyses	Result	Units	QUAL	RL	MCL	Method	Analysis Date / By	Prep Date	Prep Method	RunID	Run Order	BatchID
PHYSICAL CHARACTERISTICS												
Filterable	No					SW1311	11/27/13 10:15 / rw			ANALYST_131127A : 5		R181268
Moisture	35.0	%		0.1		D2974	11/25/13 14:39 / dm			CRUIUS CP3202_131126A : 19		131125A-MOIST
PHYSICAL PROPERTIES												
Corrosivity - pH	8.31	s.u.		0.01		SW9045D	11/26/13 11:07 / dm	11/26/13 08:59	ASA10-3.2 ION 3 STAR PH_131126A : 5			39903
Flash Point (Ignitability)	> 140	°F		60	140	SW1010A	12/04/13 14:57 / dm		FLASHPOINT A_131205A : 5			131204A-FLSHPNT-S
- Flashpoint has been corrected for barometric pressure.												
REACTIVITY												
Sulfide, Reactive	ND	mg/kg		20.0	500	SW846 Ch 7	11/22/13 14:31 / tm	11/22/13 08:15	SW846 C	TITRATION_131122A : 23		39872
Cyanide, Reactive	ND	mg/kg		0.050	250	SW846 Ch 7	11/25/13 11:15 / eli-	11/25/13 06:38	SUB-B215652 : 20			B_76178
METALS - TOTAL												
Uranium	197	mg/kg-dry		1.0		SW6020	11/28/13 06:01 / clm	11/26/13 09:56	SW3050B	ICPMS2-C_131127A : 318		39905
METALS - TCLP EXTRACTABLE												
Arsenic	ND	mg/L		0.2	5	SW6010B	12/03/13 14:33 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 35		39925
Barium	ND	mg/L		1	100	SW6010B	12/03/13 14:33 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 35		39925
Cadmium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:33 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 35		39925
Chromium	ND	mg/L		0.2	5	SW6010B	12/03/13 14:33 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 35		39925
Lead	ND	mg/L		0.2	5	SW6010B	12/03/13 14:33 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 35		39925
Mercury	ND	mg/L		0.02	0.2	SW7470A	11/27/13 15:14 / kja	11/26/13 11:26	SW1311	CVAA_C203_131127A : 49		39907
Selenium	ND	mg/L		0.1	1	SW6010B	12/03/13 14:33 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 35		39925
Silver	ND	mg/L		0.02	5	SW6010B	12/03/13 14:33 / sf	12/02/13 08:59	SW3010A	ICP2-C_131203A : 35		39925
RADIONUCLIDES - GAMMA												
Radium 226	211	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 53		39892
Radium 226 precision (±)	4.8	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 53		39892
Radium 226 MDC	1.8	pCi/g-dry				E901.1	12/16/13 08:45 / dpb	11/25/13 14:08	E901.1	GAM-HPGE_131216A : 53		39892

Report RL - Analyte reporting limit.**Definitions:** MDC - Minimum detectable concentration

MCL - Maximum contaminant level.

ND - Not detected at the reporting limit.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: E901.1										Batch: 39892
Sample ID: LCS-R181970	Laboratory Control Sample					Run: GAM-HPGE_131216A				12/16/13 08:45
Bismuth 214		22.1	pCi/g-dry	100		70	130			
- The LCS sample uses Bi214 for Ra226.										
Sample ID: MB-R181970	2	Method Blank				Run: GAM-HPGE_131216A				12/16/13 08:45
Radium 226		ND	pCi/g-dry							U
Radium 226 precision (±)		ND	pCi/g-dry							
Sample ID: C13110898-010ADUP	3	Sample Duplicate				Run: GAM-HPGE_131216A				12/16/13 08:45
Radium 226		322	pCi/g-dry					0.2	20	
Radium 226 precision (±)		6.10	pCi/g-dry							
Radium 226 MDC		2.40	pCi/g-dry							
Sample ID: C13110898-020ADUP	3	Sample Duplicate				Run: GAM-HPGE_131216A				12/16/13 08:45
Radium 226		81.2	pCi/g-dry					1.0	20	
Radium 226 precision (±)		2.60	pCi/g-dry							
Radium 226 MDC		1.20	pCi/g-dry							
Sample ID: C13110898-030ADUP	3	Sample Duplicate				Run: GAM-HPGE_131216A				12/16/13 08:45
Radium 226		2.20	pCi/g-dry					4.7	20	
Radium 226 precision (±)		0.500	pCi/g-dry							
Radium 226 MDC		0.500	pCi/g-dry							
Sample ID: C13110898-040ADUP	3	Sample Duplicate				Run: GAM-HPGE_131216A				12/16/13 08:45
Radium 226		1.30	pCi/g-dry					8.0	20	
Radium 226 precision (±)		0.500	pCi/g-dry							
Radium 226 MDC		0.600	pCi/g-dry							
Sample ID: C13110898-047ADUP	3	Sample Duplicate				Run: GAM-HPGE_131216A				12/16/13 08:45
Radium 226		209	pCi/g-dry					0.8	20	
Radium 226 precision (±)		4.70	pCi/g-dry							
Radium 226 MDC		2.00	pCi/g-dry							
Sample ID: LCS-R181970	Laboratory Control Sample					Run: GAM-HPGE_131216A				12/16/13 08:45
Bismuth 214		8.85	pCi/g-dry	102		70	130			
- The LCS sample uses Bi214 for Ra226.										
Sample ID: MB-R181970	2	Method Blank				Run: GAM-HPGE_131216A				12/16/13 08:45
Radium 226		ND	pCi/g-dry							U
Radium 226 precision (±)		ND	pCi/g-dry							

Qualifiers:

RL - Analyte reporting limit.

MDC - Minimum detectable concentration

ND - Not detected at the reporting limit.

U - Not detected at minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW1010A									Batch: 131203A-FLSHPNT-S	
Sample ID: MBLK1_131203A		Method Blank				Run: PM_FLASHPOINT A_131204A			12/03/13 13:50	
Flash Point (Ignitability)		> 140	°F	60						
- Flashpoint has been corrected for barometric pressure.										
Sample ID: LCS1_131203A		Laboratory Control Sample				Run: PM_FLASHPOINT A_131204A			12/03/13 07:54	
Flash Point (Ignitability)		90.4	°F	60	100	96	104			
- Flashpoint has been corrected for barometric pressure.										
Method: SW1010A									Batch: 131204A-FLSHPNT-S	
Sample ID: MBLK1_131204A		Method Blank				Run: PM_FLASHPOINT A_131205A			12/04/13 08:41	
Flash Point (Ignitability)		> 140	°F	60						
- Flashpoint has been corrected for barometric pressure.										
Sample ID: LCS1_131204A		Laboratory Control Sample				Run: PM_FLASHPOINT A_131205A			12/04/13 08:33	
Flash Point (Ignitability)		90.1	°F	60	100	96	104			
- Flashpoint has been corrected for barometric pressure.										

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B								Analytical Run: ICP2-C_131203A		
Sample ID: ICV	7	Initial Calibration Verification Standard							12/03/13 12:38	
Arsenic		0.967	mg/L	0.10	97	90	110			
Barium		1.02	mg/L	0.10	102	90	110			
Cadmium		0.496	mg/L	0.010	99	90	110			
Chromium		0.998	mg/L	0.050	100	90	110			
Lead		0.998	mg/L	0.050	100	90	110			
Selenium		1.00	mg/L	0.10	100	90	110			
Silver		0.489	mg/L	0.010	98	90	110			
Sample ID: ICSA	7	Interference Check Sample A							12/03/13 13:21	
Arsenic		-0.0139	mg/L	0.10						
Barium		0.00110	mg/L	0.10						
Cadmium		0.00120	mg/L	0.010						
Chromium		0.00250	mg/L	0.050						
Lead		-0.0427	mg/L	0.050						
Selenium		-0.00530	mg/L	0.10						
Silver		-0.00180	mg/L	0.010						
Sample ID: ICSAB	7	Interference Check Sample AB							12/03/13 13:25	
Arsenic		-0.0165	mg/L	0.10						
Barium		0.520	mg/L	0.10	104	80	120			
Cadmium		0.990	mg/L	0.010	99	80	120			
Chromium		0.499	mg/L	0.050	100	80	120			
Lead		0.970	mg/L	0.050	97	80	120			
Selenium		-0.0101	mg/L	0.10						
Silver		1.06	mg/L	0.010	106	80	120			
Method: SW6010B								Batch: 39925		
Sample ID: MB-39925	7	Method Blank							Run: ICP2-C_131203A 12/03/13 14:01	
Arsenic		ND	mg/L	0.02						
Barium		0.02	mg/L	0.004						
Cadmium		ND	mg/L	0.0009						
Chromium		ND	mg/L	0.006						
Lead		ND	mg/L	0.01						
Selenium		ND	mg/L	0.03						
Silver		ND	mg/L	0.004						
Sample ID: LCS3-39925	7	Laboratory Control Sample							Run: ICP2-C_131203A 12/03/13 14:05	
Arsenic		0.49	mg/L	0.20	98	85	115			
Barium		0.53	mg/L	1.0	102	85	115			
Cadmium		0.26	mg/L	0.10	102	85	115			
Chromium		0.51	mg/L	0.20	102	85	115			
Lead		0.52	mg/L	0.25	103	85	115			
Selenium		0.52	mg/L	0.10	104	85	115			
Silver		0.052	mg/L	0.020	104	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 39925
Sample ID: LCSD3-39925	7	Laboratory Control Sample Duplicate				Run: ICP2-C_131203A			12/03/13 14:09	
Arsenic		0.49	mg/L	0.20	98	85	115	0.1	20	
Barium		0.52	mg/L	1.0	99	85	115		20	
Cadmium		0.26	mg/L	0.10	102	85	115	0.0	20	
Chromium		0.51	mg/L	0.20	102	85	115	0.2	20	
Lead		0.52	mg/L	0.25	105	85	115	1.5	20	
Selenium		0.49	mg/L	0.10	98	85	115	5.6	20	
Silver		0.051	mg/L	0.020	101	85	115	2.7	20	
Sample ID: C13110898-047CDIL	7	Serial Dilution				Run: ICP2-C_131203A			12/03/13 14:38	
Arsenic		ND	mg/L	0.20					10	
Barium		0.99	mg/L	1.0					10	
Cadmium		ND	mg/L	0.10					10	
Chromium		ND	mg/L	0.20					10	
Lead		ND	mg/L	0.25					10	
Selenium		ND	mg/L	0.14					10	
Silver		ND	mg/L	0.020					10	
Sample ID: C13110898-047CMS3	7	Sample Matrix Spike				Run: ICP2-C_131203A			12/03/13 15:02	
Arsenic		0.49	mg/L	0.20	99	75	125			
Barium		1.5	mg/L	1.0	103	75	125			
Cadmium		0.25	mg/L	0.10	100	75	125			
Chromium		0.49	mg/L	0.20	99	75	125			
Lead		0.51	mg/L	0.25	103	75	125			
Selenium		0.54	mg/L	0.10	107	75	125			
Silver		0.052	mg/L	0.020	104	75	125			
Method: SW6010B										Batch: 39927
Sample ID: MB-39927	7	Method Blank				Run: ICP2-C_131203A			12/03/13 15:46	
Arsenic		ND	mg/L	0.02						
Barium		0.02	mg/L	0.004						
Cadmium		ND	mg/L	0.0009						
Chromium		ND	mg/L	0.006						
Lead		ND	mg/L	0.01						
Selenium		ND	mg/L	0.03						
Silver		ND	mg/L	0.004						
Sample ID: LCS3-39927	7	Laboratory Control Sample				Run: ICP2-C_131203A			12/03/13 15:50	
Arsenic		0.48	mg/L	0.20	97	85	115			
Barium		0.52	mg/L	1.0	100	85	115			
Cadmium		0.26	mg/L	0.10	102	85	115			
Chromium		0.50	mg/L	0.20	100	85	115			
Lead		0.53	mg/L	0.25	106	85	115			
Selenium		0.50	mg/L	0.10	100	85	115			
Silver		0.047	mg/L	0.020	94	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6010B										Batch: 39927
Sample ID: LCSD3-39927	7	Laboratory Control Sample Duplicate				Run: ICP2-C_131203A			12/03/13 15:54	
Arsenic		0.47	mg/L	0.20	94	85	115	2.6	20	
Barium		0.52	mg/L	1.0	100	85	115		20	
Cadmium		0.25	mg/L	0.10	102	85	115	0.6	20	
Chromium		0.50	mg/L	0.20	100	85	115	0.4	20	
Lead		0.52	mg/L	0.25	105	85	115	0.9	20	
Selenium		0.51	mg/L	0.10	102	85	115	1.9	20	
Silver		0.049	mg/L	0.020	97	85	115	2.9	20	
Sample ID: C13110898-013CMS3	7	Sample Matrix Spike				Run: ICP2-C_131203A			12/03/13 16:22	
Arsenic		0.50	mg/L	0.20	100	75	125			
Barium		2.6	mg/L	1.0		75	125			A
Cadmium		0.25	mg/L	0.10	101	75	125			
Chromium		0.52	mg/L	0.20	100	75	125			
Lead		0.55	mg/L	0.25	103	75	125			
Selenium		0.51	mg/L	0.10	103	75	125			
Silver		0.051	mg/L	0.020	101	75	125			
Sample ID: C13111040-001ADIL	7	Serial Dilution				Run: ICP2-C_131203A			12/03/13 16:34	
Arsenic		ND	mg/L	0.20					10	
Barium		1.5	mg/L	1.0				2.2	10	
Cadmium		0.0060	mg/L	0.10					10	N
Chromium		ND	mg/L	0.20					10	
Lead		ND	mg/L	0.25					10	
Selenium		ND	mg/L	0.14					10	
Silver		ND	mg/L	0.020					10	

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020								Analytical Run: ICPMS2-C_131127A		
Sample ID: ICV	Initial Calibration Verification Standard									11/27/13 13:24
Uranium		0.0507	mg/L	0.00030	101	90	110			
Sample ID: ICSA	Interference Check Sample A									11/27/13 13:27
Uranium		1.49E-05	mg/L	0.00030						
Sample ID: ICSAB	Interference Check Sample AB									11/27/13 13:30
Uranium		4.00E-06	mg/L	0.00030						
Method: SW6020								Batch: 39905		
Sample ID: MB-39905	Method Blank									11/28/13 04:59
Uranium		0.03	mg/kg	0.005						
Sample ID: LCS3-39905	Laboratory Control Sample									11/28/13 05:03
Uranium		130	mg/kg	1.0	126	80	120			S
- Response is above standard QA limit. This could indicate a high bias for the sample results. Since LFB and instrument QC meets criteria, this batch is approved.										
Sample ID: LFB-39905	Laboratory Fortified Blank									11/28/13 05:19
Uranium		27	mg/kg	1.0	110	80	120			
Sample ID: C13100790-001AMS3	Sample Matrix Spike									11/28/13 05:28
Uranium		74	mg/kg-dry	1.0	79	75	125			
Sample ID: C13100790-001AMSD3	Sample Matrix Spike Duplicate									11/28/13 05:31
Uranium		100	mg/kg-dry	1.0	176	75	125	30	20	SR
Sample ID: C13110898-045BDIL	Serial Dilution									11/28/13 05:41
Uranium		2900	mg/kg-dry	1.0				3.0	10	
Sample ID: C13110898-047BMS3	Sample Matrix Spike									11/28/13 06:04
Uranium		220	mg/kg-dry	1.0		75	125			A
Sample ID: C13110898-047BMSD3	Sample Matrix Spike Duplicate									11/28/13 06:07
Uranium		310	mg/kg-dry	1.0		75	125	36	20	AR

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

R - RPD exceeds advisory limit.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

MDC - Minimum detectable concentration

S - Spike recovery outside of advisory limits.

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW6020								Analytical Run: ICPMS2-C_131202A		
Sample ID: ICV	Initial Calibration Verification Standard									12/02/13 14:47
Uranium		0.0490	mg/L	0.00030	98	90	110			
Sample ID: ICSA	Interference Check Sample A									12/02/13 14:23
Uranium		5.30E-06	mg/L	0.00030						
Sample ID: ICSAB	Interference Check Sample AB									12/02/13 14:27
Uranium		ND	mg/L	0.00030						
Method: SW6020								Batch: 39888		
Sample ID: MB-39888	Method Blank									12/03/13 01:38
Uranium		0.02	mg/kg	0.005						
Sample ID: LCS3-39888	Laboratory Control Sample									12/03/13 01:41
Uranium		120	mg/kg	1.0	121	80	120			S
- Response is above standard QA limit. This could indicate a high bias for the sample results. Since LFB and instrument QC meets criteria, this batch is approved.										
Sample ID: LFB-39888	Laboratory Fortified Blank									12/03/13 01:44
Uranium		26	mg/kg	1.0	103	80	120			
Sample ID: C13110898-011BDIL	Serial Dilution									12/03/13 02:26
Uranium		100	mg/kg-dry	1.0				5.9	10	
Sample ID: C13110898-019BMS3	Sample Matrix Spike									12/03/13 02:55
Uranium		200	mg/kg-dry	1.0		75	125			A
Sample ID: C13110898-019BMDS3	Sample Matrix Spike Duplicate									12/03/13 02:59
Uranium		210	mg/kg-dry	1.0		75	125	3.1	20	A

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

S - Spike recovery outside of advisory limits.

A - The analyte level was greater than four times the spike level. In accordance with the method % recovery is not calculated.

MDC - Minimum detectable concentration

QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7470A								Analytical Run: CVAA_C203_131127A		
Sample ID: ICV	Initial Calibration Verification Standard									11/27/13 13:57
Mercury		0.0051	mg/L	0.020	102	90	110			
Method: SW7470A								Batch: 39907		
Sample ID: MB-39907	Method Blank					Run: CVAA_C203_131127A			11/27/13 15:01	
Mercury		ND	mg/L	4E-06						
Sample ID: LCS-39907	Laboratory Control Sample					Run: CVAA_C203_131127A			11/27/13 15:03	
Mercury		0.0054	mg/L	0.020	109	85	115			
Sample ID: LCSD-39907	Laboratory Control Sample Duplicate					Run: CVAA_C203_131127A			11/27/13 15:04	
Mercury		0.0053	mg/L	0.0020	106	85	115	2.9	10	
Sample ID: C13110898-047CDIL	Serial Dilution					Run: CVAA_C203_131127A			11/27/13 15:15	
Mercury		ND	mg/L	0.020						20
Sample ID: C13110898-047CMS	Sample Matrix Spike					Run: CVAA_C203_131127A			11/27/13 15:17	
Mercury		0.0054	mg/L	0.020	107	85	115			
Method: SW7470A								Batch: 39912		
Sample ID: MB-39912	Method Blank					Run: CVAA_C203_131127A			11/27/13 14:43	
Mercury		ND	mg/L	4E-06						
Sample ID: LCS-39912	Laboratory Control Sample					Run: CVAA_C203_131127A			11/27/13 14:48	
Mercury		0.00539	mg/L	0.00010	108	80	120			
Sample ID: LCSD-39912	Laboratory Control Sample Duplicate					Run: CVAA_C203_131127A			11/27/13 14:50	
Mercury		0.00523	mg/L	0.00010	105	80	120	3.1	20	
Sample ID: C13110898-013CDIL	Serial Dilution					Run: CVAA_C203_131127A			11/27/13 14:54	
Mercury		ND	mg/L	0.020						20
Sample ID: C13110898-013CMS	Sample Matrix Spike					Run: CVAA_C203_131127A			11/27/13 14:55	
Mercury		0.0052	mg/L	0.020	105	85	115			
Sample ID: C13111040-001AMS	Sample Matrix Spike					Run: CVAA_C203_131127A			11/27/13 14:59	
Mercury		0.0052	mg/L	0.020	104	85	115			

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration



QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW7470A								Analytical Run: CVAA_C203_131203A		
Sample ID: ICV		Initial Calibration Verification Standard								12/03/13 13:46
Mercury		0.00534	mg/L	0.00010	107	90	110			
Method: SW7470A								Batch: 39907		
Sample ID: MB-39907		Method Blank								12/03/13 14:24
Mercury		ND	mg/L	6E-06				Run: CVAA_C203_131203A		
Sample ID: LCS-39907		Laboratory Control Sample								12/03/13 14:26
Mercury		0.0055	mg/L	0.020	110	85	115	Run: CVAA_C203_131203A		
Sample ID: C13110898-007CDIL		Serial Dilution								12/03/13 14:32
Mercury		ND	mg/L	0.020				Run: CVAA_C203_131203A		20
Sample ID: C13110898-007CMS		Sample Matrix Spike								12/03/13 14:34
Mercury		0.0053	mg/L	0.020	105	85	115	Run: CVAA_C203_131203A		

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration



QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW846 Ch 7										Batch: B_76178
Sample ID: C13110898-007C										
Sample Matrix Spike						Run: SUB-B215652				11/25/13 10:51
Cyanide, Reactive		0.10	mg/kg	0.050	105	80	120			
Sample ID: C13110898-007C										
Sample Matrix Spike Duplicate						Run: SUB-B215652				11/25/13 10:54
Cyanide, Reactive		0.11	mg/kg	0.050	105	80	120	0.7	10	
Sample ID: MB-76178										
Method Blank						Run: SUB-B215652				11/25/13 12:39
Cyanide, Reactive		ND	mg/kg	0.05						
Method: SW846 Ch 7										Batch: 39872
Sample ID: MB-39872										
Method Blank						Run: TITRATION_131122A				11/22/13 13:05
Sulfide, Reactive		2	mg/kg	1						

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration



QA/QC Summary Report

Prepared by Casper, WY Branch

Client: Montgomery Watson Harza

Report Date: 01/06/14

Project: NECR

Work Order: C13110898

Analyte	Count	Result	Units	RL	%REC	Low Limit	High Limit	RPD	RPDLimit	Qual
Method: SW9045D										Batch: 39903
Sample ID: C13110898-047CDUP										
Sample Duplicate		Run: ORION 3 STAR PH_131126A								
Corrosivity - pH		8.28	s.u.	0.010				0.4		11/26/13 11:07
										10
Sample ID: LCS1-39903										
Laboratory Control Sample		Run: ORION 3 STAR PH_131126A								
Corrosivity - pH		7.12	s.u.	0.010	101	94.9	104			11/26/13 11:07

Qualifiers:

RL - Analyte reporting limit.

ND - Not detected at the reporting limit.

MDC - Minimum detectable concentration

Workorder Receipt Checklist

Montgomery Watson Harza

C13110898

Login completed by: Debra Williams

Date Received: 11/21/2013

Reviewed by: BL2000\khelm

Received by: dw

Reviewed Date: 11/25/2013

Carrier Ground
name:

Shipping container/cooler in good condition?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Not Present <input type="checkbox"/>
Custody seals intact on all shipping container(s)/cooler(s)?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	Not Present <input type="checkbox"/>
Custody seals intact on all sample bottles?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Present <input checked="" type="checkbox"/>
Chain of custody present?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody signed when relinquished and received?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Chain of custody agrees with sample labels?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Samples in proper container/bottle?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sample containers intact?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Sufficient sample volume for indicated test?	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
All samples received within holding time? (Exclude analyses that are considered field parameters such as pH, DO, Res Cl, Sulfite, Ferrous Iron, etc.)	Yes <input checked="" type="checkbox"/>	No <input type="checkbox"/>	
Temp Blank received in all shipping container(s)/cooler(s)?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Applicable <input checked="" type="checkbox"/>
Container/Temp Blank temperature:	NA °C NA		
Water - VOA vials have zero headspace?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	No VOA vials submitted <input checked="" type="checkbox"/>
Water - pH acceptable upon receipt?	Yes <input type="checkbox"/>	No <input type="checkbox"/>	Not Applicable <input checked="" type="checkbox"/>

Standard Reporting Procedures:

Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH, Dissolved Oxygen and Residual Chlorine, are qualified as being analyzed outside of recommended holding time.

Solid/soil samples are reported on a wet weight basis (as received) unless specifically indicated. If moisture corrected, data units are typically noted as –dry. For agricultural and mining soil parameters/characteristics, all samples are dried and ground prior to sample analysis.

Contact and Corrective Action Comments:

None



Chain of Custody and Analytical Request Record

Page 1 of 5

PLEASE PRINT - Provide as much information as possible.

Company Name: MWH Americas		Project Name, PWS, Permit, Etc. NECR-Pre Design Study		Sample Origin State: NM		EPA/State Compliance: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Report Mail Address: Toby Leeson@mwhglobal.com 2130 Resort Dr. Suite 200 Steamboat Springs, CO 80487		Contact Name: Toby Leeson		Phone/Fax: 970-871-4361		Sampler: (Please Print) C. Esposito	
Invoice Address: MWH Broomfield, CO		Invoice Contact & Phone: Toby Leeson 970-871-4361		Purchase Order:		Quote/Bottle Order:	
Special Report/Formats - ELI must be notified prior to sample submittal for the following: <input type="checkbox"/> DW <input type="checkbox"/> A2LA <input type="checkbox"/> GSA <input type="checkbox"/> EDD/EDT (Electronic Data) <input type="checkbox"/> POTW/WWTP Format: <input type="checkbox"/> State: <input type="checkbox"/> LEVEL IV <input type="checkbox"/> Other: <input type="checkbox"/> NELAC				Contact ELI prior to RUSH sample submittal for charges and scheduling - See Instruction Page		Shipped by: K. Johnson	
				Comments: R U S H		Cooler ID(s): 2123	
Number of Containers Sample Type: A W S V B O Vegetation Bioassay Other		Ra-226		SEE ATTACHED		Receipt Temp: 10A °C	
MATRIX		Total Uranium		Reactivity (cyanide/sulfide)		On Ice: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	
Collection Date		Collection Time		Corrosivity (9045/9040)		Custody Seal <input checked="" type="checkbox"/> N	
NECR2-CC05-004(5-8)		10/29/13 17:02		Ignitability (USEPA 1010)		Intact <input checked="" type="checkbox"/> N	
ROAD-CC01-002(5-10)		10/30/13 10:05		Toxicity (TCLP Metals)		Signature Match <input checked="" type="checkbox"/> N	
ROAD-CC02-001(0-5)		10/30/13 10:30		Ra-226		LABORATORY USE ONLY	
ROAD-CC03-001(0-5)		10/30/13 11:13		S			
P1-CC11-004(7.5-10)		11/12/13 13:21		S			
P1-CC13-002(5-7.5)		11/12/13 15:56		S			
TPH-P1-CC11-005(10-12.5)		11/12/13 13:42		S			
P1-CC08-001(0-2.5)		11/12/13 9:08		S			
P1-CC04-002(2.5-5)		11/11/13 13:46		S			
P1-CC07-002(2.5-5)		11/12/13 8:10		S			
Relinquished by (print): Kellie Johnson		Date/Time: 11-18-2013 08:00		Received by (print): <i>[Signature]</i>		Date/Time: 11-21-13	
Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>		Signature: <i>[Signature]</i>	
Custody Record MUST be Signed		Sample Disposal: Return to Client:		Lab Disposal:		Signature: 9130	

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.



Chain of Custody and Analytical Request Record

PLEASE PRINT - Provide as much information as possible.

Company Name: MWH Americas		Project Name, PWS, Permit, Etc. NECR-Pre Design Study		Sample Origin State: NM		EPA/State Compliance: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>																									
Report Mail Address: Toby Leeson@mwglobal.com 2130 Resort Dr. Suite 200 Steamboat Springs, CO 80487		Contact Name: Toby Leeson		Phone/Fax: 970-871-4361		Sampler: (Please Print) C. Esposito																									
Invoice Address: MWH Broomfield, CO		Invoice Contact & Phone: Toby Leeson 970-871-4361		Purchase Order:		Quote/Bottle Order:																									
Special Report/Formats - ELI must be notified prior to sample submittal for the following: <input type="checkbox"/> DW <input type="checkbox"/> A2LA <input type="checkbox"/> GSA <input type="checkbox"/> EDD/EDT (Electronic Data) <input type="checkbox"/> POTW/WWTP Format: _____ <input type="checkbox"/> State: _____ <input type="checkbox"/> LEVEL IV <input type="checkbox"/> Other: _____ <input type="checkbox"/> NELAC				Number of Containers Sample Type: A W S V B O Air Water Soils/Solids Vegetation Bioassay Other				MATRIX																							
SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)		Collection Date	Collection Time	Ra-226		Total Uranium		Toxicity (TCLP Metals)		Ignitability (USEPA 1010)		Corrosivity (9045/9040)		Reactivity (cyanide/sulfide)		SEE ATTACHED		Normal Turnaround (TAT)		R U S H		Contact ELI prior to RUSH sample submittal for charges and scheduling - See Instruction Page		Comments:		Shipped by: K. Johnson					
SP-CC04-004(7.5-10)		11/1/13	11:16	S		X		X		X		X		X		X		X		X		Cooler ID(s): 2173		Receipt Temp 10A °C		On Ice: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>					
SP-CC08-001(0-2.5)		11/4/13	11:00	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
TPH-P1-CC12-004(12.5-15)		11/12/13	14:55	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
SP-CC11-001(0-2.5)		11/4/13	15:11	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
SP-CC08-002(2.5-5)		11/4/13	11:05	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
NECR1-CC11-001(3-5)		11/6/13	13:22	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
NECR1-CC12-002(2.5-5)		11/6/13	14:18	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
SP-CC12-001(0-2)		11/4/13	15:54	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
SP-CC01-001(0-5)		11/1/13	8:41	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
SP-CC07-002(2.5-5)		11/4/13	10:17	S		X		X		X		X		X		X		X		X		Custody Seal Intact		Signature Match		LABORATORY USE ONLY					
Custody Record MUST be Signed		Relinquished by (print): Kelly Johnson		Date/Time: 11-18-2013 08:00		Signature: <i>[Signature]</i>		Received by (print):		Date/Time:		Signature:		Received by (print):		Date/Time:		Signature:		Received by (print):		Date/Time:		Signature:		Received by (print):		Date/Time:		Signature:	
Sample Disposal:		Return to Client:		Lab Disposal:		Received by Laboratory:		Date/Time:		Signature:		Received by (print):		Date/Time:		Signature:		Received by (print):		Date/Time:		Signature:		Received by (print):		Date/Time:		Signature:			

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Chain of Custody and Analytical Request Record

PLEASE PRINT- Provide as much information as possible.

Company Name: MWH Americas		Project Name, PWS, Permit, Etc. NECR-Pre Design Study		Sample Origin State: NM		EPA/State Compliance: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	
Report Mail Address: Toby.leeson@mwhglobal.com 2130 Resort Dr. Suite 200 Steamboat Springs, CO 80487		Contact Name: Toby Leeson		Phone/Fax: 970-871-4361		Sampler: (Please Print) C. Esposito	
Invoice Address: MWH Broomfield, CO		Invoice Contact & Phone: Toby Leeson 970-871-4361		Purchase Order:		Quote/Bottle Order:	
Special Report/Formats – ELI must be notified prior to sample submittal for the following: <input type="checkbox"/> DW <input type="checkbox"/> A2LA <input type="checkbox"/> EDD/EDT (Electronic Data) <input type="checkbox"/> GSA <input type="checkbox"/> POTW/WWTP Format: _____ <input type="checkbox"/> State: _____ <input type="checkbox"/> LEVEL IV <input type="checkbox"/> Other: _____ <input type="checkbox"/> NELAC		Number of Containers Sample Type: A W S V B O Air Water Soils/Solids Vegetation Bioassay Other		MATRIX		Normal Turnaround (TAT)	
SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)		Collection Date	Collection Time	SEE ATTACHED		Contact ELI prior to RUSH sample submittal for charges and scheduling – See Instruction Page	
SP-CC11-002(2.5-4.5)	11/4/13	15:13	S	X	X	Comments:	
SP-CC04-005(10-12.5)	11/4/13	11:24	S	X	X	Shipped by: K. Johnson	
NMSA-CC03-004(5-7.5)	11/8/13	14:10	S	X	X	Cooler ID(s): 2173	
P1-CC07-003(5-7.5)	11/12/13	8:30	S	X	X	Receipt Temp: 74 °C	
NECR1-CC13-004(10-12.5)	11/6/13	15:28	S	X	X	On Ice: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
P1-CC08-002(2.5-5)	11/12/13	9:08	S	X	X	Custody Seal Intact <input checked="" type="checkbox"/> Y N	
SP-CC10-004(11-15)	11/4/13	14:24	S	X	X	Signature Match <input checked="" type="checkbox"/> Y N	
SP-CC10-005(15-17.5)	11/4/13	14:35	S	X	X	LABORATORY USE ONLY	
PND3-CC04-002(5-10)	11/7/13	13:55	S	X	X		
P1-CC05-003(5-7)	11/11/13	14:54	S	X	X		
Custody Record MUST be Signed		Relinquished by (print): Kelly Johnson	Date/Time: 11-18-2013 08:00	Received by (print): <i>[Signature]</i>	Date/Time:	Signature: <i>[Signature]</i>	
Sample Disposal:		Return to Client:	Lab Disposal:	Received by Laboratory: <i>[Signature]</i>	Date/Time: 11-21-13	Signature: 930	

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Chain of Custody and Analytical Request Record

PLEASE PRINT - Provide as much information as possible.

Company Name: MWH Americas		Project Name, PWS, Permit, Etc. NECR-Pre Design Study		Sample Origin State: NM		EPA/State Compliance: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>							
Report Mail Address: Toby.leeson@mwhglobal.com 2130 Resort Dr. Suite 200 Steamboat Springs, CO 80487		Contact Name: Toby Leeson		Phone/Fax: 970-871-4361		Email: Toby.leeson@mwhglobal.com		Sampler: (Please Print) C. Esposito					
Invoice Address: MWH Broomfield, CO		Invoice Contact & Phone: Toby Leeson 970-871-4361		Purchase Order:		Quote/Bottle Order:							
Special Report/Formats - ELI must be notified prior to sample submittal for the following: <input type="checkbox"/> DW <input type="checkbox"/> A2LA <input type="checkbox"/> GSA <input type="checkbox"/> EDD/EDT (Electronic Data) <input type="checkbox"/> POTW/WWTP Format: _____ <input type="checkbox"/> State: _____ <input type="checkbox"/> LEVEL IV <input type="checkbox"/> Other: _____				R U S H		Contact ELI prior to RUSH sample submittal for charges and scheduling - See Instruction Page		Shipped by: K. Johnson					
				SEE ATTACHED		Normal Turnaround (TAT)		Cooler ID(s): 2173					
Number of Containers Sample Type: A W S V B O Air Water Soils/Solids Vegetation Bioassay Other		MATRIX		Ra-226		Toxicity (TCLP Metals)		Reactivity (cyanide/sulfide)		Comments:		Receipt Temp 10 A °C	
SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)		Collection Date		Collection Time		Total Uranium		Ignitability (USEPA 1010)		Corrosivity (9045/9040)		On Ice: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	
NECR1-CC10-001(9.5-15)		10/31/13		14:12		X		X		X		Custody Seal Intact Y N	
NECR2-CC3-005(15-20)		10/29/13		14:53		X		X		X		Signature Match Y N	
NECR1-CC09-001(5-8.8)		10/31/13		13:26		X		X		X			
NECR1-CC02-06-BULK		10/31/13		10:25		X		X		X			
P1-CC01-002(5-10)		11/6/13		10:40		X		X		X			
NECR1-CC15-001(5-10)		11/7/13		9:00		X		X		X			
P1-CC04-003(5-7.5)		11/11/13		14:00		X		X		X			
P1-CC16-005(12.5-15)		11/13/13		13:45		X		X		X			
PND3-CC02-002(5-10)		10/31/13		16:18		X		X		X			
PND3-CC03-002(10-20)		10/31/13		17:27		X		X		X		LABORATORY USE ONLY 2131/0898	
Custody Record MUST be Signed		Relinquished by (print): Kelly Johnson		Date/Time: 11-18-2013 08:00		Signature: <i>Kelly Johnson</i>		Received by (print):		Date/Time:		Signature:	
Sample Disposal:		Return to Client:		Lab Disposal:		Received by Laboratory: <i>[Signature]</i>		Date/Time: 11-21-13		Signature: 930			

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.



Chain of Custody and Analytical Request Record

PLEASE PRINT - Provide as much information as possible.

Company Name: MWH Americas		Project Name: PWS, Permit, Etc. NECR-Pre Design Study		Sample Origin State: NM		EPA/State Compliance: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>																	
Report Mail Address: Toby.leeson@mwhglobal.com 2130 Resort Dr. Suite 200 Steamboat Springs, CO 80487		Contact Name: Toby Leeson		Phone/Fax: 970-871-4361		Email: Toby.leeson@mwhglobal.com																	
Invoice Address: MWH Broomfield, CO		Invoice Contact & Phone: Toby Leeson 970-871-4361		Purchase Order:		Quote/Bottle Order:																	
Special Report/Formats - ELI must be notified prior to sample submittal for the following: <input type="checkbox"/> DW <input type="checkbox"/> A2LA <input type="checkbox"/> GSA <input type="checkbox"/> EDD/EDT (Electronic Data) <input type="checkbox"/> POTW/WWTP Format: _____ <input type="checkbox"/> State: _____ <input type="checkbox"/> LEVEL IV <input type="checkbox"/> Other: _____		Number of Containers Sample Type: A W S V B O Air Water Soils/Solids Vegetation Bioassay Other		Ra-226		Toxicity (TCLP Metals)		Ignitability (USEPA 1010)		Corrosivity (9045/9040)		Reactivity (cyanide/sulfide)		SEE ATTACHED		Normal Turnaround (TAT)		R U S H		Contact ELI prior to RUSH sample submittal for charges and scheduling - See Instruction Page Comments:		Shipped by: K. Johnson	
																						Cooler ID(s): 2173	
SAMPLE IDENTIFICATION (Name, Location, Interval, etc.)		Collection Date	Collection Time	LABORATORY USE ONLY																			
SP-CC03-002(2.5-5)		11/1/13	10:21	X																			
SP-CC06-002(2.5-5)		11/4/13	9:32	X																			
NECR1-CC14-003(12-15)		11/6/13	16:40	X																			
P2-CC02-002(5-10)		11/6/13	9:17	X																			
P2-CC03-001(0-5)		11/6/13	9:45	X																			
NMSA-CC01-002(5.5-7.5)		11/8/13	10:58	X																			
SP-CC10-203(5-7.4)		11/4/13	14:05	X																			
TPH-P1-CC11-004(7.5-10)		11/12/13	13:21	X																			
TPH-P1-CC13-003(7.5-10)		11/12/13	16:10	X																			
TPH-P1-CC10-003(5-7.5)		11/12/13	11:38	X																			
Relinquished by (print): Kelly Johnson		Date/Time: 11-18-2013 08:00		Signature: <i>[Signature]</i>		Received by (print):		Date/Time:		Signature:		Received by Laboratory: <i>[Signature]</i>		Date/Time: 11-21-13		Signature: 938							
Custody Record MUST be Signed		Sample Disposal:		Return to Client:		Lab Disposal:		Signature:		Date/Time:		Signature:		Date/Time:		Signature:							

In certain circumstances, samples submitted to Energy Laboratories, Inc. may be subcontracted to other certified laboratories in order to complete the analysis requested. This serves as notice of this possibility. All sub-contract data will be clearly notated on your analytical report. Visit our web site at www.energylab.com for additional information, downloadable fee schedule, forms, and links.

Radiochemistry
Level 4 Reporting Checklist Gamma

Method #: 901.1 Analyte: $^{226}\text{Ra}/^{214}\text{Bi}$

☒ Energy Labs Batch ID: GEGG, 131216A, 8:45, 39892

☒ Omega Data Entry Batch ID: GEGG, 131216A, 8:45, R181970

☒ Instrument ID: (DET 1, DET 2) Gam-HpGe

☒ Instrument background check

☒ Instrument efficiency/calibration check

☒ Bench-sheets (Sample run order should include MD 10 samples)

☒ Photocopy of instrument run log

☒ Photocopy of standard source calibration certificate noting manufacturer, stock and/or lot number

☐ Photocopy of method control charts for the following:
(provided by QA Dept.)

N/A Matrix Duplicates (MD)

☒ Analyst Case Narrative consisting of the following:

☒ A statement documenting the analytes and the method used

☒ Date of analysis

☒ Any instrument adjustment or anomalies encountered during analysis

☒ Printed name and signature of analyst

Analyst Case Narrative

Method #: EPA 901.1 Analyte: 12a-226 Date/time of analysis: 12-16-13 @ 8:45

Any problems or anomalies encountered during analysis?

No ☒ Yes ☐ (please explain below)

Analyst case narrative: 12AN SAMPLES ACCORDING TO
EPA 901.1 METHOD UTILIZING ORTEC
GAMMAVISION SOFTWARE.

Any instrument adjustments or anomalies encountered during analysis?

No ☐ Yes ☒ (please explain below)

Analyst case narrative: NO INSTRUMENT ADJUSTMENTS,
DAILY BACKGROUND CHECKS WERE LOW ON
A COUPLE OF ASSASIONS FOR DET 2.

Analyst: DAVID BLAIDA

Please print

Signature: David Blaida

4

PREP BATCH REPORT

Prep Batch 39892 Prep Code: PRP-GAMMA Technician: David Mikesell Prep Start Date: 11/25/2013 14:08:01 Prep End Date: 11/25/2013 14:15:00

Sample ID	Matrix	pH	Initial Samp Amt	Sol Added	Sol Recov	Fin Vol (mL)	Factor	Balance	PrepStart	PrepEnd
C13110898-001A - D & G	Soil	DET	156.39	0	0	156.39	1	Sartorius	11/25/2013	11/25/2013
C13110898-002A	Soil		173.86	0	0	173.86	1	Sartorius	11/25/2013	11/25/2013
C13110898-003A	Soil		178.7	0	0	178.7	1	Sartorius	11/25/2013	11/25/2013
C13110898-004A	Soil		188.93	0	0	188.93	1	Sartorius	11/25/2013	11/25/2013
C13110898-005A	Soil		105.62	0	0	105.62	1	Sartorius	11/25/2013	11/25/2013
C13110898-006A	Soil		100.46	0	0	100.46	1	Sartorius	11/25/2013	11/25/2013
C13110898-007A	Soil		152.01	0	0	152.01	1	Sartorius	11/25/2013	11/25/2013
C13110898-008A	Soil		118.25	0	0	118.25	1	Sartorius	11/25/2013	11/25/2013
C13110898-009A	Soil		134.86	0	0	134.86	1	Sartorius	11/25/2013	11/25/2013
C13110898-010A	Soil		132.19	0	0	132.19	1	Sartorius	11/25/2013	11/25/2013
C13110898-011A	Soil		179.9	0	0	179.9	1	Sartorius	11/25/2013	11/25/2013
C13110898-012A	Soil		196.38	0	0	196.38	1	Sartorius	11/25/2013	11/25/2013
C13110898-013A	Soil		104.79	0	0	104.79	1	Sartorius	11/25/2013	11/25/2013
C13110898-014A	Soil		190.32	0	0	190.32	1	Sartorius	11/25/2013	11/25/2013
C13110898-015A	Soil		176.01	0	0	176.01	1	Sartorius	11/25/2013	11/25/2013
C13110898-016A	Soil		186.83	0	0	186.83	1	Sartorius	11/25/2013	11/25/2013
C13110898-017A	Soil		192.98	0	0	192.98	1	Sartorius	11/25/2013	11/25/2013
C13110898-018A	Soil		181.42	0	0	181.42	1	Sartorius	11/25/2013	11/25/2013
C13110898-019A	Soil		171.34	0	0	171.34	1	Sartorius	11/25/2013	11/25/2013
C13110898-020A	Soil		187.87	0	0	187.87	1	Sartorius	11/25/2013	11/25/2013
C13110898-021A	Soil		191.79	0	0	191.79	1	Sartorius	11/25/2013	11/25/2013
C13110898-022A	Soil		188.5	0	0	188.5	1	Sartorius	11/25/2013	11/25/2013

Count on or
after 12-15-13
HP Ge Ra-226

Started 12-16-13 @ 8:45 AM
GEGG
131216A
8:45
QA/QC
12/27/13
R.S.

12-15-13

PREP BATCH REPORT

Technician: David Mikesell
Batch Units: G

Prep Start Date: 11/25/2013 14:08:01
Prep End Date: 11/25/2013 14:15:00

Prep Batch 39892 Prep Code: PRP-GAMMA

Sample ID	Matrix	pH	Initial Samp Amt	Sol Added	Sol Recov	Fin Vol (mL)	Factor	Balance	PrepStart	PrepEnd
C13110898-023A	Soil	DET 1	150.65	0	0	150.65	1	Sartorius	11/25/2013	11/25/2013
C13110898-024A	Soil	DET 2	194.9	0	0	194.9	1	Sartorius	11/25/2013	11/25/2013
C13110898-025A	Soil		164.21	0	0	164.21	1	Sartorius	11/25/2013	11/25/2013
C13110898-026A	Soil		206.02	0	0	206.02	1	Sartorius	11/25/2013	11/25/2013
C13110898-027A	Soil		124.9	0	0	124.9	1	Sartorius	11/25/2013	11/25/2013
C13110898-028A	Soil	DUP	169.09	0	0	169.09	1	Sartorius	11/25/2013	11/25/2013
C13110898-029A	Soil		148.83	0	0	148.83	1	Sartorius	11/25/2013	11/25/2013
C13110898-030A	Soil		200.2	0	0	200.2	1	Sartorius	11/25/2013	11/25/2013
C13110898-031A	Soil		186.14	0	0	186.14	1	Sartorius	11/25/2013	11/25/2013
C13110898-032A	Soil	DUP	172.08	0	0	172.08	1	Sartorius	11/25/2013	11/25/2013
C13110898-033A	Soil		179.16	0	0	179.16	1	Sartorius	11/25/2013	11/25/2013
C13110898-034A	Soil		172.19	0	0	172.19	1	Sartorius	11/25/2013	11/25/2013
C13110898-035A	Soil		160.87	0	0	160.87	1	Sartorius	11/25/2013	11/25/2013
C13110898-036A	Soil	DUP	175.41	0	0	175.41	1	Sartorius	11/25/2013	11/25/2013
C13110898-037A	Soil		176.9	0	0	176.9	1	Sartorius	11/25/2013	11/25/2013
C13110898-038A	Soil		173.97	0	0	173.97	1	Sartorius	11/25/2013	11/25/2013
C13110898-039A	Soil		188.97	0	0	188.97	1	Sartorius	11/25/2013	11/25/2013
C13110898-040A	Soil	DUP	166.89	0	0	166.89	1	Sartorius	11/25/2013	11/25/2013
C13110898-041A	Soil		171.08	0	0	171.08	1	Sartorius	11/25/2013	11/25/2013
C13110898-042A	Soil		166.82	0	0	166.82	1	Sartorius	11/25/2013	11/25/2013
C13110898-043A	Soil		167.26	0	0	167.26	1	Sartorius	11/25/2013	11/25/2013
C13110898-044A	Soil	DUP	201.93	0	0	201.93	1	Sartorius	11/25/2013	11/25/2013
C13110898-045A	Soil		100.67	0	0	100.67	1	Sartorius	11/25/2013	11/25/2013

PREP BATCH REPORT

Technician: David Mikesell
 Prep Batch 39892 Prep Code: PRP-GAMMA Batch Units: G Prep Start Date: 11/25/2013 14:08:01 Prep End Date: 11/25/2013 14:15:00

Sample ID	Matrix	pH	Initial Samp Amt	Sol Added	Sol Recov	Fin Vol (mL)	Factor	Balance	PrepStart	PrepEnd
C13110898-046A	Soil	10.21	122.84	0	0	122.84	1	Sartorius	11/25/2013	11/25/2013
C13110898-047A	Soil	11.91	111.91	0	0	111.91	1	Sartorius	11/25/2013	11/25/2013

✓

Energy Laboratories, Inc.
Alpha Spectroscopy / Gamma Spectroscopy
Instrument / Maintenance Run Log

Instruments: EGG Ortec Octete PC Alpha Spectroscopy System and EGG Ortec High Purity Germanium Detector

Date	Det. No.	Count Time Min.	Isotope	Batch ID	Associated Samples	Data File Number	Instrument ID		Comments Maintenance Log
							Alpha Spec	Gamma Spec	
12-16-13	3-9	1000	Th	1970					Int DA
12-16-13	1, 2	10,30,60	Th	1970	C13110898, 1-47				
12-17-13	1, 2	10,30,60	Th	1969	C13110898, 1-47				
12-17-13	3-14	240	Th	1969		TH-1969			
12-17-13	3-7	240	Th	1971		TH-1971			
12-18-13	1, 2	10,30,60	Th	1970	C13110898, 1-47				
12-19-13	1, 2	10,30,60	Th	1970	C13110898, 1-47				
12-19-13	3-14	240	Th	1974		TH-1974			
12-19-13	3-5, 7-9	1000	Th	1973		TH-1973			
12-20-13	3-5, 7-10	240	Th	1972		TH-1972			
12-20-13	13-18	240	U	630		U-630			
12-20-13	1, 2	10,30,60	Th	1970	C13110898, 1-47				
12-20-13	3-5, 7-9	1000	Th	1975		TH-1975			
12-23-13	1, 2	10,30,60	Th	1970	C13110898, 1-47				
12-23-13	1, 2	10,30,60	Th	1970	C13110961, 1-37				

ACTIVITY DECAY CORRECTIONS LCS CANS 6 - 10, gbkg

Input Analyte	LCS #	Input Half life Years	Calc Half life Days	Calc Half life Hours	Input Original pCi	Calc Original uCi	Calc Corrected pCi	Calc Corrected nCi	Calc Corrected uCi	Calc Corrected Bq	Input Reference Date	Input Current Date	Calc DPM	Input Measured pCi	Calc Percent Recovery	LCS #
IPL-6	6	1600	5.84E+05	14025600	47.4	4.74E-05	46.85	0.05	4.69E-05	1.734	4/1/1987	12/20/2013	104.02	43.10	0.92	6
IPL-6	6	1600	5.84E+05	14025600	47.4	4.74E-05	46.85	0.05	4.69E-05	1.734	4/1/1987	12/20/2013	104.02	41.40	0.88	6
IPL-7	7	1600	5.84E+05	14025600	8.72	8.72E-06	8.66	0.01	8.66E-06	0.320	2/1/1997	12/20/2013	19.22	9.14	1.06	7
IPL-7	7	1600	5.84E+05	14025600	8.72	8.72E-06	8.66	0.01	8.66E-06	0.320	2/1/1997	12/19/2013	19.22	8.85	1.02	7
IPL-7	7	1600	5.84E+05	14025600	8.72	8.72E-06	8.66	0.01	8.66E-06	0.320	2/1/1997	12/20/2013	19.22	8.84	1.02	7
IPL-8	8	1600	5.84E+05	14025600	23.93	2.39E-05	23.76	0.02	2.38E-05	0.879	2/1/1997	12/20/2013	52.74	22.10	0.93	8
IPL-8	8	1600	5.84E+05	14025600	23.93	2.39E-05	23.76	0.02	2.38E-05	0.879	2/1/1997	12/20/2013	52.74	22.10	0.93	8



Eckert & Ziegler

Isotope Products

24937 Avenue Tibbitts
Valencia, California 91355

Tel 661-309-1010

Fax 661-257-8303

CERTIFICATE OF CALIBRATION MULTINUCLIDE STANDARD SOURCE

Customer: ENERGY LABORATORIES
P.O. No.: 89552
Catalog No.: EG-ML

Source No.: 1692-18
Reference Date: 1-Jul-13 12:00 PST
Contained Radioactivity: 0.9146 μ Ci 33.84 kBq

Physical Description:

A. Capsule type:	Customer supplied 3" can
B. Nature of active deposit:	Multinuclide distributed in 1.5g/cc epoxy matrix
C. Active diameter/volume:	Approximately 124.1 mL (186.1 grams)
D. Backing:	Plastic
E. Cover:	Plastic

Gamma-Ray Energy (keV)	Nuclide	Half-life	Branching Ratio (%)	Activity (μ Ci)	Gammas per second	Total Uncert.
60	Am-241	432.17 \pm 0.66 years	36.0	0.02632	350.6	3.0 %
88	Cd-109	462.6 \pm 0.7 days	3.63	0.2603	349.6	3.2 %
122	Co-57	271.79 \pm 0.09 days	85.6	0.01012	320.5	3.1 %
159	Te-123m	119.7 \pm 0.1 days	84.0	0.01317	409.3	3.1 %
320	Cr-51	27.706 \pm 0.007 days	9.86	0.3094	1129	3.0 %
392	Sn-113	115.09 \pm 0.04 days	64.9	0.04999	1200	3.0 %
514	Sr-85	64.849 \pm 0.004 days	98.4	0.05939	2162	3.0 %
662	Cs-137	30.17 \pm 0.16 years	85.1	0.04230	1332	3.1 %
898	Y-88	106.630 \pm 0.025 days	94.0	0.09347	3251	3.0 %
1173	Co-60	5.272 \pm 0.001 years	99.86	0.05012	1852	3.1 %
1333	Co-60	5.272 \pm 0.001 years	99.98	0.05012	1854	3.1 %
1836	Y-88	106.630 \pm 0.025 days	99.4	0.09347	3438	3.0 %

Method of Calibration:

This source was prepared from weighed aliquots of solutions whose concentrations in μ Ci/g were determined by gamma spectrometry.

Notes:

- See reverse side for leak test(s) performed on this source.
- EZIP participates in a NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (as in NRC Regulatory Guide 4.15).
- Nuclear data was taken from IAEA-TECDOC-619, 1991.
- Overall uncertainty is calculated at the 99% confidence level.
- This source has a working life of 1 year.


Quality Control

16-Jul-13
Date

EZIP Ref. No.: 1692-18

ISO 9001 CERTIFIED

Medical Imaging Laboratory

24937 Avenue Tibbitts Valencia, California 91355

Industrial Gauging Laboratory

1800 North Keystone Street Burbank, California 91504

Calibration Data from file: julycc_5th_det1_169218.C1b
 Energy Calibration Date: 12/10/2013 Time: 10:50:03
 Efficiency Calibration Date: 7/26/2013 Time: 07:55:14

Calibration Description:
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration Fit
 Energy = -0.4469 +0.243196*Channel +1.47595e-009*Channel**2
 FWHM (keV) = 2.7806 +0.001109*Channel -4.93042e-008*Channel**2

Energy/FWHM Table						
Channel	Energy(keV)	Fit(keV)	Delta	FWHM	Fit	Delta
246.10	59.54	59.40	0.23%	0.71	0.74	-4.73%
363.33	88.00	87.91	0.10%	0.76	0.77	-1.72%
503.25	122.00	121.94	0.05%	0.78	0.81	-4.09%
655.18	159.00	158.89	0.07%	0.86	0.85	0.90%
1318.39	320.00	320.18	-0.06%	1.14	1.01	11.50%
1612.23	391.00	391.64	-0.16%	1.06	1.08	-1.87%
2114.89	514.00	513.92	0.02%	1.17	1.19	-1.58%
2722.39	662.00	661.64	0.05%	1.33	1.32	1.00%
2694.44	898.00	898.05	-0.01%	1.48	1.51	-1.84%
1826.12	1173.00	1173.28	-0.02%	1.71	1.70	0.71%
3480.98	1333.00	1332.55	0.03%	1.75	1.79	-2.26%
7581.30	1836.00	1836.13	-0.01%	2.05	2.03	0.94%

Efficiency Calibration Fit
 Polynomial Uncertainty = 1.3912 %
 Coefficients:
 -0.329484 -5.959887 0.633715 -0.076489 0.004220 -0.000092

Efficiency Table				
Energy	Efficiency	Fit	Delta	
59.54	1.4792E-002	1.4791E-002	0.00%	
88.00	1.8292E-002	1.8301E-002	-0.05%	
122.05	1.8426E-002	1.7693E-002	3.98%	
159.03	1.5851E-002	1.5830E-002	0.13%	
320.06	8.9257E-003	8.9862E-003	-0.68%	
391.58	7.4870E-003	7.4242E-003	0.84%	
513.94	5.6263E-003	5.7648E-003	-2.46%	
661.60	4.7749E-003	4.6047E-003	3.56%	
898.05	3.5676E-003	3.5554E-003	0.34%	
1173.18	2.8125E-003	2.8533E-003	-1.45%	
1332.77	2.5347E-003	2.5675E-003	-1.29%	
1836.10	1.9651E-003	1.9465E-003	0.95%	

Calibration Certificate Table								
Isotope	Energy	Pct	Half-life	Activity	GPS	Error	Date & Time	
Cd-109	88.03	3.63	4.63E+002	9630.85	349.60	3.20%	7/1/2013	12:00:00
Co-57	122.07	85.60	2.72E+002	374.42	320.50	31.00%	7/1/2013	12:00:00
Fe-123m	159.07	84.00	1.20E+002	487.26	409.30	3.10%	7/1/2013	12:00:00
Sn-113	391.69	64.90	1.15E+002	1849.00	1200.00	3.00%	7/1/2013	12:00:00
Y-88	898.02	94.00	1.07E+002	3458.51	3251.00	3.00%	7/1/2013	12:00:00
Co-60	1173.24	99.86	1.93E+003	1854.60	1852.00	3.10%	7/1/2013	12:00:00
Co-60	1333.00	99.98	1.93E+003	1854.37	1854.00	3.10%	7/1/2013	12:00:00
Y-88	1836.01	99.40	1.07E+002	3458.75	3438.00	3.00%	7/1/2013	12:00:00
Cr-51	320.00	9.86	2.77E+001	11450.30	1129.00	3.00%	7/1/2013	12:00:00
Sr-85	514.00	98.40	6.48E+001	2197.15	2162.00	3.00%	7/1/2013	12:00:00
Cs-137	661.66	85.10	1.10E+004	1565.22	1332.00	3.10%	7/1/2013	12:00:00
Cd-109	1836.27	3.63	4.63E+002	9220.39	334.70	3.10%	6/1/2009	12:00:00
Am-241	59.72	36.30	1.58E+005	965.84	350.60	3.00%	7/13/2013	12:00:00
	392.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
	514.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
	662.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
Y-88	898.00	94.00	1.07E+002	3458.51	3251.00	3.00%	7/13/2013	12:00:00
	1173.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
	1333.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
Am-241	1836.00	36.30	1.58E+005	965.84	350.60	3.00%	7/1/2013	12:00:00

Calibration Data from file: julycc_5th_det2_169218.C1b
 Energy Calibration Date: 12/10/2013 Time: 16:47:09
 Efficiency Calibration Date: 7/26/2013 Time: 08:05:07

Calibration Description:

12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration Fit

Energy = $-0.1662 + 0.244704 \cdot \text{Channel} - 2.81498e-008 \cdot \text{Channel}^2$
 FWHM (keV) = $3.5735 + 0.000969 \cdot \text{Channel} - 3.59628e-008 \cdot \text{Channel}^2$

Energy/FWHM Table

Channel	Energy(keV)	Fit(keV)	Delta	FWHM	Fit	Delta
242.83	59.00	59.25	-0.43%	0.91	0.93	-2.49%
359.71	88.00	87.85	0.17%	0.97	0.96	1.41%
497.52	121.45	121.57	-0.10%	0.00	0.99	100.00%
649.40	159.00	158.73	0.17%	1.05	1.02	2.73%
1308.90	320.00	320.08	-0.02%	1.16	1.17	-0.73%
1600.72	391.42	391.46	-0.01%	1.21	1.23	-1.55%
2100.80	513.62	513.78	-0.03%	1.32	1.33	-0.92%
2704.82	662.00	661.51	0.07%	1.45	1.45	0.12%
3671.93	898.00	897.99	0.00%	1.66	1.63	2.17%
4797.75	1173.00	1173.21	-0.02%	1.81	1.81	0.21%
5449.33	1332.33	1332.47	-0.01%	1.87	1.90	-1.52%
7509.67	1836.00	1835.89	0.01%	2.16	2.15	0.30%

Efficiency Calibration Fit

Polynomial Uncertainty = 0.6131 %

Coefficients:

-0.361975 -5.553226 0.556215 -0.064968 0.003465 -0.000073

Efficiency Table

Energy	Efficiency	Fit	Delta
59.49	1.8571E-002	1.8566E-002	0.03%
88.08	2.2432E-002	2.2519E-002	-0.39%
122.05	2.2068E-002	2.1787E-002	1.27%
158.71	1.9327E-002	1.9560E-002	-1.21%
320.00	1.1444E-002	1.1486E-002	-0.37%
391.60	9.6427E-003	9.6223E-003	0.21%
514.01	7.6376E-003	7.6076E-003	0.39%
661.58	6.2341E-003	6.1653E-003	1.10%
898.05	4.8038E-003	4.8207E-003	-0.35%
1173.32	3.8997E-003	3.8915E-003	0.21%
1332.55	3.4328E-003	3.5059E-003	-2.13%
1836.01	2.6761E-003	2.6490E-003	1.01%

Calibration Certificate Table

Isotope	Energy	Pct	Half-life	Activity	GPS	Error	Date & Time	
Cd-109	88.03	3.63	4.63E+002	9630.85	349.60	3.20%	7/1/2013	12:00:00
Ce-57	122.07	85.60	2.72E+002	374.42	320.50	3.10%	7/1/2013	12:00:00
Te-123m	159.07	84.00	1.20E+002	487.26	409.30	3.10%	7/1/2013	12:00:00
Sn-113	391.69	64.90	1.15E+002	1849.00	1200.00	3.00%	7/1/2013	12:00:00
Y-88	898.02	94.00	1.07E+002	3458.51	3251.00	3.00%	7/1/2013	12:00:00
Co-60	1173.24	99.86	1.93E+003	1854.60	1852.00	3.10%	7/1/2013	12:00:00
Co-60	1333.00	99.98	1.93E+003	1854.37	1854.00	3.10%	7/1/2013	12:00:00
Co-60	1836.01	99.40	1.07E+002	3458.75	3438.00	3.00%	7/1/2013	12:00:00
Ir-192	320.00	9.86	2.77E+001	11450.30	1129.00	3.00%	7/1/2013	12:00:00
Ir-192	514.00	98.40	6.48E+001	2197.15	2162.00	3.00%	7/1/2013	12:00:00
Cs-137	661.66	85.10	1.10E+004	1565.22	1332.00	3.00%	7/1/2013	12:00:00
Cd-109	1836.27	3.63	4.63E+002	9220.39	334.70	3.10%	6/1/2009	12:00:00
Am-241	59.72	36.30	1.58E+005	965.84	350.60	3.00%	7/13/2013	12:00:00
Am-241	392.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
Am-241	514.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
Am-241	662.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
Y-88	898.00	94.00	1.07E+002	3458.51	3251.00	3.00%	7/13/2013	12:00:00
Y-88	1173.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
Y-88	1333.00	0.00	0.00E+000	0.00	0.00	5.00%	00:00:00	
Am-241	1836.00	36.30	1.58E+005	965.84	350.60	3.00%	7/1/2013	12:00:00

RS-17

CERTIFICATE OF CALIBRATION GAMMA STANDARD SOURCE

IPL 7

CAN

Radionuclide: Ra-226
Half Life: 1600 \pm 7 years
Catalog No.: EG-0242
Source No.: 548-133-2

Customer.: ENERGY LABORATORIES
P.O. No: C40177
Reference Date: 1 February 1997 12:00 PST
Contained Radioactivity: (Ra-226) 1.423 nCi (52.64 Bq)

Description of Source

a. Capsule type:	Customer supplied can
b. Nature of active deposit:	Metallic salts in epoxy matrix
c. Active diameter/volume:	Approx. 125 ml (mass of epoxy = 163.16 g)
d. Backing:	Steel
e. Cover:	Steel

Radioimpurities:

None detected (other than daughters)

Method of Calibration

The source was prepared from a weighed aliquot of a solution whose concentration in $\mu\text{Ci}/\text{gram}$ was determined by gamma spectrometry:

Energy peak(s) integrated under:	186	keV.
Branching ratio(s) used:	0.0351	gamma rays per decay.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	$\pm 3.0\%$
b. Random uncertainty in assay:	$\pm 3.0\%$
c. Random uncertainty in weighing(s):	$\pm 0.6\%$
d. Total uncertainty at the 99% confidence level:	$\pm 4.3\%$

NIST Traceability

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

Leak Test(s)

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

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
2. This source has a Ra-226 concentration of 8.722 pCi/g

ID #: 3132

Opened:

Gamma Standard Source-548-133-2

Expires: 2/1/1999

Rec'd: 2/1/1997

Energy Laboratories, Inc. 2393 Salt Creek Hwy
Casper WY 82602

Ann W. M.
QUALITY CONTROL

24 Jan 97

Date Signed



ISOTOPE PRODUCTS LABORATORIES

1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504

818-843-7000 FAX 818-843-6168

IPL Ref. No.: 548-133-2

RS-18

CERTIFICATE OF CALIBRATION GAMMA STANDARD SOURCE

IPL 8
CAN

Radionuclide: Ra-226
Half Life: 1600 \pm 7 years
Catalog No.: EG-0243
Source No.: 548-133-3

Customer.: ENERGY LABORATORIES
P.O. No: C40177
Reference Date: 1 February 1997 12:00 PST
Contained Radioactivity: (Ra-226) 3.988 nCi (147.5 Bq)

Description of Source

a. Capsule type:	Customer supplied can
b. Nature of active deposit:	Metallic salts in epoxy matrix
c. Active diameter/volume:	Approx. 128 ml (mass of epoxy = 166.68 g)
d. Backing:	Steel
e. Cover:	Steel

Radioimpurities:

None detected (other than daughters)

Method of Calibration

The source was prepared from a weighed aliquot of a solution whose concentration in $\mu\text{Ci}/\text{gram}$ was determined by gamma spectrometry:

Energy peak(s) integrated under:	186	keV.
Branching ratio(s) used:	0.0351	gamma rays per decay.

Uncertainty of Measurement

a. Systematic uncertainty in instrument calibration:	$\pm 3.0\%$
b. Random uncertainty in assay:	$\pm 3.0\%$
c. Random uncertainty in weighing(s):	$\pm 0.4\%$
d. Total uncertainty at the 99% confidence level:	$\pm 4.3\%$

NIST Traceability

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

Leak Test(s)

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

Notes

1. IPL participates in an NIST measurement assurance program to establish and maintain implicit traceability for a number of nuclides, based on the blind assay (and later NIST certification) of Standard Reference Materials (As in NRC Regulatory Guide 4.15).
2. This source has a Ra-226 concentration of 23.92 pCi/g

IN # 3132
Opened: *2/1/97*
Gamma Standard Source-548-133-2
Expires: 2/1/1999
Rec'd: 2/1/1997
Energy Laboratories, Inc. 2393 Salt Creek Hwy
Casper WY 82602-

Peter L. Baepes
QUALITY CONTROL

24 Jan 97
Date Signed



ISOTOPE PRODUCTS LABORATORIES

1800 N. KEYSTONE STREET
BURBANK, CALIFORNIA 91504

818-843-7000 FAX 818-843-6168

IPL Ref. No.: 548-133-3

Detector: 2 Det 1
Measurement Number: 654
Data Acquired On: 12/16/2013 08:52:09
Real Time: 1800.00 Sec.
Live Time: 1799.16 Sec.
Status: Warning (Below Low Limit)

	Minimum	Low	Actual	High	Maximum
Background (CPS):	1.96	2.21	2.20	2.70	2.95

Detector: 1 Det 2
Measurement Number: 828
Data Acquired On: 12/16/2013 08:52:17
Real Time: 1800.00 Sec.
Live Time: 1798.68 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
Background (CPS):	3.99	4.49	4.74	5.40	5.99

Detector: 1 Det 2
Measurement Number: 829
Data Acquired On: 12/17/2013 11:38:54
Real Time: 1800.00 Sec.
Live Time: 1798.66 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
-----	-----	-----	-----	-----	-----
Background (CPS):	3.99	4.49	4.89	5.40	5.99

Detector: 2 Det 1
Measurement Number: 655
Data Acquired On: 12/17/2013 11:39:01
Real Time: 1800.00 Sec.
Live Time: 1799.12 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
Background (CPS):	1.96	2.21	2.29	2.70	2.95

Detector: 1 Det 2
Measurement Number: 830
Data Acquired On: 12/18/2013 10:57:32
Real Time: 1800.00 Sec.
Live Time: 1798.64 Sec.
Status: Warning (Above High Limit)

	Minimum	Low	Actual	High	Maximum
-----	-----	-----	-----	-----	-----
Background (CPS):	3.99	4.49	5.43	5.40	5.99

Detector: 2 Det 1
Measurement Number: 656
Data Acquired On: 12/18/2013 10:58:35
Real Time: 1800.00 Sec.
Live Time: 1799.12 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
-----	-----	-----	-----	-----	-----
Background (CPS):	1.96	2.21	2.33	2.70	2.95

Detector: 2 Det 1
Measurement Number: 657
Data Acquired On: 12/19/2013 11:51:55
Real Time: 1800.00 Sec.
Live Time: 1799.10 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
Background (CPS):	1.96	2.21	2.44	2.70	2.95

Detector: 1 Det 2
Measurement Number: 831
Data Acquired On: 12/19/2013 12:35:27
Real Time: 1800.00 Sec.
Live Time: 1798.68 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
-----	-----	-----	-----	-----	-----
Background (CPS):	3.99	4.49	4.56	5.40	5.99

Detector: 2 Det 1
Measurement Number: 658
Data Acquired On: 12/20/2013 10:47:18
Real Time: 1800.00 Sec.
Live Time: 1799.06 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
-----	-----	-----	-----	-----	-----
Background (CPS):	1.96	2.21	2.53	2.70	2.95

Detector: 1 Det 2
Measurement Number: 832
Data Acquired On: 12/20/2013 10:47:11
Real Time: 1800.00 Sec.
Live Time: 1798.68 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
Background (CPS):	3.99	4.49	4.66	5.40	5.99

Detector: 1 Det 2
Measurement Number: 833
Data Acquired On: 12/23/2013 09:15:27
Real Time: 1800.00 Sec.
Live Time: 1798.70 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
-----	-----	-----	-----	-----	-----
Background (CPS):	3.99	4.49	4.55	5.40	5.99

Detector: 2 Det 1
Measurement Number: 659
Data Acquired On: 12/23/2013 09:15:04
Real Time: 1800.00 Sec.
Live Time: 1799.14 Sec.
Status: OK

	Minimum	Low	Actual	High	Maximum
-----	-----	-----	-----	-----	-----
Background (CPS):	1.96	2.21	2.28	2.70	2.95

ORTEC g v - i (15) wan32 G53w2.06 16-DEC-2013 08:50:56 Page 1
 Energy Laboratory Spectrum name: QA000596.Spc

Sample description
 121613pck

Spectrum Filename: C:\User\QA000596.Spc

Acquisition information

Start time: 16-Dec-2013 08:40:45
 Live time: 596
 Real time: 600
 Dead time: 0.75 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: apr13mb_15th_det2_1671271.clb
 7/9/13 mb calibration polynomial new standard re-cal energy
 IPL #1671272

Energy Calibration

Created: 09-Jul-2013 11:53:21
 Zero offset: 0.117 keV
 Gain: 0.244 keV/channel
 Quadratic: -1.865E-08 keV/channel^2

Efficiency Calibration

Created: 17-May-2013 13:54:27
 Type: Polynomial
 Uncertainty: 1.261 %
 Coefficients: -0.354746 -4.877195 0.565757
 -0.066718 0.003195 -0.000059

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (49.00keV)
 Stop channel: 8144 (1989.30keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+04* 1.0000E+00) =
 2.7000E-03
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.3470

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.2888E+00	4.6960E+00	2.8013E-01	3.0807E-01	1.791E-01
CS-137	4.0713E+00	5.1032E+00	1.0901E-01	1.8099E-01	2.026E-01
AM-241	2.8959E+00	2.9420E+00	1.4463E-01	1.8096E-01	3.317E-01

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (49.0 to 1989.3 keV) 8.2560272E+00 pCi/g
 Total Decayed Activity (49.0 to 1989.3 keV) 1.2741171E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1332.50 - CO-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at Fw25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 16-DEC-2013 08:51:03 Page 1
 Energy Laboratory Spectrum name: QA000698.Spc

Sample description
 121613pck

Spectrum Filename: C:\User\QA000698.Spc

Acquisition information

Start time: 16-Dec-2013 08:40:56
 Live time: 600
 Real time: 606
 Dead time: 1.03 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: apr13mb_16th_det1_1671271.clb
 10/9/13 mb calibration polynomial energy re-cal
 IPL #1671271

Energy Calibration

Created: 09-Oct-2013 13:50:38
 Zero offset: -0.317 keV
 Gain: 0.243 keV/channel
 Quadratic: 2.269E-09 keV/channel²

Efficiency Calibration

Created: 25-Apr-2013 08:44:34
 Type: Polynomial
 Uncertainty: 1.119 %
 Coefficients: -0.379781 -4.955815 0.632347
 -0.076310 0.004092 -0.000084

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (48.31keV)
 Stop channel: 8144 (1980.10keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
 2.7000E+01
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	
	Slope	1.0000E+00
	Net factor	1.0000E+00

Energy Calibration
 Normalized diff: 0.0644

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.4849E+04	5.4104E+04	1.7370E+03	2.2510E+03	1.605E+03
CS-137	3.8646E+04	4.8441E+04	1.0949E+03	1.7246E+03	2.035E+03
AM-241	2.8504E+04	2.8957E+04	6.9514E+02	1.2764E+03	1.594E+03

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (48.3 to 1980.1 keV) 8.1998930E+04 pCi/g
 Total Decayed Activity (48.3 to 1980.1 keV) 1.3150233E+05 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 17-DEC-2013 11:38:08 Page 1
 Energy Laboratory Spectrum name: QA000597.Spc

Sample description
 121713pck

Spectrum Filename: C:\User\QA000597.Spc

Acquisition information

Start time: 17-Dec-2013 11:27:56
 Live time: 596
 Real time: 600
 Dead time: 0.74 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: apr13mb_15th_det2_1671271.Clb
 7/9/13 mb calibration polynomial new standard re-cal energy
 IPL #1671272

Energy Calibration

Created: 09-Jul-2013 11:53:21
 Zero offset: 0.117 keV
 Gain: 0.244 keV/channel
 Quadratic: -1.865E-08 keV/channel²

Efficiency Calibration

Created: 17-May-2013 13:54:27
 Type: Polynomial
 Uncertainty: 1.261 %
 Coefficients: -0.354746 -4.877195 0.565757
 -0.066718 0.003195 -0.000059

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (49.00keV)
 Stop channel: 8144 (1989.30keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+04* 1.0000E+00) =
 2.7000E-03
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.3320

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.1548E+00	4.2092E+00	3.7802E-01	3.9510E-01	2.416E-01
CS-137	4.1501E+00	5.2023E+00	1.1154E-01	1.8475E-01	2.073E-01
AM-241	2.8568E+00	2.9022E+00	1.1098E-01	1.5436E-01	2.545E-01

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (49.0 to 1989.3 keV) 8.1615887E+00 pCi/g
 Total Decayed Activity (49.0 to 1989.3 keV) 1.2313734E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1332.50 % CO-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 17-DEC-2013 11:38:13 Page 1
 Energy Laboratory Spectrum name: QA000699.Spc

Sample description
 121713pck

Spectrum Filename: C:\User\QA000699.Spc

Acquisition information

Start time: 17-Dec-2013 11:28:05
 Live time: 600
 Real time: 606
 Dead time: 1.02 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: apr13mb_16th_det1_1671271.clb
 10/9/13 mb calibration polynomial energy re-cal
 IPL #1671271

Energy Calibration

Created: 09-Oct-2013 13:50:38
 Zero offset: -0.317 keV
 Gain: 0.243 keV/channel
 Quadratic: 2.269E-09 keV/channel²

Efficiency Calibration

Created: 25-Apr-2013 08:44:34
 Type: Polynomial
 Uncertainty: 1.119 %
 Coefficients: -0.379781 -4.955815 0.632347
 -0.076310 0.004092 -0.000084

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (48.31keV)
 Stop channel: 8144 (1980.10keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
 2.7000E+01
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0688

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.5116E+04	5.5098E+04	1.7056E+03	2.2439E+03	1.565E+03
CS-137	3.9309E+04	4.9276E+04	1.0744E+03	1.7296E+03	1.997E+03
AM-241	2.8314E+04	2.8764E+04	7.1189E+02	1.2797E+03	1.633E+03

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (48.3 to 1980.1 keV) 8.2738570E+04 pCi/g
 Total Decayed Activity (48.3 to 1980.1 keV) 1.3313797E+05 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 18-DEC-2013 11:43:31 Page 1
 Energy Laboratory Spectrum name: QA000700.Spc

Sample description
 121813pck

Spectrum Filename: C:\User\QA000700.Spc

Acquisition information

Start time: 18-Dec-2013 11:33:23
 Live time: 600
 Real time: 606
 Dead time: 1.03 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: apr13mb_16th_det1_1671271.clb
 10/9/13 mb calibration polynomial energy re-cal
 IPL #1671271

Energy Calibration

Created: 09-Oct-2013 13:50:38
 Zero offset: -0.317 keV
 Gain: 0.243 keV/channel
 Quadratic: 2.269E-09 keV/channel²

Efficiency Calibration

Created: 25-Apr-2013 08:44:34
 Type: Polynomial
 Uncertainty: 1.119 %
 Coefficients: -0.379781 -4.955815 0.632347
 -0.076310 0.004092 -0.000084

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (48.31keV)
 Stop channel: 8144 (1980.10keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
 2.7000E+01
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0460

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.5412E+04	5.6199E+04	2.3911E+03	2.8159E+03	1.528E+03
CS-137	3.8929E+04	4.8802E+04	1.0765E+03	1.7206E+03	2.001E+03
AM-241	2.8855E+04	2.9314E+04	7.3506E+02	1.3095E+03	1.686E+03

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (48.3 to 1980.1 keV) 8.3196125E+04 pCi/g
 Total Decayed Activity (48.3 to 1980.1 keV) 1.3431547E+05 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1332.50 - CO-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at Fw25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 18-DEC-2013 11:43:43 Page 1
 Energy Laboratory Spectrum name: QA000598.Spc

Sample description
 121813pck

Spectrum Filename: C:\User\QA000598.Spc

Acquisition information

Start time: 18-Dec-2013 11:33:30
 Live time: 596
 Real time: 600
 Dead time: 0.74 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: apr13mb_15th_det2_1671271.clb
 7/9/13 mb calibration polynomial new standard re-cal energy
 IPL #1671272

Energy Calibration

Created: 09-Jul-2013 11:53:21
 Zero offset: 0.117 keV
 Gain: 0.244 keV/channel
 Quadratic: -1.865E-08 keV/channel²

Efficiency Calibration

Created: 17-May-2013 13:54:27
 Type: Polynomial
 Uncertainty: 1.261 %
 Coefficients: -0.354746 -4.877195 0.565757
 -0.066718 0.003195 -0.000059

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (49.00keV)
 Stop channel: 8144 (1989.30keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+04* 1.0000E+00) =
 2.7000E-03
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.3137

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.2891E+00	4.7007E+00	2.7354E-01	3.0215E-01	1.748E-01
CS-137	4.0190E+00	5.0383E+00	1.1413E-01	1.8268E-01	2.121E-01
AM-241	3.0448E+00	3.0933E+00	1.1126E-01	1.5955E-01	2.552E-01

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (49.0 to 1989.3 keV) 8.3529339E+00 pCi/g
 Total Decayed Activity (49.0 to 1989.3 keV) 1.2832283E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1332.50 ? CO-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53W2.06 19-DEC-2013 11:44:37 Page 1
 Energy Laboratory Spectrum name: QA000701.Spc

Sample description
 121913pck

Spectrum Filename: C:\User\QA000701.Spc

Acquisition information

Start time: 19-Dec-2013 11:34:29
 Live time: 600
 Real time: 606
 Dead time: 1.03 %
 Detector ID: 2

Detector system

Det 1

Calibration

Filename: apr13mb_16th_det1_1671271.c1b
 10/9/13 mb calibration polynomial energy re-cal
 IPL #1671271

Energy Calibration

Created: 09-Oct-2013 13:50:38
 Zero offset: -0.317 keV
 Gain: 0.243 keV/channel
 Quadratic: 2.269E-09 keV/channel²

Efficiency Calibration

Created: 25-Apr-2013 08:44:34
 Type: Polynomial
 Uncertainty: 1.119 %
 Coefficients: -0.379781 -4.955815 0.632347
 -0.076310 0.004092 -0.000084

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 200 (48.31keV)
 Stop channel: 8144 (1980.10keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
 2.7000E+01
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0311

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Nuclide   Time of Count   Time Corrected   Uncertainty   2 Sigma   MDA
           Activity       Activity          Counting      Total
           pCi/g         pCi/g           pCi/g        pCi/g
-----
CO-60     1.4826E+04    5.4083E+04    1.7037E+03    2.2250E+03    1.567E+03
CS-137    3.8614E+04    4.8411E+04    1.0816E+03    1.7155E+03    2.010E+03
AM-241    2.9137E+04    2.9601E+04    7.1527E+02    1.3073E+03    1.640E+03

```

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

```

----- S U M M A R Y -----
Total Activity ( 48.3 to 1980.1 keV) 8.2577688E+04 pCi/g
Total Decayed Activity ( 48.3 to 1980.1 keV) 1.3209447E+05 pCi/g

```

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 19-DEC-2013 11:44:49 Page 1
 Energy Laboratory Spectrum name: QA000599.Spc

Sample description
 121913pck

Spectrum Filename: C:\User\QA000599.Spc

Acquisition information

Start time: 19-Dec-2013 11:34:37
 Live time: 596
 Real time: 600
 Dead time: 0.74 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: apr13mb_15th_det2_1671271.clb
 7/9/13 mb calibration polynomial new standard re-cal energy
 IPL #1671272

Energy Calibration

Created: 09-Jul-2013 11:53:21
 Zero offset: 0.117 keV
 Gain: 0.244 keV/channel
 Quadratic: -1.865E-08 keV/channel²

Efficiency Calibration

Created: 17-May-2013 13:54:27
 Type: Polynomial
 Uncertainty: 1.261 %
 Coefficients: -0.354746 -4.877195 0.565757
 -0.066718 0.003195 -0.000059

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (49.00keV)
 Stop channel: 8144 (1989.30keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+04* 1.0000E+00) =
 2.7000E-03
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	
	Slope	1.0000E+00
	Net factor	1.0000E+00

Energy Calibration
 Normalized diff: 0.2465

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	<	4.9759E-04	1.8151E-03			
CS-137		4.1268E+00	5.1738E+00	1.1085E-01	1.8369E-01	2.060E-01
AM-241		2.9846E+00	3.0322E+00	1.0469E-01	1.5338E-01	2.401E-01

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (49.0 to 1989.3 keV) 7.1114769E+00 pCi/g
 Total Decayed Activity (49.0 to 1989.3 keV) 8.2059984E+00 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.24 ? CO-60 1332.50 % CO-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at Fw25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53W2.06 20-DEC-2013 10:45:29 Page 1
 Energy Laboratory Spectrum name: QA000702.Spc

Sample description
 122013pck

Spectrum Filename: C:\User\QA000702.Spc

Acquisition information

Start time: 20-Dec-2013 10:35:21
 Live time: 600
 Real time: 606
 Dead time: 1.02 %
 Detector ID: 2

Detector system

Det 1

Calibration

Filename: apr13mb_16th_det1_1671271.clb
 10/9/13 mb calibration polynomial energy re-cal
 IPL #1671271

Energy Calibration

Created: 09-Oct-2013 13:50:38
 Zero offset: -0.317 keV
 Gain: 0.243 keV/channel
 Quadratic: 2.269E-09 keV/channel^2

Efficiency Calibration

Created: 25-Apr-2013 08:44:34
 Type: Polynomial
 Uncertainty: 1.119 %
 Coefficients: -0.379781 -4.955815 0.632347
 -0.076310 0.004092 -0.000084

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 200 (48.31keV)
 Stop channel: 8144 (1980.10keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
 2.7000E+01
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0692

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.5066E+04	5.4977E+04	1.6602E+03	2.2075E+03	1.505E+03
CS-137	3.7893E+04	4.7509E+04	1.0598E+03	1.6825E+03	1.969E+03
AM-241	2.7868E+04	2.8312E+04	6.8722E+02	1.2521E+03	1.576E+03

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (48.3 to 1980.1 keV) 8.0827258E+04 pCi/g
 Total Decayed Activity (48.3 to 1980.1 keV) 1.3079781E+05 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 20-DEC-2013 10:45:47 Page 1
 Energy Laboratory Spectrum name: QA000600.Spc

Sample description
 122013pck

Spectrum Filename: C:\User\QA000600.Spc

Acquisition information

Start time: 20-Dec-2013 10:35:36
 Live time: 596
 Real time: 600
 Dead time: 0.74 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: apr13mb_15th_det2_1671271.clb
 7/9/13 mb calibration polynomial new standard re-cal energy
 IPL #1671272

Energy Calibration

Created: 09-Jul-2013 11:53:21
 Zero offset: 0.117 keV
 Gain: 0.244 keV/channel
 Quadratic: -1.865E-08 keV/channel²

Efficiency Calibration

Created: 17-May-2013 13:54:27
 Type: Polynomial
 Uncertainty: 1.261 %
 Coefficients: -0.354746 -4.877195 0.565757
 -0.066718 0.003195 -0.000059

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (49.00keV)
 Stop channel: 8144 (1989.30keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+04* 1.0000E+00) =
 2.7000E-03
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.3264

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.1841E+00	4.3207E+00	3.1824E-01	3.3940E-01	2.032E-01
CS-137	4.1253E+00	5.1723E+00	1.0994E-01	1.8311E-01	2.043E-01
AM-241	2.8434E+00	2.8887E+00	1.1935E-01	1.6015E-01	2.737E-01

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (49.0 to 1989.3 keV) 8.1527767E+00 pCi/g
 Total Decayed Activity (49.0 to 1989.3 keV) 1.2381565E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1332.50 - CO-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53W2.06 23-DEC-2013 09:13:23 Page 1
 Energy Laboratory Spectrum name: QA000703.Spc

Sample description
 122313pck

Spectrum Filename: C:\User\QA000703.Spc

Acquisition information

Start time: 23-Dec-2013 09:03:15
 Live time: 600
 Real time: 606
 Dead time: 1.03 %
 Detector ID: 2

Detector system

Det 1

Calibration

Filename: apr13mb_16th_det1_1671271.Clb
 10/9/13 mb calibration polynomial energy re-cal
 IPL #1671271

Energy Calibration

Created: 09-Oct-2013 13:50:38
 Zero offset: -0.317 keV
 Gain: 0.243 keV/channel
 Quadratic: 2.269E-09 keV/channel²

Efficiency Calibration

Created: 25-Apr-2013 08:44:34
 Type: Polynomial
 Uncertainty: 1.119 %
 Coefficients: -0.379781 -4.955815 0.632347
 -0.076310 0.004092 -0.000084

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 200 (48.31keV)
 Stop channel: 8144 (1980.10keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
 2.7000E+01
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0413

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	1.5470E+04	5.6509E+04	1.6736E+03	2.2443E+03	1.495E+03
CS-137	3.8589E+04	4.8392E+04	1.0729E+03	1.7096E+03	1.994E+03
AM-241	2.8552E+04	2.9007E+04	7.1945E+02	1.2913E+03	1.650E+03

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (48.3 to 1980.1 keV) 8.2611227E+04 pCi/g
 Total Decayed Activity (48.3 to 1980.1 keV) 1.3390769E+05 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at Fw25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

□

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (15) wan32 G53w2.06 23-DEC-2013 09:13:50 Page 1
 Energy Laboratory Spectrum name: QA000601.Spc

Sample description
 122313pck

Spectrum Filename: C:\User\QA000601.Spc

Acquisition information

Start time: 23-Dec-2013 09:03:38
 Live time: 596
 Real time: 600
 Dead time: 0.74 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: apr13mb_15th_det2_1671271.Clb
 7/9/13 mb calibration polynomial new standard re-cal energy
 IPL #1671272

Energy Calibration

Created: 09-Jul-2013 11:53:21
 Zero offset: 0.117 keV
 Gain: 0.244 keV/channel
 Quadratic: -1.865E-08 keV/channel²

Efficiency Calibration

Created: 17-May-2013 13:54:27
 Type: Polynomial
 Uncertainty: 1.261 %
 Coefficients: -0.354746 -4.877195 0.565757
 -0.066718 0.003195 -0.000059

Library Files

Main analysis library: qaeff.Lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53w2.06
 Start channel: 200 (49.00keV)
 Stop channel: 8144 (1989.30keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0000E+00
 Activity scaling factor: 2.7000E+01/(1.0000E+04* 1.0000E+00) =
 2.7000E-03
 Detection limit method: LLD - ORTEC method (US-NRC)
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	15-Feb-2004 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.3304

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

CO-60	<	3.8423E-04	1.4035E-03			
CS-137		4.1616E+00	5.2187E+00	1.1058E-01	1.8455E-01	2.055E-01
AM-241		3.0377E+00	3.0861E+00	1.0845E-01	1.5741E-01	2.487E-01

< - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Half-life limit exceeded

----- S U M M A R Y -----
 Total Activity (49.0 to 1989.3 keV) 7.1992912E+00 pCi/g
 Total Decayed Activity (49.0 to 1989.3 keV) 8.3048058E+00 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.24 ? CO-60 1332.50 % CO-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

LCS
DETI

122013p181csdet1.Rpt

ORTEC g v - i (15) wan32 G53W2.06 20-DEC-2013 15:25:55 Page 1
Energy Laboratory Spectrum name: 122013p181csdet1.An1

Sample description
122013p181csdet1

Spectrum Filename: C:\User\122013p181csdet1.An1

Acquisition information

Start time: 20-Dec-2013 14:11:42
Live time: 3600
Real time: 3603
Dead time: 0.09 %
Detector ID: 2

Detector system
Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 200 (48.19keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.6668E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6668E+02) =
1.6199E-01
Detection limit method: LLD - ORTEC method (US-NRC)
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

□

ORTEC g v - i (15) wan32 G53W2.06 20-DEC-2013 15:25:55 Page 2
 Energy Laboratory Spectrum name: 122013p181csdet1.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	01-Feb-1997 16:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	NO	
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1591

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Nuclide   Time of Count   Time Corrected   Uncertainty   1 Sigma   MDA
           Activity       Activity          Counting      Total
           pci/g         pci/g           pci/g         pci/g
-----
Ra-228 B<  1.4041E+00    1.0745E+01
Ra-226      2.1197E+01    2.1352E+01    2.7474E+00    2.7638E+00    1.271E+01
Bi-214      2.2090E+01    2.2252E+01    8.0003E-01    8.5908E-01    3.701E+00
Pb-214      2.2790E+01    2.2957E+01    5.9005E-01    6.7263E-01    3.195E+00
Ir-192 B<   3.96E-01 >12 Halflives
Sb-124 B<   2.30E-01 >12 Halflives
Sc-46      3.1994E+00 >12 Halflives    2.3766E-01    2.4189E-01    1.108E+00
Pb-210 No in-range peaks
Th-228 <    1.5318E+01    7.0128E+03
Th-230 <    7.5034E+01    7.5046E+01
Cs-137 <    4.2550E-01    6.2768E-01
Co-60 B<   3.4661E-01    3.1914E+00
Am-241 <    9.9766E-01    1.0250E+00
K-40 <     5.1777E+00    5.1777E+00
U-235 <     8.1330E-01    8.1330E-01
Th-234 B<   3.33E+01 >12 Halflives
Cs-134 <    1.8846E-01    5.4926E+01
Pb-212 <    5.7945E-01    5.7945E-01
Ra-224 <    1.49E+01 >12 Halflives
I-131 B<    3.25E-04 >12 Halflives
Mn-54 <     3.32E-01 >12 Halflives
Tl-208 <     6.34E-01 >12 Halflives
Bi-212 <     3.33E+00 >12 Halflives
Ra-223 <     3.67E+00 >12 Halflives
Pa-234 <     6.26E-04 >12 Halflives
Eu-154 <    2.2167E-03    8.3791E-03
Eu-152 #    3.6612E+00    8.8078E+00    1.6059E+00    1.6106E+00    3.111E+00
  
```

□

ORTEC g v - i (15) wan32 G53W2.06 20-DEC-2013 15:25:55 Page 3

Na-22 < 3.2041E-01 2.8860E+01
Zn-65 < 1.39E-03 >12 Halflives
Ba-133 < 4.6146E-01 1.4065E+00
Ru-103 B< 4.08E-04 >12 Halflives
Be-7 B< 4.86E+00 >12 Halflives
I-125 No in-range peaks
Tl-201 B< 1.37E-03 >12 Halflives
Pa-234 B< 1.13E+00 >12 Halflives
Np-237 B< 2.8988E+00 2.8989E+00
Ce-144 B< 1.10E-03 >12 Halflives
Eu-155 < 1.0408E+00 1.1015E+01

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (48.2 to 1980.2 keV) 6.9737053E+01 pCi/g
Total Decayed Activity (48.2 to 1980.2 keV) 7.5368637E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 & Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 Zn-65
1173.00 % Co-60 1274.50 & Na-22 1274.54 Eu-154 1333.00 % Co-60
1460.80 % K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

□

ORTEC g v - i (15) wan32 G53W2.06 20-DEC-2013 15:25:55 Page 4
Energy Laboratory Spectrum name: 122013pl8lcsdet1.An1

Reviewed by: _____
Supervisor

122013p181csdet1.Rpt

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 15:04:33 Page 1
Energy Laboratory Spectrum name: 121913ipl7lcsdet2.An1

Sample description
121913ipl7lcsdet2

Spectrum Filename: C:\User\121913ipl7lcsdet2.An1

Acquisition information

Start time: 19-Dec-2013 13:51:32
Live time: 3512
Real time: 3600
Dead time: 2.45 %
Detector ID: 1

Detector system
Det 2

Calibration

Filename: julycc_5th_det2_169218.c1b
12/10/13 calibration energy det2
IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
Zero offset: -0.166 keV
Gain: 0.245 keV/channel
Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
Type: Polynomial
Uncertainty: 0.613 %
Coefficients: -0.361975 -5.553226 0.556215
-0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 200 (48.77keV)
Stop channel: 8144 (1990.83keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.6316E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6316E+02) =
1.6548E-01
Detection limit method: Nureg 4.16

Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).

Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 15:04:33 Page 2
 Energy Laboratory Spectrum name: 121913ip171csdet2.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	01-Feb-1997 16:00:00
Decay during acquisition:	NO	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1350

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Nuclide      Time of Count   Time Corrected   Uncertainty   1 Sigma   MDA
              Activity       Activity          Counting      Total
              pCi/g         pCi/g           pCi/g         pCi/g
-----
Ra-228 B<    1.2138E+00    9.2856E+00
Ra-226 <      6.4377E+00    6.4849E+00
Bi-214      8.8454E+00    8.9103E+00    4.9414E-01    5.0572E-01    7.005E-01
Pb-214      8.2975E+00    8.3584E+00    3.3872E-01    3.5344E-01    5.603E-01
Ir-192 B<    1.88E-01 >12 Halflives
Sb-124 B<    2.19E-01 >12 Halflives
Sc-46       1.4329E+00 >12 Halflives    1.3962E-01    1.4069E-01    2.052E-01
Pb-210 No in-range peaks
Th-228 <      1.1267E+01    5.1531E+03
Th-230 <      3.2808E+01    3.2813E+01
Cs-137 <      1.8129E-01    2.6742E-01
Co-60 B<     1.9604E-01    1.8044E+00
Am-241 <      3.8704E-01    3.9766E-01
K-40 <       6.1109E+00    6.1109E+00
U-235 <      3.4119E-01    3.4119E-01
Th-234 B<    1.52E+01 >12 Halflives
Cs-134 <      2.2984E-01    6.6925E+01
Pb-212 <      3.8447E-01    3.8447E-01
Ra-224 <      6.54E+00 >12 Halflives
I-131 B<     1.77E-01 >12 Halflives
Mn-54 <      1.33E-01 >12 Halflives
Tl-208 <      2.25E-01 >12 Halflives
Bi-212 <      1.44E+00 >12 Halflives
Ra-223 <      9.03E-01 >12 Halflives
Pa-234 <      6.89E-01 >12 Halflives
Eu-154 <      3.9006E-01    1.4741E+00
  
```

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 15:04:33 Page 3

Eu-152 < 1.1356E+00 2.7315E+00
Na-22 < 9.6440E-02 8.6802E+00
Zn-65 < 4.20E-01 >12 Halflives
Ba-133 < 2.7634E-01 8.4208E-01
Ru-103 B< 2.18E-01 >12 Halflives
Be-7 B< 1.28E+00 >12 Halflives
I-125 No in-range peaks
Tl-201 B< 1.17E+00 >12 Halflives
Pa-234 B< 3.01E-01 >12 Halflives
Np-237 B< 1.2947E+00 1.2947E+00
Ce-144 B< 7.15E-01 >12 Halflives
Eu-155 < 3.6870E-01 3.9002E+00

< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (48.8 to 1990.8 keV) 1.7142912E+01 pCi/g
Total Decayed Activity (48.8 to 1990.8 keV) 1.7268726E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 % Na-22 1274.54 ? Eu-154 1333.00 % Co-60
1408.00 & Eu-152 1460.80 ? K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

DET 1

122013blankdet1.Rpt

ORTEC g v - i (143) wan32 G53W2.06 23-DEC-2013 09:00:40 Page 1
Energy Laboratory Spectrum name: 122013blankdet1.An1

Sample description
122013blankdet1

Spectrum Filename: C:\User\122013blankdet1.An1

Acquisition information

Start time: 20-Dec-2013 15:29:43
Live time: 3598
Real time: 3600
Dead time: 0.05 %
Detector ID: 2

Detector system
Det 1

Calibration

Filename: julycc_5th_det1_169218.c1b
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 200 (48.19keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 5
Sample Size: 1.0000E+00
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
2.7000E+01
Detection limit method: Nureg 4.16

Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).

Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 23-DEC-2013 09:00:40 Page 2
 Energy Laboratory Spectrum name: 122013blankdet1.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	30-Apr-1999 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 1.0000

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Nuclide   Time of Count   Time Corrected   Uncertainty   2 Sigma   MDA
           Activity       Activity          Counting      Total
           pCi/l         pCi/l           pCi/l        pCi/l
-----
Ra-228 B<  1.9071E+02    1.1142E+03
Ra-226 <    6.4768E+02    6.5181E+02
Bi-214 B<   8.8904E+01    8.9469E+01
Pb-214 <    7.6916E+01    7.7405E+01
Ir-192 B<    1.08E+01 >12 Halflives
Sb-124 B<    2.60E+01 >12 Halflives
Sc-46 <     2.11E+01 >12 Halflives
Pb-210 No in-range peaks
Th-228 <    1.1693E+03    2.3755E+05
Th-230 <    2.6154E+03    2.6157E+03
Cs-137 <    2.6451E+01    3.7058E+01
Co-60 B<    2.6796E+01    1.8380E+02
Am-241 <    4.5126E+01    4.6198E+01
K-40 <     4.0463E+02    4.0463E+02
U-235 <     4.2024E+01    4.2024E+01
Th-234 B<    2.62E+03 >12 Halflives
Cs-134 <    2.7236E+01    3.7398E+03
Pb-212 <    4.2653E+01    4.2653E+01
Ra-224 <     5.35E+02 >12 Halflives
I-131 B<    2.22E+01 >12 Halflives
Mn-54 <     3.66E+01 >12 Halflives
Tl-208 <     3.92E+01 >12 Halflives
Bi-212 <     2.82E+02 >12 Halflives
Ra-223 <     1.26E+02 >12 Halflives
Pa-234 <     6.22E+01 >12 Halflives
Eu-154 <     5.8463E+01    1.8526E+02

```

□

ORTEC g v - i (143) wan32 G53W2.06 23-DEC-2013 09:00:40 Page 3

Eu-152 < 1.1862E+02 2.5400E+02
Na-22 < 3.1721E+01 1.5729E+03
Zn-65 < 6.94E+01 >12 Halflives
Ba-133 < 2.0256E+01 5.3255E+01
Ru-103 B< 1.36E+01 >12 Halflives
Be-7 B< 1.67E+02 >12 Halflives
I-125 No in-range peaks
Tl-201 B< 1.05E+02 >12 Halflives
Pa-234 B< 5.86E+01 >12 Halflives
Np-237 B< 8.6246E+01 8.6247E+01
Ce-144 B< 6.86E+01 >12 Halflives
Eu-155 < 3.7535E+01 2.9049E+02

< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (48.2 to 1980.2 keV) 0.0000000E+00 pCi/l
Total Decayed Activity (48.2 to 1980.2 keV) 0.0000000E+00 pCi/l

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 & Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1120.51 % Sc-46 1173.00 ? Co-60 1274.50 Na-22 1274.54 & Eu-154
1333.00 & Co-60 1408.00 % Eu-152 1460.80 & K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

DET2

122313blankdet2.Rpt

ORTEC g v - i (143) wan32 G53W2.06 23-DEC-2013 12:16:03 Page 1
Energy Laboratory Spectrum name: 122313blankdet2.An1

Sample description
122313blankdet2

Spectrum Filename: C:\User\122313blankdet2.An1

Acquisition information
Start time: 23-Dec-2013 11:07:24
Live time: 3597
Real time: 3600
Dead time: 0.07 %
Detector ID: 1

Detector system
Det 2

Calibration
Filename: julycc_5th_det2_169218.Clb
12/10/13 calibration energy det2
IPL #1692-18 recal calibration perched

Energy Calibration
Created: 10-Dec-2013 16:47:09
Zero offset: -0.166 keV
Gain: 0.245 keV/channel
Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration
Created: 26-Jul-2013 08:05:07
Type: Polynomial
Uncertainty: 0.613 %
Coefficients: -0.361975 -5.553226 0.556215
-0.064968 0.003465 -0.000073

Library Files
Main analysis library: Norman.lib
Library Match Width: 0.500

Analysis parameters
Analysis engine: wan32 G53W2.06
Start channel: 200 (48.77keV)
Stop channel: 8144 (1990.83keV)
Peak rejection level: 20.000%
Peak search sensitivity: 2
Sample Size: 1.0000E+00
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0000E+00) =
2.7000E+01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 23-DEC-2013 12:16:03 Page 2
 Energy Laboratory Spectrum name: 122313blankdet2.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	30-Apr-1999 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0758

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Nuclide   Time of Count   Time Corrected   Uncertainty   2 Sigma   MDA
           Activity      Activity          Counting      Total
           pCi/l        pCi/l           pCi/l        pCi/l
-----
Ra-228 B<  1.7035E+02    9.9620E+02
Ra-226 <    6.3733E+02    6.4139E+02
Bi-214 B<  9.2819E+01    9.3410E+01
Pb-214 <    7.9273E+01    7.9778E+01
Ir-192 B<  2.17E+01 >12 Halflives
Sb-124 B<  3.26E+01 >12 Halflives
Sc-46 <    1.37E+01 >12 Halflives
Pb-210 No in-range peaks
Th-228 <    1.2716E+03    2.5905E+05
Th-230 <    1.8478E+03    1.8480E+03
Cs-137 <    2.1781E+01    3.0521E+01
Co-60 B<  3.3997E+01    2.3343E+02
Am-241 <    2.5903E+01    2.6519E+01
K-40 <     9.8443E+02    9.8443E+02
U-235 <    4.0903E+01    4.0903E+01
Th-234 B<  2.57E+03 >12 Halflives
Cs-134 <    3.2033E+01    4.4098E+03
Pb-212 <    5.4855E+01    5.4855E+01
Ra-224 <    6.16E+02 >12 Halflives
I-131 B<  1.91E+01 >12 Halflives
Mn-54 <    2.99E+01 >12 Halflives
Tl-208 <    4.89E+01 >12 Halflives
Bi-212 <    2.61E+02 >12 Halflives
Ra-223 <    1.23E+02 >12 Halflives
Pa-234 <    7.91E+01 >12 Halflives
Eu-154 <    6.2501E+01    1.9818E+02
  
```

□

ORTEC g v - i (143) wan32 G53W2.06 23-DEC-2013 12:16:03 Page 3

Eu-152 < 1.7391E+02 3.7255E+02
 Na-22 < 1.5361E+01 7.6327E+02
 Zn-65 < 6.32E+01 >12 Halflives
 Ba-133 < 3.8165E+01 1.0039E+02
 Ru-103 B< 2.40E+01 >12 Halflives
 Be-7 B< 1.61E+02 >12 Halflives
 I-125 No in-range peaks
 Tl-201 B< 1.47E+02 >12 Halflives
 Pa-234 B< 4.96E+01 >12 Halflives
 Np-237 B< 1.2558E+02 1.2558E+02
 Ce-144 B< 1.07E+02 >12 Halflives
 Eu-155 < 6.9212E+01 5.3622E+02

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

S U M M A R Y

Total Activity (48.8 to 1990.8 keV) 0.0000000E+00 pCi/l
 Total Decayed Activity (48.8 to 1990.8 keV) 0.0000000E+00 pCi/l

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 Zn-65
 1120.51 % Sc-46 1173.00 & Co-60 1274.50 ? Na-22 1274.54 ? Eu-154
 1333.00 % Co-60 1408.00 % Eu-152 1460.80 K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 10:35:56 Page 1
 Energy Laboratory Spectrum name: C13110898.1.An1

Sample description
 C13110898.1

Spectrum Filename: C:\User\C13110898.1.An1

Acquisition information

Start time: 16-Dec-2013 09:31:01
 Live time: 3598
 Real time: 3600
 Dead time: 0.05 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.Clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.5639E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.5639E+02) =
 1.7265E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 10:35:56 Page 2
 Energy Laboratory Spectrum name: C13110898.1.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1573

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.4304E+00	1.4403E+00			
Ra-226 <	5.3109E+00	5.3111E+00			
Bi-214	1.6732E+00 ✓	1.6732E+00	5.6443E-01 ✓	5.6639E-01	6.103E-01 ✓
Pb-214	1.3910E+00	1.3911E+00	3.9173E-01	3.9368E-01	4.715E-01
Ir-192 B<	1.2444E-01	1.5133E-01			
Sb-124 B<	1.4317E-01	1.8211E-01			
Sc-46 <	2.4265E-01	2.8841E-01			
Pb-210 <	3.7291E+00	3.7357E+00			
Th-228 <	1.0135E+01	1.0348E+01			
Th-230 <	3.5457E+01	3.5457E+01			
Cs-137 <	2.4801E-01	2.4834E-01			
Co-60 B<	1.7135E-01	1.7264E-01			
Am-241 <	3.6534E-01	3.6537E-01			
K-40	2.0454E+01	2.0454E+01	4.0285E+00	4.0694E+00	2.587E+00
U-235 <	2.7332E-01	2.7332E-01			
Th-234 B<	2.4984E+01	4.5571E+01			
Cs-134 <	1.7686E-01	1.8030E-01			
Pb-212	9.2432E-01	9.2432E-01	2.7263E-01	2.7392E-01	3.741E-01
Ra-224 <	4.8375E+00	2.6444E+02			
I-131 B<	1.5314E-01	9.2787E-01			
Mn-54 <	1.7119E-01	1.7930E-01			
Tl-208 <	2.53E-01	>12 Halflives			
Bi-212 <	2.22E+00	>12 Halflives			
Ra-223 <	8.1898E-01	2.9082E+00			
Pa-234 <	5.35E-01	>12 Halflives			
Eu-154 <	8.8497E-01	8.8896E-01			

Eu-152	<	1.1835E+00	1.1870E+00
Na-22	<	1.4526E-01	1.4749E-01
Zn-65	<	4.3223E-01	4.5862E-01
Ba-133	<	1.7899E-01	1.7967E-01
Ru-103	B<	1.6302E-01	2.3556E-01
Be-7	B<	1.2005E+00	1.5746E+00
I-125	B<	1.1777E+00	1.4985E+00
Tl-201	B<	5.9184E-01	6.8962E+01
Pa-234	B<	4.36E-01	>12 Halflives
Np-237	B<	1.0834E+00	1.0834E+00
Ce-144	B<	9.3941E-01	9.8851E-01
Eu-155	<	4.5331E-01	4.5695E-01

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

S U M M A R Y

Total Activity (19.0 to 1980.2 keV) 2.4442837E+01 pCi/g

Total Decayed Activity (19.0 to 1980.2 keV) 2.4442913E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 % Th-234	1115.52 % Zn-65
1120.51 % Sc-46	1173.00 ? Co-60	1274.50 & Na-22	1274.54 Eu-154
1333.00 % Co-60	1408.00 % Eu-152		

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (2191) wan32 G53W2.06 16-DEC-2013 14:10:51 Page 1
 Energy Laboratory Spectrum name: c13110898.2.An1

Sample description
 c13110898.2

Spectrum Filename: C:\User\c13110898.2.An1

Acquisition information

Start time: 16-Dec-2013 10:38:14
 Live time: 3598
 Real time: 3600
 Dead time: 0.05 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7386E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7386E+02) =
 1.5530E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 16-DEC-2013 14:10:51 Page 2
 Energy Laboratory Spectrum name: c13110898.2.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1301

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	pCi/g
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 #B	1.2622E+00	1.2709E+00	5.4910E-01	5.5026E-01	1.533E+00
Ra-226 A	2.5459E-01	2.5459E-01	2.5576E+00	2.5576E+00	4.437E+00
Bi-214 F	1.0276E+00	1.0276E+00	4.8343E-01	4.8429E-01	5.814E-01
Pb-214	9.3626E-01	9.3628E-01	3.8962E-01	3.9051E-01	5.023E-01
Ir-192 #B	1.1473E-01	1.3959E-01	1.6517E-01	1.6521E-01	1.620E-01
Sb-124 #B	0.0000E+00	0.0000E+00	9.9003E+01	9.9003E+01	6.505E-02
Sc-46	3.2623E-01	3.8791E-01	1.7723E-01	1.7757E-01	1.328E-01
Pb-210	3.7170E+00	3.7236E+00	2.1600E+00	2.1617E+00	2.717E+00
Th-228 #A	-1.8697E-01	-1.9090E-01	-6.3962E+00	-6.3962E+00	9.552E+00
Th-230 #A	8.8448E+00	8.8448E+00	1.2981E+01	1.2982E+01	2.164E+01
Cs-137 #A	-1.8492E-02	-1.8516E-02	2.1023E+02	2.1023E+02	1.409E-01
Co-60 #B	-3.2271E-02	-3.2515E-02	2.5514E+02	2.5514E+02	1.795E-01
Am-241 #A	1.9827E-01	1.9829E-01	2.2458E-01	2.2462E-01	3.255E-01
K-40	1.5514E+01	1.5514E+01	3.3426E+00	3.3710E+00	2.327E+00
U-235 A	1.1098E-01	1.1098E-01	1.3487E-01	1.3491E-01	2.461E-01
Th-234 B	4.4856E+00	8.1926E+00	6.0250E+00	6.0340E+00	3.851E+01
Cs-134 #A	-3.3910E-02	-3.4570E-02	1.8757E+02	1.8757E+02	1.321E-01
Pb-212	9.3857E-01	9.3857E-01	2.2383E-01	2.2544E-01	2.711E-01
Ra-224 A	1.1514E+00	6.3503E+01	1.1455E+02	1.1456E+02	3.532E+00
I-131 #F	1.3144E-01	7.9963E-01	6.1051E-01	6.1093E-01	1.241E-01
Mn-54 #A	-1.9481E-03	-2.0407E-03	-8.2145E-02	-8.2145E-02	1.736E-01
Tl-208 H	4.8495E-01	>12 Halflives	2.0321E-01	2.0367E-01	2.311E-01
Bi-212 #A	5.7898E-01	>12 Halflives	1.0107E+00	1.0109E+00	1.581E+00
Ra-223 #A	-1.4795E-02	-5.2687E-02	-2.3057E+00	-2.3057E+00	8.301E-01
Pa-234 A	2.2638E-02	>12 Halflives	1.9409E-01	1.9409E-01	3.538E-01
Eu-154 #A	5.5967E-02	5.6220E-02	7.6315E-02	7.6332E-02	3.363E-01

ORTEC g v - i (2191) wan32 G53W2.06 16-DEC-2013 14:10:51 Page 3

Eu-152	#A	2.8897E-01	2.8984E-01	2.8920E-01	2.8932E-01	6.823E-01
Na-22	#A	-2.0972E-02	-2.1295E-02	2.4452E+02	2.4452E+02	1.595E-01
Zn-65	A	7.9617E-02	8.4489E-02	1.9230E-01	1.9231E-01	3.528E-01
Ba-133	A	5.7255E-02	5.7472E-02	1.2993E-01	1.2994E-01	2.424E-01
Ru-103	#B	0.0000E+00	0.0000E+00	1.0713E+02	1.0713E+02	6.195E-02
Be-7	#B	3.1713E-01	4.1620E-01	7.3784E-01	7.3803E-01	9.155E-01
I-125	#B	7.5861E-01	9.6572E-01	1.5819E+00	1.5823E+00	1.879E+00
Tl-201	#B	4.8005E-01	5.6534E+01	7.8837E+01	7.8870E+01	8.983E-01
Pa-234	#B	2.3396E-01	>12 Halflives	3.2958E-01	3.2970E-01	4.104E-01
Np-237	#B	0.0000E+00	0.0000E+00	1.4144E+03	1.4144E+03	9.667E-01
Ce-144	B	5.8739E-01	6.1816E-01	1.1430E+00	1.1431E+00	7.987E-01
Eu-155	A	2.8937E-01	2.9169E-01	1.4968E-01	1.4983E-01	3.643E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 1.6452654E+01 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 1.6452654E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.00 - Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 16-DEC-2013 14:10:51 Page 4
 Energy Laboratory Spectrum name: c13110898.2.An1

Laboratory: Energy Laboratory c13110898.2.Rpt

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 14:00:25 Page 1
 Energy Laboratory Spectrum name: C13110898.3.An1

Sample description
 C13110898.3

Spectrum Filename: C:\User\C13110898.3.An1

Acquisition information

Start time: 16-Dec-2013 12:05:07
 Live time: 3598
 Real time: 3600
 Dead time: 0.05 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7870E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7870E+02) =
 1.5109E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 14:00:25 Page 2
 Energy Laboratory Spectrum name: C13110898.3.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0864

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
		Activity pCi/g	Activity pCi/g	Counting pCi/g	Total pCi/g	
Ra-228	B<	1.5999E+00	1.6110E+00			
Ra-226	<	4.6595E+00	4.6596E+00			
Bi-214		1.0915E+00 ✓	1.0915E+00	3.9892E-01 ✓	4.0010E-01	4.809E-01 ✓
Pb-214		1.2036E+00	1.2037E+00	3.9246E-01	3.9392E-01	4.638E-01
Ir-192	B<	1.0396E-01	1.2656E-01			
Sb-124	B<	1.2129E-01	1.5448E-01			
Sc-46	<	2.3619E-01	2.8098E-01			
Pb-210	<	3.5305E+00	3.5369E+00			
Th-228	<	8.5470E+00	8.7272E+00			
Th-230	<	2.1785E+01	2.1785E+01			
Cs-137	<	1.3313E-01	1.3330E-01			
Co-60	B<	1.4996E-01	1.5110E-01			
Am-241	<	3.3518E-01	3.3522E-01			
K-40		1.5589E+01	1.5589E+01	3.3020E+00	3.3310E+00	2.264E+00
U-235	<	2.4831E-01	2.4831E-01			
Th-234	B<	1.8482E+01	3.3815E+01			
Cs-134	<	2.1478E-01	2.1897E-01			
Pb-212		1.1795E+00	1.1795E+00	2.5002E-01	2.5231E-01	2.981E-01
Ra-224	<	3.8136E+00	2.1279E+02			
I-131	B<	1.0892E-01	6.6606E-01			
Mn-54	<	1.4982E-01	1.5696E-01			
Tl-208	<	2.55E-01	>12 Halflives			
Bi-212	<	1.27E+00	>12 Halflives			
Ra-223	<	9.2031E-01	3.2893E+00			
Pa-234	<	3.33E-01	>12 Halflives			
Eu-154	<	3.2718E-01	3.2866E-01			

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 14:00:25 Page 3

Eu-152	<	7.8604E-01	7.8839E-01
Na-22	<	1.9663E-01	1.9967E-01
Zn-65	<	3.2388E-01	3.4376E-01
Ba-133	<	1.2976E-01	1.3026E-01
Ru-103	B<	1.6475E-01	2.3851E-01
Be-7	B<	7.4169E-01	9.7415E-01
I-125	B<	2.0175E+00	2.5700E+00
Tl-201	B<	6.7496E-01	8.0588E+01
Pa-234	B<	2.59E-01	>12 Halflives
Np-237	B<	9.5286E-01	9.5286E-01
Ce-144	B<	8.1791E-01	8.6088E-01
Eu-155	<	3.6333E-01	3.6626E-01

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

S U M M A R Y

Total Activity (19.0 to 1980.2 keV) 1.9064087E+01 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 1.9064144E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 % Th-234	1115.52 % Zn-65
1120.51 % Sc-46	1173.00 ? Co-60	1274.50 Na-22	1274.54 % Eu-154
1333.00 & Co-60	1408.00 % Eu-152		

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 15:17:46 Page 1
 Energy Laboratory Spectrum name: C13110898.4.An1

Sample description
 C13110898.4

Spectrum Filename: C:\User\C13110898.4.An1

Acquisition information

Start time: 16-Dec-2013 14:04:08
 Live time: 3598
 Real time: 3600
 Dead time: 0.06 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample size: 1.8893E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8893E+02) =
 1.4291E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 15:17:46 Page 2
 Energy Laboratory Spectrum name: C13110898.4.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1725

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count Activity pCi/g	Time Corrected Activity pCi/g	Uncertainty Counting pCi/g	2 Sigma Total pCi/g	MDA
Ra-228	B<	1.0095E+00	1.0165E+00			
Ra-226	<	4.2509E+00	4.2510E+00			
Bi-214		1.2405E+00 ✓	1.2406E+00	4.7434E-01 ✓	4.7562E-01	5.283E-01 ✓
Pb-214		1.4879E+00	1.4880E+00	3.4562E-01	3.4815E-01	4.721E-01
Ir-192	B<	8.5325E-02	1.0395E-01			
Sb-124	B<	1.3237E-01	1.6874E-01			
Sc-46	<	2.3228E-01	2.7652E-01			
Pb-210	<	3.1317E+00	3.1373E+00			
Th-228	<	8.9306E+00	9.1196E+00			
Th-230	<	2.2363E+01	2.2363E+01			
Cs-137	<	1.3666E-01	1.3684E-01			
Co-60	B<	1.4184E-01	1.4292E-01			
Am-241	<	2.7464E-01	2.7467E-01			
K-40		1.7869E+01	1.7869E+01	3.4214E+00	3.4582E+00	2.142E+00
U-235	<	2.5849E-01	2.5849E-01			
Th-234	B<	1.8475E+01	3.3882E+01			
Cs-134	<	1.5698E-01	1.6006E-01			
Pb-212		8.2930E-01	8.2930E-01	2.1584E-01	2.1715E-01	2.785E-01
Ra-224	<	3.6522E+00	2.0703E+02			
I-131	B<	1.3517E-01	8.3249E-01			
Mn-54	<	1.4857E-01	1.5568E-01			
Tl-208	<	2.00E-01	>12 Halflives			
Bi-212	<	1.53E+00	>12 Halflives			
Ra-223	<	8.2191E-01	2.9523E+00			
Pa-234	<	3.88E-01	>12 Halflives			
Eu-154	<	3.0947E-01	3.1088E-01			

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 15:17:46 Page 3

Eu-152	<	7.2247E-01	7.2464E-01
Na-22	<	1.3874E-01	1.4090E-01
Zn-65	<	3.6987E-01	3.9266E-01
Ba-133	<	1.7089E-01	1.7154E-01
Ru-103	B<	1.3108E-01	1.9005E-01
Be-7	B<	6.7425E-01	8.8652E-01
I-125	B<	2.2085E+00	2.8161E+00
Tl-201	B<	7.4649E-01	9.0821E+01
Pa-234	B<	3.30E-01	>12 Half-lives
Np-237	B<	9.9845E-01	9.9845E-01
Ce-144	B<	7.0738E-01	7.4469E-01
Eu-155	<	4.2451E-01	4.2795E-01

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

S U M M A R Y

Total Activity (19.0 to 1980.2 keV) 2.1426878E+01 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 2.1426947E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 % Th-234	1115.52 % Zn-65
1120.51 % Sc-46	1173.00 % Co-60	1274.50 % Na-22	1274.54 ? Eu-154
1333.00 % Co-60	1408.00 % Eu-152		

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 16:38:09 Page 1
 Energy Laboratory Spectrum name: C13110898.5.An1

sample description
 C13110898.5

Spectrum Filename: C:\User\C13110898.5.An1

Acquisition information

Start time: 16-Dec-2013 15:23:15
 Live time: 3557
 Real time: 3600
 Dead time: 1.19 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.Clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0562E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0562E+02) =
 2.5563E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 16:38:09 Page 2
 Energy Laboratory Spectrum name: C13110898.5.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1091

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.0421E+01	1.0494E+01			
Ra-226	6.5431E+02	6.5432E+02	5.2975E+01	5.6082E+01	8.108E+01
Bi-214	8.8656E+02	8.8658E+02	1.1873E+01	2.7623E+01	4.829E+00
Pb-214	9.1966E+02	9.1968E+02	8.8385E+00	2.7340E+01	4.123E+00
Ir-192 B<	1.1032E+00	1.3447E+00			
Sb-124 B<	1.5585E+00	1.9881E+00			
Sc-46	1.3729E+02	1.6352E+02	4.6007E+00	6.5059E+00	2.151E+00
Pb-210	8.3291E+02	8.3441E+02	3.8192E+01	4.2778E+01	4.301E+01
Th-228 <	1.4891E+02	1.5207E+02			
Th-230	1.4182E+03	1.4182E+03	3.5328E+02	3.5480E+02	4.659E+02
Cs-137 <	1.8111E+00	1.8135E+00			
Co-60 B<	2.1927E+00	2.2095E+00			
Am-241 <	3.9870E+00	3.9874E+00			
K-40 <	2.4128E+01	2.4128E+01			
U-235	8.2022E+01	8.2022E+01	2.9232E+00	3.7242E+00	3.893E+00
Th-234	1.4351E+03	2.6361E+03	8.5858E+01	1.3661E+02	3.396E+02
Cs-134 <	2.1636E+00	2.2061E+00			
Pb-212 <	3.0947E+00	3.0947E+00			
Ra-224 <	8.2366E+01	4.7184E+03			
I-131 B<	1.7863E+00	1.1054E+01			
Mn-54 <	1.6703E+00	1.7505E+00			
Tl-208 <	1.94E+00	>12 Half-lives			
Bi-212 <	1.92E+01	>12 Half-lives			
Ra-223	6.0084E+01	2.1655E+02	2.6474E+01	2.7166E+01	1.081E+01
Pa-234 <	6.27E+00	>12 Half-lives			
Eu-154 <	5.5981E+00	5.6237E+00			

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 16:38:09 Page 3

Eu-152		9.8098E+01	9.8394E+01	9.9866E+00	1.0363E+01	1.130E+01
Na-22	<	1.8363E+00	1.8649E+00			
Zn-65	<	3.3296E+00	3.5354E+00			
Ba-133	<	2.3454E+00	2.3544E+00			
Ru-103	B<	1.8666E+00	2.7088E+00			
Be-7	B<	1.5056E+01	1.9810E+01			
I-125	B<	2.0115E+01	2.5665E+01			
Tl-201	B<	9.4331E+00	1.1621E+03			
Pa-234	#	2.1496E+01	>12 Halflives	3.8927E+00	3.9730E+00	5.031E+00
Np-237	B<	1.6365E+01	1.6365E+01			
Ce-144	B<	9.6212E+00	1.0130E+01			
Eu-155	<	5.3955E+00	5.4393E+00			

- # - All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 6.5242905E+03 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 7.9097959E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 & Ra-228 969.10 % Ra-228 1115.52 % Zn-65 1173.00 % Co-60
 1274.50 % Na-22 1274.54 % Eu-154 1333.00 % Co-60 1460.80 % K-40

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 □

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 16:38:09 Page 4
 Energy Laboratory Spectrum name: C13110898.5.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:37:00 Page 1
 Energy Laboratory Spectrum name: C13110898.6.An1

Sample description
 C13110898.6

Spectrum Filename: C:\User\C13110898.6.An1

Acquisition information

Start time: 16-Dec-2013 16:39:11
 Live time: 3560
 Real time: 3600
 Dead time: 1.10 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0046E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0046E+02) =
 2.6876E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:37:00 Page 2
 Energy Laboratory Spectrum name: C13110898.6.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1895

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Time of Count		Time Corrected		2 Sigma	
Nuclide	Activity pCi/g	Activity pCi/g	Uncertainty Counting pCi/g	Total pCi/g	MDA
Ra-228 B<	5.5156E+00	5.5544E+00			
Ra-226	8.0283E+02	8.0285E+02	4.7643E+01	5.2726E+01	6.921E+01
Bi-214	9.2259E+02 ✓	9.2261E+02	1.1718E+01 ✓	2.8478E+01	4.594E+00 ✓
Pb-214	9.4165E+02	9.4168E+02	9.3053E+00	2.8078E+01	4.367E+00
Ir-192 B<	1.5494E+00	1.8896E+00			
Sb-124 B<	1.2878E+00	1.6437E+00			
Sc-46	1.3867E+02	1.6523E+02	4.7273E+00	6.6297E+00	2.158E+00
Pb-210	8.7028E+02	8.7186E+02	4.3938E+01	4.8332E+01	4.751E+01
Th-228 <	1.4413E+02	1.4720E+02			
Th-230 #	1.4387E+03	1.4387E+03	3.5448E+02	3.5603E+02	4.669E+02
Cs-137 <	1.4065E+00	1.4084E+00			
Co-60 B<	8.1011E-01	8.1631E-01			
Am-241 <	4.1758E+00	4.1762E+00			
K-40 <	2.0010E+01	2.0010E+01			
U-235	4.9246E+01	4.9246E+01	2.8553E+00	3.1737E+00	4.143E+00
Th-234 B<	3.4541E+02	6.3543E+02			
Cs-134 <	2.2479E+00	2.2922E+00			
Pb-212 <	3.1914E+00	3.1914E+00			
Ra-224 <	8.5772E+01	4.9633E+03			
I-131 B<	2.1476E+00	1.3350E+01			
Mn-54 <	1.5143E+00	1.5872E+00			
Tl-208 <	2.25E+00	>12 Halflives			
Bi-212 <	1.52E+01	>12 Halflives			
Ra-223	4.4563E+01	1.6112E+02	2.7377E+01	2.7750E+01	1.156E+01
Pa-234 <	6.19E+00	>12 Halflives			
Eu-154 <	5.9749E+00	6.0023E+00			

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:37:00 Page 3

Eu-152	#	1.1747E+02	1.1783E+02	1.6528E+01	1.6858E+01	1.146E+01
Na-22	<	2.4302E+00	2.4681E+00			
Zn-65	<	4.5367E+00	4.8178E+00			
Ba-133	<	2.4568E+00	2.4663E+00			
Ru-103	B<	1.1550E+00	1.6778E+00			
Be-7	B<	1.2489E+01	1.6444E+01			
I-125	B<	1.7897E+01	2.2849E+01			
Tl-201	B<	9.5673E+00	1.1929E+03			
Pa-234		1.0616E+01	>12 Halflives	3.6100E+00	3.6313E+00	4.901E+00
Np-237	B<	1.6438E+01	1.6438E+01			
Ce-144	B<	1.0226E+01	1.0768E+01			
Eu-155	<	4.8158E+00	4.8550E+00			

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Half-life limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 5.3259683E+03 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 5.4710835E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1173.00 % Co-60 1274.50 % Na-22 1274.54 % Eu-154 1333.00 % Co-60
 1460.80 % K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 □

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:37:00 Page 4
 Energy Laboratory Spectrum name: C13110898.6.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:20:27 Page 1
 Energy Laboratory Spectrum name: C13110898.7.An1

Sample description
 C13110898.7

Spectrum Filename: C:\User\C13110898.7.An1

Acquisition information

Start time: 17-Dec-2013 08:43:07
 Live time: 3567
 Real time: 3600
 Dead time: 0.92 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.c1b
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.5201E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.5201E+02) =
 1.7762E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:20:27 Page 2
 Energy Laboratory Spectrum name: C13110898.7.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1134

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Activity	Time Corrected	Uncertainty	2 Sigma
	Activity	pCi/g	Activity	Counting	Total
		pCi/g		pCi/g	pCi/g
					MDA
Ra-228 B<	3.3143E+00		3.3383E+00		
Ra-226	3.7991E+02		3.7992E+02	3.0460E+01	3.2281E+01 4.581E+01
Bi-214	4.7286E+02 ✓		4.7287E+02	7.1104E+00 ✓	1.5084E+01 2.963E+00 ✓
Pb-214	4.7710E+02		4.7711E+02	5.4282E+00	1.4478E+01 3.227E+00
Ir-192 B<	8.9251E-01		1.0953E+00		
Sb-124 B<	1.0564E+00		1.3588E+00		
Sc-46	7.1963E+01		8.6222E+01	2.8144E+00	3.7154E+00 1.404E+00
Pb-210	4.1062E+02		4.1139E+02	2.7791E+01	2.9370E+01 3.046E+01
Th-228 <	8.7060E+01		8.8972E+01		
Th-230 #	5.9896E+02		5.9896E+02	2.2418E+02	2.2461E+02 2.980E+02
Cs-137 <	1.1789E+00		1.1805E+00		
Co-60 B<	9.3109E-01		9.3844E-01		
Am-241 <	2.4410E+00		2.4413E+00		
K-40 <	1.5460E+01		1.5460E+01		
U-235	3.4312E+01		3.4312E+01	1.7475E+00	1.9964E+00 2.448E+00
Th-234	8.1968E+02		1.5372E+03	4.0622E+02	4.1092E+02 2.269E+02
Cs-134 <	1.1120E+00		1.1346E+00		
Pb-212 <	1.9331E+00		1.9331E+00		
Ra-224 <	4.9641E+01		3.2654E+03		
I-131 B<	9.2931E-01		6.1200E+00		
Mn-54 <	6.3021E-01		6.6151E-01		
Tl-208 <	1.12E+00	>12 Halflives			
Bi-212 <	1.29E+01	>12 Halflives			
Ra-223	2.4890E+01		9.3719E+01	1.6775E+01	1.6981E+01 6.768E+00
Pa-234 <	3.84E+00	>12 Halflives			
Eu-154 <	2.9825E+00		2.9966E+00		

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:20:27 Page 3

Eu-152	#	6.7487E+01	6.7698E+01	8.7936E+00	8.9975E+00	6.776E+00
Na-22	<	1.0384E+00	1.0551E+00			
Zn-65	<	2.6593E+00	2.8294E+00			
Ba-133	<	1.1441E+00	1.1486E+00			
Ru-103	B<	8.5344E-01	1.2544E+00			
Be-7	B<	9.6878E+00	1.2867E+01			
I-125	B<	1.3890E+01	1.7871E+01			
Tl-201	B<	7.2817E+00	1.0574E+03			
Pa-234	#	1.1474E+01	>12 Halflives	2.3546E+00	2.3925E+00	3.045E+00
Np-237	B<	9.7252E+00	9.7252E+00			
Ce-144	B<	5.0156E+00	5.2902E+00			
Eu-155	<	2.8886E+00	2.9129E+00			

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 3.3577712E+03 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 4.1594062E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 & Ra-228 969.10 ? Ra-228 1115.52 % Zn-65 1173.00 & Co-60
 1274.50 & Na-22 1274.54 Eu-154 1333.00 % Co-60 1460.80 % K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:20:27 Page 4
 Energy Laboratory Spectrum name: C13110898.7.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 11:24:31 Page 1
 Energy Laboratory Spectrum name: C13110898.8.An1

Sample description
 C13110898.8

Spectrum Filename: C:\User\C13110898.8.An1

Acquisition information

Start time: 17-Dec-2013 10:22:09
 Live time: 3574
 Real time: 3600
 Dead time: 0.71 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.1825E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.1825E+02) =
 2.2833E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 11:24:31 Page 2
 Energy Laboratory Spectrum name: C13110898.8.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1310

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pci/g	pci/g	pci/g	pci/g	
Ra-228 B<	7.7030E+00	7.7589E+00			
Ra-226	4.5648E+02	4.5649E+02	3.0794E+01	3.3365E+01	4.379E+01
Bi-214	4.9184E+02 ✓	4.9185E+02	7.9612E+00 ✓	1.5964E+01	3.354E+00 ✓
Pb-214	5.0212E+02	5.0213E+02	6.2800E+00	1.5459E+01	3.775E+00
Ir-192 B<	1.0387E+00	1.2755E+00			
Sb-124 B<	1.1579E+00	1.4905E+00			
Sc-46	7.4895E+01	8.9786E+01	3.3014E+00	4.1568E+00	1.806E+00
Pb-210	4.6131E+02	4.6218E+02	2.7949E+01	2.9918E+01	3.046E+01
Th-228 <	9.4261E+01	9.6338E+01			
Th-230 #	7.5624E+02	7.5624E+02	2.4057E+02	2.4121E+02	3.177E+02
Cs-137 <	1.3588E+00	1.3607E+00			
Co-60 B<	1.0232E+00	1.0313E+00			
Am-241 <	2.2189E+00	2.2191E+00			
K-40 #	5.6710E+01	5.6710E+01	2.2471E+01	2.2527E+01	1.630E+01
U-235	2.0713E+01	2.0713E+01	1.9099E+00	1.9968E+00	2.863E+00
Th-234 B<	2.2553E+02	4.2379E+02			
Cs-134 <	1.4989E+00	1.5294E+00			
Pb-212 <	2.1720E+00	2.1720E+00			
Ra-224 <	5.7546E+01	3.8356E+03			
I-131 B<	1.1447E+00	7.5834E+00			
Mn-54 <	1.1795E+00	1.2382E+00			
Tl-208 <	1.50E+00	>12 Halflives			
Bi-212 <	8.85E+00	>12 Halflives			
Ra-223	2.7424E+01	1.0369E+02	1.9683E+01	1.9898E+01	7.890E+00
Pa-234 <	3.74E+00	>12 Halflives			
Eu-154 <	4.1540E+00	4.1736E+00			

Eu-152		6.0685E+01	6.0875E+01	1.1573E+01	1.1699E+01	9.181E+00
Na-22	<	1.6626E+00	1.6894E+00			
Zn-65	<	2.9931E+00	3.1851E+00			
Ba-133	<	1.5923E+00	1.5986E+00			
Ru-103	B<	1.1430E+00	1.6820E+00			
Be-7	B<	8.7349E+00	1.1612E+01			
I-125	B<	8.8613E+00	1.1410E+01			
Tl-201	B<	6.5757E+00	9.6994E+02			
Pa-234	B<	3.26E+00	>12 Halflives			
Np-237		1.8930E+01	1.8930E+01	6.6210E+00	6.6579E+00	1.072E+01
Ce-144	B<	6.6623E+00	7.0283E+00			
Eu-155	<	3.4416E+00	3.4706E+00			

- # - All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 2.9273513E+03 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 3.0196038E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 & Ra-228 969.10 & Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1173.00 % Co-60 1274.50 % Na-22 1274.54 % Eu-154 1333.00 % Co-60

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 □

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 11:24:31 Page 4
 Energy Laboratory Spectrum name: C13110898.8.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 14:11:24 Page 1
 Energy Laboratory Spectrum name: C13110898.9.An1

Sample description
 C13110898.9

Spectrum Filename: C:\User\C13110898.9.An1

Acquisition information

Start time: 17-Dec-2013 12:12:01
 Live time: 3576
 Real time: 3600
 Dead time: 0.67 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.3486E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.3486E+02) =
 2.0021E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

C13110898.9.Rpt

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 14:11:24 Page 2
 Energy Laboratory Spectrum name: C13110898.9.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1070

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	5.5500E+00	5.5905E+00			
Ra-226	3.2448E+02	3.2449E+02	2.8516E+01	2.9941E+01	4.249E+01
Bi-214	3.7176E+02 ✓	3.7177E+02	6.5347E+00 ✓	1.2332E+01	2.497E+00 ✓
Pb-214	3.8883E+02	3.8884E+02	5.2866E+00	1.2149E+01	2.537E+00
Ir-192 B<	9.1596E-01	1.1256E+00			
Sb-124 B<	1.0107E+00	1.3022E+00			
Sc-46	5.8504E+01	7.0180E+01	2.6645E+00	3.3162E+00	1.230E+00
Pb-210	3.3143E+02	3.3205E+02	2.1705E+01	2.3020E+01	2.474E+01
Th-228 <	8.4124E+01	8.5984E+01			
Th-230 <	2.8948E+02	2.8948E+02			
Cs-137 <	8.7807E-01	8.7929E-01			
Co-60 B<	5.4209E-01	5.4640E-01			
Am-241 <	2.6645E+00	2.6647E+00			
K-40 <	1.1718E+01	1.1718E+01			
U-235	2.5834E+01	2.5834E+01	1.6522E+00	1.8050E+00	2.343E+00
Th-234	4.3316E+02	8.1574E+02	4.6510E+01	5.6959E+01	1.847E+02
Cs-134 <	1.2036E+00	1.2282E+00			
Pb-212 <	1.8348E+00	1.8348E+00			
Ra-224 <	4.7618E+01	3.2205E+03			
I-131 B<	5.8340E-01	3.8904E+00			
Mn-54 <	7.5791E-01	7.9580E-01			
Tl-208 <	1.17E+00	>12 Halflives			
Bi-212 <	1.12E+01	>12 Halflives			
Ra-223	1.8934E+01	7.1923E+01	1.6107E+01	1.6234E+01	6.496E+00
Pa-234 <	3.59E+00	>12 Halflives			
Eu-154 <	3.5831E+00	3.6002E+00			

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 14:11:24 Page 3

Eu-152		5.3168E+01	5.3335E+01	9.0659E+00	9.1892E+00	7.211E+00
Na-22	<	1.1316E+00	1.1499E+00			
Zn-65	<	2.4314E+00	2.5880E+00			
Ba-133	<	1.2998E+00	1.3050E+00			
Ru-103	B<	1.0077E+00	1.4850E+00			
Be-7	B<	7.6345E+00	1.0159E+01			
I-125	B<	1.1003E+01	1.4180E+01			
Tl-201	B<	8.2950E+00	1.2450E+03			
Pa-234	B<	3.00E+00	>12 Halflives			
Np-237	B<	9.2098E+00	9.2098E+00			
Ce-144	B<	5.4758E+00	5.7776E+00			
Eu-155	<	2.3099E+00	2.3295E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

----- S U M M A R Y -----

Total Activity (19.0 to 1980.2 keV) 2.0061000E+03 pCi/g

Total Decayed Activity (19.0 to 1980.2 keV) 2.4541619E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 & Ra-228	969.10 & Ra-228	1115.52 % Zn-65	1173.00 & Co-60
1274.50 & Na-22	1274.54 Eu-154	1333.00 % Co-60	1460.80 % K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:35:20 Page 1
 Energy Laboratory Spectrum name: C13110898.10.An1

Sample description
 C13110898.10

Spectrum Filename: C:\User\C13110898.10.An1

Acquisition information

Start time: 17-Dec-2013 14:15:38
 Live time: 3581
 Real time: 3600
 Dead time: 0.53 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.3219E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.3219E+02) =
 2.0425E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:35:20 Page 2
 Energy Laboratory Spectrum name: C13110898.10.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1226

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Activity	Time Corrected	Uncertainty	2 Sigma
	Activity	pCi/g	Activity	Counting	Total
		pCi/g		pCi/g	pCi/g
					MDA
Ra-228 B<	4.9953E+00		5.0319E+00		
Ra-226	3.1652E+02		3.1653E+02	2.2770E+01	2.4449E+01 3.165E+01
Bi-214	3.2161E+02		3.2162E+02	5.9662E+00	1.0838E+01 2.333E+00
Pb-214	3.2817E+02		3.2818E+02	4.7922E+00	1.0402E+01 3.199E+00
Ir-192 B<	9.5516E-01		1.1747E+00		
Sb-124 B<	8.0650E-01		1.0401E+00		
Sc-46	4.7611E+01		5.7154E+01	2.4058E+00	2.8937E+00 1.027E+00
Pb-210	2.9470E+02		2.9526E+02	2.4184E+01	2.5127E+01 2.572E+01
Th-228 <	7.1570E+01		7.3159E+01		
Th-230 <	2.6082E+02		2.6082E+02		
Cs-137 <	1.0991E+00		1.1007E+00		
Co-60 B<	6.3912E-01		6.4422E-01		
Am-241 <	2.4408E+00		2.4411E+00		
K-40 #	3.9086E+01		3.9086E+01	1.4322E+01	1.4364E+01 1.219E+01
U-235	1.1126E+01		1.1126E+01	1.4575E+00	1.4907E+00 2.232E+00
Th-234 B<	1.6693E+02		3.1515E+02		
Cs-134 <	1.0447E+00		1.0662E+00		
Pb-212 <	1.6991E+00		1.6991E+00		
Ra-224 <	4.4344E+01		3.0488E+03		
I-131 B<	7.4824E-01		5.0267E+00		
Mn-54 <	7.6312E-01		8.0142E-01		
Tl-208 <	1.31E+00	>12 Halflives			
Bi-212 <	8.62E+00	>12 Halflives			
Ra-223	1.7810E+01		6.8008E+01	1.4920E+01	1.5042E+01 5.922E+00
Pa-234 <	3.32E+00	>12 Halflives			
Eu-154 <	2.9167E+00		2.9306E+00		

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:35:20 Page 3

Eu-152		3.9723E+01	3.9849E+01	7.9338E+00	8.0127E+00	6.443E+00
Na-22	<	1.0107E+00	1.0271E+00			
Zn-65	<	2.0668E+00	2.2004E+00			
Ba-133	<	1.3640E+00	1.3694E+00			
Ru-103	B<	9.8460E-01	1.4531E+00			
Be-7	B<	5.9435E+00	7.9176E+00			
I-125	B<	1.2055E+01	1.5551E+01			
Tl-201	B<	3.6482E+00	5.5836E+02			
Pa-234	B<	2.21E+00	>12 Halflives			
Np-237	B<	8.1945E+00	8.1945E+00			
Ce-144	B<	4.8491E+00	5.1175E+00			
Eu-155	<	2.8137E+00	2.8375E+00			

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 1.4163606E+03 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 1.4768073E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1173.00 & Co-60 1274.50 & Na-22 1274.54 Eu-154 1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 □

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:35:20 Page 4
 Energy Laboratory Spectrum name: C13110898.10.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

C13110898.10.Rpt

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:38 Page 1
 Energy Laboratory Spectrum name: C13110898.10dup.An1

Sample description
 C13110898.10dup

Spectrum Filename: C:\User\C13110898.10dup.An1

Acquisition information

Start time: 17-Dec-2013 15:36:04
 Live time: 3581
 Real time: 3600
 Dead time: 0.53 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.c1b
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.3219E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.3219E+02) =
 2.0425E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:38 Page 2
 Energy Laboratory Spectrum name: C13110898.10dup.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1228

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Time of Count   Time Corrected   Uncertainty   2 Sigma
Nuclide         Activity          Activity          Counting      Total
                pCi/g           pCi/g           pCi/g         pCi/g
                MDA
Ra-228 B<      6.6327E+00    6.6814E+00
Ra-226      3.2430E+02    3.2431E+02    2.2711E+01    2.4475E+01    3.137E+01
Bi-214      3.2214E+02 ✓    3.2214E+02    6.0865E+00 ✓    1.0917E+01    2.385E+00 ✓
Pb-214      3.2408E+02    3.2409E+02    4.7475E+00    1.0279E+01    2.284E+00
Ir-192 B<     1.0347E+00    1.2732E+00
Sb-124 B<     6.5017E-01    8.3906E-01
Sc-46       4.8408E+01    5.8138E+01    2.4738E+00    2.9655E+00    1.234E+00
Pb-210      2.8206E+02    2.8260E+02    2.1579E+01    2.2545E+01    2.394E+01
Th-228 <      7.2003E+01    7.3605E+01
Th-230 <      2.2853E+02    2.2853E+02
Cs-137 <      1.0011E+00    1.0025E+00
Co-60 B<     9.0102E-01    9.0823E-01
Am-241 <      2.6191E+00    2.6194E+00
K-40 <       1.4034E+01    1.4034E+01
U-235       1.0244E+01    1.0244E+01    1.4675E+00    1.4955E+00    2.266E+00
Th-234 B<     1.9958E+02    3.7739E+02
Cs-134 <     9.1047E-01    9.2922E-01
Pb-212 <     1.7089E+00    1.7089E+00
Ra-224 <     4.4193E+01    3.0711E+03
I-131 B<     9.0855E-01    6.1331E+00
Mn-54 <      1.2149E+00    1.2761E+00
Tl-208 <      1.10E+00 >12 Halflives
Bi-212 <      9.14E+00 >12 Halflives
Ra-223      1.7880E+01    6.8505E+01    1.4834E+01    1.4959E+01    5.854E+00
Pa-234 <      3.35E+00 >12 Halflives
Eu-154 <     2.7693E+00    2.7826E+00
  
```

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:38 Page 3

Eu-152	#	4.1456E+01	4.1587E+01	7.2081E+00	7.3024E+00	5.802E+00
Na-22	<	6.3545E-01	6.4581E-01			
Zn-65	<	2.0652E+00	2.1991E+00			
Ba-133	<	1.3669E+00	1.3724E+00			
Ru-103	B<	9.3511E-01	1.3814E+00			
Be-7	B<	6.1025E+00	8.1353E+00			
I-125	B<	1.1754E+01	1.5173E+01			
Tl-201	B<	7.4492E+00	1.1547E+03			
Pa-234	B<	2.48E+00	>12 Half-lives			
Np-237	B<	8.4051E+00	8.4051E+00			
Ce-144	B<	4.9827E+00	5.2592E+00			
Eu-155	<	2.4856E+00	2.5068E+00			

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Half-life limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 1.3705621E+03 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 1.4316068E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 & Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1173.00 % Co-60 1274.50 & Na-22 1274.54 Eu-154 1333.00 % Co-60
 1460.80 % K-40

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:38 Page 4
 Energy Laboratory Spectrum name: C13110898.10dup.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor C13110898.10dup.Rpt

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 08:38:51 Page 1
 Energy Laboratory Spectrum name: C13110898.11.An1

Sample description
 C13110898.11

Spectrum Filename: C:\User\C13110898.11.An1

Acquisition information

Start time: 17-Dec-2013 16:45:34
 Live time: 3585
 Real time: 3600
 Dead time: 0.41 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7990E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7990E+02) =
 1.5008E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 08:38:51 Page 2
 Energy Laboratory Spectrum name: C13110898.11.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1399

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	3.3084E+00	3.3328E+00			
Ra-226	1.9036E+02	1.9037E+02	1.4364E+01	1.5330E+01	1.953E+01
Bi-214	1.6229E+02	1.6229E+02	3.7659E+00	5.9184E+00	1.747E+00
Pb-214	1.6993E+02	1.6994E+02	2.9865E+00	5.6368E+00	1.740E+00
Ir-192 B<	6.1572E-01	7.5799E-01			
Sb-124 B<	4.5469E-01	5.8711E-01			
Sc-46	2.5567E+01	3.0718E+01	1.5284E+00	1.7558E+00	7.240E-01
Pb-210	1.4760E+02	1.4788E+02	1.5060E+01	1.5443E+01	1.652E+01
Th-228 <	4.5415E+01	4.6428E+01			
Th-230 <	1.3326E+02	1.3326E+02			
Cs-137 <	5.1581E-01	5.1653E-01			
Co-60 B<	5.2438E-01	5.2858E-01			
Am-241 <	1.6295E+00	1.6297E+00			
K-40	2.8217E+01	2.8217E+01	9.8257E+00	9.8577E+00	8.400E+00
U-235	5.1676E+00	5.1676E+00	9.3825E-01	9.4945E-01	1.463E+00
Th-234 B<	1.0776E+02	2.0405E+02			
Cs-134 <	5.5210E-01	5.6350E-01			
Pb-212 <	1.0995E+00	1.0995E+00			
Ra-224 <	2.7509E+01	1.9294E+03			
I-131 B<	6.1865E-01	4.1936E+00			
Mn-54 <	5.6005E-01	5.8830E-01			
Tl-208 <	7.49E-01	>12 Halflives			
Bi-212 <	3.17E+00	>12 Halflives			
Ra-223	9.3686E+00	3.6001E+01	9.3940E+00	9.4484E+00	3.724E+00
Pa-234 <	2.15E+00	>12 Halflives			
Eu-154 <	1.3400E+00	1.3464E+00			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 08:38:51 Page 3

Eu-152		2.4679E+01	2.4757E+01	4.9126E+00	4.9618E+00	3.755E+00
Na-22	<	5.5680E-01	5.6590E-01			
Zn-65	<	1.0784E+00	1.1485E+00			
Ba-133	<	6.1861E-01	6.2109E-01			
Ru-103	B<	4.1353E-01	6.1139E-01			
Be-7	B<	5.9886E+00	7.9885E+00			
I-125	B<	7.5490E+00	9.7500E+00			
Tl-201	B<	5.1111E+00	8.0103E+02			
Pa-234	B<	1.59E+00	>12 Halflives			
Np-237	B<	5.3139E+00	5.3139E+00			
Ce-144	B<	2.9848E+00	3.1508E+00			
Eu-155	<	1.2142E+00	1.2245E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 7.6318011E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 7.9533466E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 & Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 & Co-60 1274.50 Na-22 1274.54 % Eu-154 1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:43:00 Page 1
 Energy Laboratory Spectrum name: C13110898.12.An1

Sample description
 C13110898.12

Spectrum Filename: C:\User\C13110898.12.An1

Acquisition information

Start time: 18-Dec-2013 08:39:35
 Live time: 3585
 Real time: 3600
 Dead time: 0.42 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.9638E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.9638E+02) =
 1.3749E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:43:00 Page 2
 Energy Laboratory Spectrum name: C13110898.12.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1292

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide	Time of Count	Activity	Time Corrected	Uncertainty	2 Sigma	MDA
		pCi/g	Activity	Counting	Total	
		pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	2.9195E+00	2.9416E+00				
Ra-226	1.6666E+02	1.6666E+02	1.3755E+01	1.4532E+01	1.927E+01	
Bi-214	1.5006E+02	1.5006E+02	3.6036E+00	5.5505E+00	1.530E+00	
Pb-214	1.5280E+02	1.5281E+02	2.7598E+00	5.1085E+00	1.714E+00	
Ir-192 B<	5.1884E-01	6.4270E-01				
Sb-124 B<	4.9619E-01	6.4560E-01				
Sc-46	2.3165E+01	2.7985E+01	1.4135E+00	1.6180E+00	7.136E-01	
Pb-210	1.0653E+02	1.0674E+02	1.2586E+01	1.2825E+01	1.459E+01	
Th-228 <	4.2981E+01	4.3968E+01				
Th-230	2.1782E+02	2.1782E+02	8.1408E+01	8.1563E+01	1.303E+02	
Cs-137 <	3.7880E-01	3.7934E-01				
Co-60 B<	2.3637E-01	2.3832E-01				
Am-241 <	1.2607E+00	1.2608E+00				
K-40 #	2.4495E+01	2.4495E+01	8.5194E+00	8.5472E+00	7.278E+00	
U-235	6.0580E+00	6.0580E+00	8.7494E-01	8.9138E-01	1.340E+00	
Th-234 B<	1.1257E+02	2.1726E+02				
Cs-134 <	6.3801E-01	6.5158E-01				
Pb-212 <	1.0255E+00	1.0255E+00				
Ra-224 <	2.5250E+01	2.0105E+03				
I-131 B<	4.0495E-01	2.9063E+00				
Mn-54 <	3.7625E-01	3.9581E-01				
Tl-208 <	6.93E-01	>12 Half-lives				
Bi-212 <	6.06E+00	>12 Half-lives				
Ra-223	8.2134E+00	3.2855E+01	9.2407E+00	9.2868E+00	3.555E+00	
Pa-234 <	1.58E+00	>12 Half-lives				
Eu-154 <	6.0976E-01	6.1278E-01				

□

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:43:00 Page 3

Eu-152	#	2.1884E+01	2.1955E+01	4.4416E+00	4.4843E+00	3.565E+00
Na-22	<	2.3431E-01	2.3826E-01			
Zn-65	<	1.2691E+00	1.3541E+00			
Ba-133	<	6.6077E-01	6.6350E-01			
Ru-103	B<	5.0000E-01	7.4792E-01			
Be-7	B<	4.0507E+00	5.4500E+00			
I-125	B<	6.9655E+00	9.0653E+00			
Tl-201	B<	4.7154E+00	8.5935E+02			
Pa-234	B<	1.55E+00	>12 Halflives			
Np-237	B<	4.9702E+00	4.9702E+00			
Ce-144	B<	1.8124E+00	1.9163E+00			
Eu-155	<	1.2705E+00	1.2817E+00			

- # - All peaks for activity calculation had bad shape.
- * - Activity omitted from total
- & - Activity omitted from total and all peaks had bad shape.
- < - MDA value printed.
- A - Activity printed, but activity < MDA.
- B - Activity < MDA and failed test.
- C - Area < Critical level.
- F - Failed fraction or key line test.
- H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 8.7768951E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 9.0744330E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 & Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 ? Na-22 1274.54 ? Eu-154 1333.00 ? Co-60

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
- ? - Peak is too narrow.
- @ - Peak is too wide at FW25M, but ok at FWHM.
- % - Peak fails sensitivity test.
- \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
- + - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
- = - Peak outside analysis energy range.
- & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
- P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:43:00 Page 4
Energy Laboratory Spectrum name: C13110898.12.An1

Analyzed by: _____
Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 10:57:46 Page 1
 Energy Laboratory Spectrum name: C13110898.13.An1

Sample description
 C13110898.13

Spectrum Filename: C:\User\C13110898.13.An1

Acquisition information

Start time: 18-Dec-2013 09:44:07
 Live time: 3592
 Real time: 3600
 Dead time: 0.24 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0479E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0479E+02) =
 2.5766E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 10:57:46 Page 2
 Energy Laboratory Spectrum name: C13110898.13.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0885

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	4.1113E+00	4.1425E+00			
Ra-226	1.6577E+02	1.6578E+02	1.9969E+01	2.0506E+01	2.873E+01
Bi-214	1.5199E+02 ✓	1.5199E+02	4.6341E+00 ✓	6.3054E+00	2.086E+00 ✓
Pb-214	1.5656E+02	1.5656E+02	3.6614E+00	5.7275E+00	2.104E+00
Ir-192 B<	5.6883E-01	7.0492E-01			
Sb-124 B<	6.1174E-01	7.9636E-01			
Sc-46	2.2915E+01	2.7693E+01	1.9016E+00	2.0550E+00	8.998E-01
Pb-210	1.5732E+02	1.5763E+02	1.4550E+01	1.4998E+01	1.640E+01
Th-228 <	5.8940E+01	6.0297E+01			
Th-230 <	1.8145E+02	1.8145E+02			
Cs-137 <	8.1749E-01	8.1867E-01			
Co-60 B<	5.5579E-01	5.6040E-01			
Am-241 <	1.9183E+00	1.9185E+00			
K-40 <	1.0384E+01	1.0384E+01			
U-235	8.4273E+00	8.4273E+00	1.2218E+00	1.2446E+00	1.823E+00
Th-234 B<	1.4157E+02	2.7358E+02			
Cs-134 <	9.4620E-01	9.6636E-01			
Pb-212 <	1.3576E+00	1.3576E+00			
Ra-224 <	3.4632E+01	2.7813E+03			
I-131 B<	8.7265E-01	6.2872E+00			
Mn-54 <	5.8002E-01	6.1023E-01			
Tl-208 <	9.28E-01 >12	Half lives			
Bi-212 <	8.64E+00 >12	Half lives			
Ra-223 <	4.7130E+00	1.8904E+01			
Pa-234 <	2.29E+00 >12	Half lives			
Eu-154 <	1.7861E+00	1.7949E+00			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 10:57:46 Page 3

Eu-152		2.0867E+01	2.0935E+01	5.3642E+00	5.3964E+00	4.456E+00
Na-22	<	1.0328E+00	1.0502E+00			
Zn-65	<	1.6559E+00	1.7671E+00			
Ba-133	<	9.3581E-01	9.3970E-01			
Ru-103	B<	6.0169E-01	9.0074E-01			
Be-7	B<	3.9338E+00	5.2959E+00			
I-125	B<	8.2315E+00	1.0719E+01			
Tl-201	B<	2.8105E+00	5.1744E+02			
Pa-234	B<	2.10E+00	>12 Halflives			
Np-237	B<	6.7953E+00	6.7953E+00			
Ce-144	B<	3.9851E+00	4.2139E+00			
Eu-155	<	2.0782E+00	2.0965E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

S U M M A R Y

Total Activity (19.0 to 1980.2 keV) 6.8384845E+02 pCi/g

Total Decayed Activity (19.0 to 1980.2 keV) 6.8901520E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 % Th-234	1115.52 % Zn-65
1173.00 % Co-60	1274.50 Na-22	1274.54 % Eu-154	1333.00 % Co-60
1460.80 % K-40			

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave BlaidaReviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 12:50:33 Page 1
 Energy Laboratory Spectrum name: C13110898.14.An1

Sample description
 C13110898.14

Spectrum Filename: C:\User\C13110898.14.An1

Acquisition information

Start time: 18-Dec-2013 11:45:45
 Live time: 3588
 Real time: 3600
 Dead time: 0.33 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.9032E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.9032E+02) =
 1.4187E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 12:50:33 Page 2
 Energy Laboratory Spectrum name: C13110898.14.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1200

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Nuclide      Time of Count   Time Corrected   Uncertainty   2 Sigma   MDA
              Activity       Activity          Counting      Total
              pCi/g         pCi/g            pCi/g         pCi/g
-----
Ra-228 B<    2.9901E+00    3.0129E+00
Ra-226      1.0671E+02    1.0672E+02    1.2767E+01    1.3115E+01    1.874E+01
Bi-214      1.1857E+02    1.1857E+02    3.0766E+00    4.5378E+00    1.277E+00
Pb-214      1.1932E+02    1.1933E+02    2.4231E+00    4.1400E+00    1.415E+00
Ir-192 B<    5.4372E-01    6.7433E-01
Sb-124 B<    4.4483E-01    5.7964E-01
Sc-46       1.7828E+01    2.1560E+01    1.2691E+00    1.4066E+00    6.736E-01
Pb-210      1.0321E+02    1.0341E+02    1.0748E+01    1.1010E+01    1.224E+01
Th-228 <     3.8902E+01    3.9801E+01
Th-230 <     1.4205E+02    1.4205E+02
Cs-137 <     4.1543E-01    4.1603E-01
Co-60 B<    2.2589E-01    2.2777E-01
Am-241 <     1.3529E+00    1.3530E+00
K-40 #      2.7168E+01    2.7168E+01    7.7555E+00    7.7931E+00    6.361E+00
U-235       6.0409E+00    6.0409E+00    7.7035E-01    7.8887E-01    1.147E+00
Th-234 B<    8.8552E+01    1.7154E+02
Cs-134 <     6.1927E-01    6.3251E-01
Pb-212 <     9.0599E-01    9.0599E-01
Ra-224 <     2.2787E+01    1.8599E+03
I-131 B<    6.2072E-01    4.5049E+00
Mn-54 <     2.7624E-01    2.9068E-01
Tl-208 <     6.60E-01    >12 Halflives
Bi-212 <     6.16E+00    >12 Halflives
Ra-223      5.3254E+00    2.1470E+01    8.1661E+00    8.1884E+00    3.168E+00
Pa-234 <     1.63E+00    >12 Halflives
Eu-154 <     9.0844E-01    9.1295E-01
  
```

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 12:50:33 Page 3

Eu-152		1.3929E+01	1.3975E+01	3.3301E+00	3.3532E+00	2.848E+00
Na-22	<	4.9474E-01	5.0311E-01			
Zn-65	<	1.0401E+00	1.1101E+00			
Ba-133	<	5.2149E-01	5.2366E-01			
Ru-103	B<	4.9004E-01	7.3469E-01			
Be-7	B<	4.1321E+00	5.5689E+00			
I-125	B<	5.4542E+00	7.1089E+00			
Tl-201	B<	3.7379E+00	7.0156E+02			
Pa-234	B<	1.40E+00	>12 Halflives			
Np-237	B<	4.3552E+00	4.3552E+00			
Ce-144	B<	3.3352E+00	3.5274E+00			
Eu-155	<	1.1634E+00	1.1736E+00			

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.0 to 1980.2 keV) 5.1810150E+02 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 5.3823651E+02 pCi/g

The library has energies which are not separable.

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 & Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1173.00 & Co-60 1274.50 Na-22 1274.54 & Eu-154 1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 12:50:33 Page 4
 Energy Laboratory Spectrum name: C13110898.14.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 14:36:22 Page 1
 Energy Laboratory Spectrum name: C13110898.15.An1

Sample description
 C13110898.15

Spectrum Filename: C:\User\C13110898.15.An1

Acquisition information

Start time: 18-Dec-2013 12:51:38
 Live time: 3590
 Real time: 3600
 Dead time: 0.27 %
 Detector ID: 2

Detector system
 Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
 12/10/13 calibration energy/efficiency
 IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
 Zero offset: -0.447 keV
 Gain: 0.243 keV/channel
 Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
 Type: Polynomial
 Uncertainty: 1.391 %
 Coefficients: -0.329484 -5.959887 0.633715
 -0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.01keV)
 Stop channel: 8144 (1980.24keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7601E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7601E+02) =
 1.5340E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 14:36:22 Page 2
 Energy Laboratory Spectrum name: C13110898.15.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1296

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	3.3768E+00	3.4026E+00			
Ra-226	9.6752E+01	9.6754E+01	1.2139E+01	1.2440E+01	1.764E+01
Bi-214	9.8658E+01 ✓	9.8661E+01	2.9055E+00 ✓	4.0181E+00	1.175E+00 ✓
Pb-214	1.0119E+02	1.0119E+02	2.4044E+00	3.7262E+00	1.414E+00
Ir-192 B<	3.7304E-01	4.6285E-01			
Sb-124 B<	4.6407E-01	6.0503E-01			
Sc-46	1.4686E+01	1.7767E+01	1.2004E+00	1.3003E+00	6.499E-01
Pb-210	7.9374E+01	7.9530E+01	8.6369E+00	8.8301E+00	1.020E+01
Th-228 <	3.6496E+01	3.7341E+01			
Th-230 <	1.1527E+02	1.1527E+02			
Cs-137 <	5.7100E-01	5.7183E-01			
Co-60 B<	5.9317E-01	5.9811E-01			
Am-241 <	1.2628E+00	1.2630E+00			
K-40	2.4262E+01	2.4262E+01	6.8851E+00	6.9189E+00	6.022E+00
U-235	4.6174E+00	4.6174E+00	7.4670E-01	7.5791E-01	1.132E+00
Th-234 B<	9.5198E+01	1.8466E+02			
Cs-134 <	5.5569E-01	5.6760E-01			
Pb-212 <	8.7985E-01	8.7985E-01			
Ra-224 <	2.1751E+01	1.7910E+03			
I-131 B<	2.7313E-01	1.9901E+00			
Mn-54 <	2.5321E-01	2.6647E-01			
Tl-208 <	5.44E-01	>12 Halflives			
Bi-212 <	4.93E+00	>12 Halflives			
Ra-223 <	3.1411E+00	1.2699E+01			
Pa-234 <	1.65E+00	>12 Halflives			
Eu-154 <	7.1772E-01	7.2130E-01			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 14:36:22 Page 3

Eu-152		1.1645E+01	1.1683E+01	2.7603E+00	2.7798E+00	3.398E+00
Na-22	<	2.7379E-01	2.7843E-01			
Zn-65	<	9.4504E-01	1.0088E+00			
Ba-133	<	6.1702E-01	6.1959E-01			
Ru-103	B<	3.4540E-01	5.1825E-01			
Be-7	B<	3.3868E+00	4.5672E+00			
I-125	B<	6.4781E+00	8.4480E+00			
Tl-201	B<	2.0598E+00	3.9065E+02			
Pa-234	B<	1.30E+00	>12 Halflives			
Np-237	B<	4.2028E+00	4.2028E+00			
Ce-144	B<	3.1954E+00	3.3800E+00			
Eu-155	<	1.4469E+00	1.4597E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

S U M M A R Y

Total Activity (19.0 to 1980.2 keV) 4.3117923E+02 pCi/g

Total Decayed Activity (19.0 to 1980.2 keV) 4.3446301E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 & Th-234	1115.52 % Zn-65
1173.00 % Co-60	1274.50 ? Na-22	1274.54 ? Eu-154	1333.00 & Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____

Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

898
C13110989.16.Rpt
SW
12/14

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 09:40:27 Page 1
Energy Laboratory Spectrum name: C13110989.16.An1
898
SW
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Sample description
C13110989.16

898
Spectrum Filename: C:\User\C13110989.16.An1
SW
12/14

Acquisition information
Start time: 18-Dec-2013 15:51:05
Live time: 3586
Real time: 3600
Dead time: 0.39 %
Detector ID: 2

Detector system
Det 1

Calibration
Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration
Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration
Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files
Main analysis library: Norman.lib
Library Match width: 0.500

Analysis parameters
Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.8683E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8683E+02) =
1.4452E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

Page 1

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 09:40:27 Page 2
Energy Laboratory Spectrum name: C13110989.16.An1

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.1277

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	3.1464E+00	3.1705E+00			
Ra-226	1.4910E+02	1.4910E+02	1.3383E+01	1.4025E+01	1.879E+01
Bi-214	1.4695E+02 ✓	1.4696E+02	3.4090E+00 ✓	5.3585E+00	1.300E+00 ✓
Pb-214	1.5259E+02	1.5260E+02	2.7308E+00	5.0878E+00	1.661E+00
Ir-192 B<	3.6838E-01	4.5760E-01			
Sb-124 B<	5.6270E-01	7.3467E-01			
Sc-46	2.1940E+01	2.6571E+01	1.4097E+00	1.5956E+00	6.984E-01
Pb-210	1.3054E+02	1.3080E+02	1.4640E+01	1.4948E+01	1.591E+01
Th-228 <	4.0913E+01	4.1866E+01			
Th-230 <	1.5798E+02	1.5798E+02			
Cs-137 <	4.9289E-01	4.9361E-01			
Co-60 B<	5.6033E-01	5.6503E-01			
Am-241 <	1.6856E+00	1.6858E+00			
K-40 <	9.2036E+00	9.2036E+00			
U-235	5.1731E+00	5.1731E+00	8.5679E-01	8.6906E-01	1.322E+00
Th-234 B<	8.9480E+01	1.7419E+02			
Cs-134 <	6.4495E-01	6.5885E-01			
Pb-212 <	1.0290E+00	1.0290E+00			
Ra-224 <	2.5491E+01	2.1496E+03			
I-131 B<	6.1911E-01	4.5596E+00			
Mn-54 <	6.6169E-01	6.9655E-01			
Tl-208 <	6.64E-01	>12 Halflives			
Bi-212 <	7.35E+00	>12 Halflives			
Ra-223	6.3652E+00	2.5929E+01	9.3049E+00	9.3334E+00	3.576E+00
Pa-234 <	2.02E+00	>12 Halflives			
Eu-154 <	1.7764E+00	1.7853E+00			

Energy Laboratory

898
C13110989.16.Rpt
Spectrum name: C13110989.16.An1
898
SW
Y2/14

Eu-152	#	2.1861E+01	2.1933E+01	4.7774E+00	4.8171E+00	3.733E+00
Na-22	<	5.8416E-01	5.9412E-01			
Zn-65	<	1.3594E+00	1.4517E+00			
Ba-133	<	5.5804E-01	5.6038E-01			
Ru-103	B<	5.1779E-01	7.7863E-01			
Be-7	B<	4.0212E+00	5.4314E+00			
I-125	B<	7.0919E+00	9.2617E+00			
Tl-201	B<	3.1134E+00	6.0746E+02			
Pa-234	B<	1.39E+00	>12 Halflives			
Np-237	B<	5.0128E+00	5.0128E+00			
Ce-144	B<	3.7680E+00	3.9868E+00			
Eu-155	<	1.5460E+00	1.5598E+00			

- # - All peaks for activity calculation had bad shape.
- * - Activity omitted from total
- & - Activity omitted from total and all peaks had bad shape.
- < - MDA value printed.
- A - Activity printed, but activity < MDA.
- B - Activity < MDA and failed test.
- C - Area < Critical level.
- F - Failed fraction or key line test.
- H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 6.3452777E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 6.5906500E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 % Na-22 1274.54 % Eu-154 1333.00 % Co-60
1460.80 % K-40

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
- ? - Peak is too narrow.
- @ - Peak is too wide at FW25M, but ok at FWHM.
- % - Peak fails sensitivity test.
- \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
- + - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
- = - Peak outside analysis energy range.
- & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
- P - Peakbackground subtraction

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 09:40:27 Page 4
Energy Laboratory Spectrum name: C13110989.16.An1

Analyzed by: _____
Dave Blaida

Reviewed by: _____

Supervisor C13110989.16.Rpt
Laboratory: Energy Laboratory

898
C13110989.17.Rpt
898
SW 12/14

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 11:31:33 Page 1
Energy Laboratory Spectrum name: C13110989.17.An1

898
SW 12/14
Sample description
C13110989.17

898
SW 12/14
Spectrum Filename: C:\User\C13110989.17.An1

Acquisition information

Start time: 19-Dec-2013 09:42:33
Live time: 3589
Real time: 3600
Dead time: 0.30 %
Detector ID: 2

Detector system
Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.9298E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.9298E+02) =
1.3991E-01
Detection limit method: Nureg 4.16

Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).

Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 11:31:33 Page 2
Energy Laboratory Spectrum name: C13110989-17.An1

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.1069

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	3.4933E+00	3.5210E+00			
Ra-226	8.3316E+01	8.3318E+01	1.2823E+01	1.3035E+01	1.945E+01
Bi-214	9.8881E+01	9.8883E+01	3.0117E+00	4.0998E+00	1.044E+00
Pb-214	1.0102E+02	1.0102E+02	2.2729E+00	3.6390E+00	1.467E+00
Ir-192 B<	5.3130E-01	6.6459E-01			
Sb-124 B<	3.6408E-01	4.7944E-01			
Sc-46	1.4615E+01	1.7809E+01	1.1575E+00	1.2613E+00	6.370E-01
Pb-210 #	8.6698E+01	8.6875E+01	1.1129E+01	1.1309E+01	1.253E+01
Th-228 <	3.7729E+01	3.8636E+01			
Th-230 <	1.1769E+02	1.1769E+02			
Cs-137 <	4.7364E-01	4.7435E-01			
Co-60 B<	4.6531E-01	4.6933E-01			
Am-241 <	8.2796E-01	8.2805E-01			
K-40	2.1575E+01	2.1575E+01	5.2607E+00	5.2956E+00	4.714E+00
U-235	7.6322E+00	7.6322E+00	7.3750E-01	7.6812E-01	1.047E+00
Th-234 B<	9.9693E+01	1.9827E+02			
Cs-134 <	5.4353E-01	5.5562E-01			
Pb-212 <	8.5728E-01	8.5728E-01			
Ra-224 <	2.0716E+01	2.0144E+03			
I-131 B<	3.9329E-01	3.0884E+00			
Mn-54 <	2.6353E-01	2.7787E-01			
Tl-208 <	4.67E-01	>12 Halflives			
Bi-212 <	2.43E+00	>12 Halflives			
Ra-223 <	3.0784E+00	1.3119E+01			
Pa-234 <	1.40E+00	>12 Halflives			
Eu-154 <	8.3020E-01	8.3449E-01			

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 11:31:33 Page 3

Eu-152		1.3962E+01	1.4010E+01	3.4773E+00	3.4996E+00	2.880E+00
Na-22	<	2.7969E-01	2.8461E-01			
Zn-65	<	1.1041E+00	1.1815E+00			
Ba-133	<	5.4997E-01	5.5235E-01			
Ru-103	B<	3.3698E-01	5.1342E-01			
Be-7	B<	3.9301E+00	5.3599E+00			
I-125	B<	5.3549E+00	7.0535E+00			
Tl-201	B<	4.0686E+00	9.4039E+02			
Pa-234	B<	1.27E+00	>12 Half-lives			
Np-237	B<	4.1376E+00	4.1376E+00			
Ce-144	B<	1.8079E+00	1.9164E+00			
Eu-155	<	1.3145E+00	1.3266E+00			

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Half-life limit exceeded

----- S U M M A R Y -----

Total Activity (19.0 to 1980.2 keV) 4.2769534E+02 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 4.3112177E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 % Th-234	1115.52 % Zn-65
1173.00 % Co-60	1274.50 % Na-22	1274.54 % Eu-154	1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 11:31:33 Page 4
 Energy Laboratory Spectrum name: C13110989.17.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

898
C13110989-17.Rpt
Sw
1/2/14

Supervisor

Laboratory: Energy Laboratory

898
C13110989.18.Rpt
SW 1/21/14

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 13:48:02 Page 1
Energy Laboratory Spectrum name: C13110989.18.An1

898
SW 1/21/14
Sample description
C13110989.18

898
Spectrum Filename: C:\User\C13110989.18.An1
SW 1/21/14

Acquisition information
Start time: 19-Dec-2013 12:33:01
Live time: 3592
Real time: 3600
Dead time: 0.23 %
Detector ID: 2

Detector system
Det 1

Calibration
Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration
Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration
Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files
Main analysis library: Norman.lib
Library Match Width: 0.500

Analysis parameters
Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.8142E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8142E+02) =
1.4883E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

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C13110989.18.Rpt
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ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 13:48:02 Page 2
Energy Laboratory Spectrum name: C13110989.18.An1

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.1329

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
Time of Count Time Corrected Uncertainty 2 Sigma
Nuclide Activity Activity Counting Total MDA
pCi/g pCi/g pCi/g pCi/g

Ra-228	B<	2.7507E+00	2.7726E+00			
Ra-226		7.9568E+01	7.9570E+01	1.0566E+01	1.0801E+01	1.525E+01
Bi-214		7.8633E+01	7.8636E+01	2.5988E+00	3.4129E+00	1.147E+00
Pb-214		8.0702E+01	8.0704E+01	2.0887E+00	3.0850E+00	1.276E+00
Ir-192	B<	3.7052E-01	4.6400E-01			
Sb-124	B<	2.3681E-01	3.1227E-01			
Sc-46		1.1700E+01	1.4270E+01	1.0666E+00	1.1396E+00	5.848E-01
Pb-210		6.2212E+01	6.2340E+01	7.9908E+00	8.1194E+00	9.706E+00
Th-228	<	3.4246E+01	3.5074E+01			
Th-230	<	1.1360E+02	1.1360E+02			
Cs-137	<	4.2617E-01	4.2682E-01			
Co-60	B<	3.9593E-01	3.9937E-01			
Am-241	<	1.0953E+00	1.0954E+00			
K-40		2.1303E+01	2.1303E+01	5.1710E+00	5.2056E+00	4.403E+00
U-235		3.7561E+00	3.7561E+00	6.5249E-01	6.6099E-01	9.878E-01
Th-234	B<	6.9928E+01	1.3955E+02			
Cs-134	<	2.2527E-01	2.3031E-01			
Pb-212	<	7.9572E-01	7.9572E-01			
Ra-224	<	1.9414E+01	1.9311E+03			
I-131	B<	4.0746E-01	3.2326E+00			
Mn-54	<	2.9120E-01	3.0712E-01			
Tl-208	<	6.26E-01	>12 Halflives			
Bi-212	<	3.90E+00	>12 Halflives			
Ra-223		4.5825E+00	1.9669E+01	7.5558E+00	7.5760E+00	2.725E+00
Pa-234	<	1.27E+00	>12 Halflives			
Eu-154	<	1.4821E+00	1.4898E+00			

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 13:48:02 Page 3

Energy Laboratory

898 SW 214
C13110989.18.Rpt
Spectrum name: C13110989.18.An1

Eu-152		1.0346E+01	1.0381E+01	2.6333E+00	2.6495E+00	2.100E+00
Na-22	<	5.5881E-01	5.6869E-01			
Zn-65	<	1.1144E+00	1.1930E+00			
Ba-133	<	6.6006E-01	6.6293E-01			
Ru-103	B<	3.7091E-01	5.6630E-01			
Be-7	B<	2.4280E+00	3.3164E+00			
I-125	B<	4.8938E+00	6.4549E+00			
Tl-201	B<	2.2358E+00	5.3089E+02			
Pa-234	B<	1.29E+00	>12 Halflives			
Np-237	B<	3.6407E+00	3.6407E+00			
Ce-144	B<	1.5671E+00	1.6616E+00			
Eu-155	<	1.3703E+00	1.3830E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

S U M M A R Y

Total Activity (19.0 to 1980.2 keV) 3.5280194E+02 pCi/g

Total Decayed Activity (19.0 to 1980.2 keV) 3.7062949E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 % Th-234	1115.52 % Zn-65
1173.00 % Co-60	1274.50 % Na-22	1274.54 % Eu-154	1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

898
C13110989.19.Rpt
898
8/21/14

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 15:02:06 Page 1
Energy Laboratory Spectrum name: C13110989.19.An1

898
8/21/14

Sample description
C13110989.19

898
Spectrum Filename: C:\User\C13110989.19.An1
8/21/14

Acquisition information

Start time: 19-Dec-2013 13:49:21
Live time: 3589
Real time: 3600
Dead time: 0.30 %
Detector ID: 2

Detector system
Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.7134E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7134E+02) =
1.5758E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

898
C1311089-19.Rpt
SW/2/14

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 15:02:06 Page 2
Energy Laboratory Spectrum name: C1311089-19.An1

898
SW/2/14

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.1383

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	2.8466E+00	2.8693E+00			
Ra-226	9.7425E+01	9.7428E+01	1.4038E+01	1.4303E+01	2.109E+01
Bi-214	1.1817E+02	1.1817E+02	3.2521E+00	4.6506E+00	1.315E+00
Pb-214	1.2015E+02	1.2016E+02	2.5494E+00	4.2338E+00	1.653E+00
Ir-192 B<	4.0548E-01	5.0802E-01			
Sb-124 B<	4.2089E-01	5.5534E-01			
Sc-46	1.7801E+01	2.1722E+01	1.3341E+00	1.4674E+00	6.568E-01
Pb-210	9.6020E+01	9.6217E+01	1.0309E+01	1.0545E+01	1.215E+01
Th-228 <	4.1353E+01	4.2354E+01			
Th-230 <	1.4400E+02	1.4400E+02			
Cs-137 <	5.8484E-01	5.8573E-01			
Co-60 B<	4.5216E-01	4.5610E-01			
Am-241 <	1.4264E+00	1.4265E+00			
K-40	1.7539E+01	1.7539E+01	6.4407E+00	6.4595E+00	6.455E+00
U-235	7.7607E+00	7.7607E+00	8.1624E-01	8.4494E-01	1.174E+00
Th-234 B<	1.1051E+02	2.2087E+02			
Cs-134 <	6.1219E-01	6.2591E-01			
Pb-212 <	9.5927E-01	9.5927E-01			
Ra-224 <	2.3742E+01	2.3857E+03			
I-131 B<	5.0254E-01	4.0051E+00			
Mn-54 <	4.0413E-01	4.2629E-01			
Tl-208 <	4.41E-01	>12 Halflives			
Bi-212 <	4.53E+00	>12 Halflives			
Ra-223 <	3.3719E+00	1.4520E+01			
Pa-234 <	1.83E+00	>12 Halflives			
Eu-154 <	9.0564E-01	9.1035E-01			

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 15:02:06 Page 3

Energy Laboratory

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C13110989.19.Rpt
Spectrum Name: C13110989.19.An1

Eu-152		1.7075E+01	1.7133E+01	3.6832E+00	3.7146E+00	2.853E+00
Na-22	<	6.3208E-01	6.4328E-01			
Zn-65	<	1.1853E+00	1.2691E+00			
Ba-133	<	5.4271E-01	5.4508E-01			
Ru-103	B<	4.7746E-01	7.2966E-01			
Be-7	B<	4.1976E+00	5.7375E+00			
I-125	B<	5.7191E+00	7.5482E+00			
Tl-201	B<	2.9111E+00	6.9963E+02			
Pa-234	B<	1.44E+00	>12 Halflives			
Np-237	B<	4.6426E+00	4.6426E+00			
Ce-144	B<	2.8561E+00	3.0288E+00			
Eu-155	<	1.5971E+00	1.6119E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 4.9193979E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 4.9612643E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 Na-22 1274.54 % Eu-154 1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

898
C13110989.20.Rpt
SW 12/14

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 16:05:04 Page 1
Energy Laboratory Spectrum name: C13110989.20.An1

898
SW 12/14

Sample description
C13110989.20

898
Spectrum Filename: C:\User\C13110989.20.An1
SW 12/14

Acquisition information

Start time: 19-Dec-2013 15:03:18
Live time: 3591
Real time: 3600
Dead time: 0.24 %
Detector ID: 2

Detector system
Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.8787E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8787E+02) =
1.4372E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

898
C13110989.20.Rpt
Sw 1/2/14

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 16:05:04 Page 2
Energy Laboratory Spectrum name: C13110989.20.An1

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections Status Comments
Decay correct to date: YES 25-Nov-2013 12:00:00
Decay during acquisition: YES
Decay during collection: NO
True coincidence correction: NO
Peaked background correction: YES 011108bkg1000mindet1.Pbc
15-Jan-2008 17:02:27
Absorption (Internal): NO
Geometry correction: NO
Random summing: YES slope 1.0000E+00
Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.1735

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228	B< 3.1118E+00	3.1366E+00			
Ra-226	6.6822E+01	6.6824E+01	1.1161E+01	1.1319E+01	1.682E+01
Bi-214	8.1971E+01	8.1974E+01	2.5783E+00	3.4591E+00	1.151E+00
Pb-214	8.0665E+01	8.0667E+01	2.0613E+00	3.0657E+00	1.461E+00
Ir-192	B< 3.2083E-01	4.0216E-01			
Sb-124	B< 4.1757E-01	5.5129E-01			
Sc-46	1.2811E+01	1.5640E+01	1.0571E+00	1.1450E+00	4.322E-01
Pb-210	7.8092E+01	7.8253E+01	9.6857E+00	9.8529E+00	1.088E+01
Th-228	< 3.2668E+01	3.3460E+01			
Th-230	< 1.1541E+02	1.1541E+02			
Cs-137	< 4.5422E-01	4.5491E-01			
Co-60	B< 2.4011E-01	2.4221E-01			
Am-241	< 1.1083E+00	1.1084E+00			
K-40	2.2305E+01	2.2305E+01	5.0064E+00	5.0455E+00	4.036E+00
U-235	5.1774E+00	5.1774E+00	6.4974E-01	6.6586E-01	9.438E-01
Th-234	1.3068E+02	2.6156E+02	1.0330E+02	1.0384E+02	5.734E+01
Cs-134	< 4.5016E-01	4.6027E-01			
Pb-212	< 7.7906E-01	7.7906E-01			
Ra-224	< 1.8893E+01	1.9172E+03			
I-131	B< 4.0786E-01	3.2650E+00			
Mn-54	< 3.6896E-01	3.8923E-01			
Tl-208	< 5.23E-01	>12 Half-lives			
Bi-212	< 2.09E+00	>12 Half-lives			
Ra-223	4.8462E+00	2.0933E+01	7.6498E+00	7.6724E+00	2.735E+00
Pa-234	< 1.42E+00	>12 Half-lives			
Eu-154	< 1.1793E+00	1.1855E+00			

ORTEC g v - i (143) wan32 G53W2.06 19-DEC-2013 16:05:04 Page 3

Energy Laboratory

898
C13110989.20.Rpt
Spectrum name: C13110989.20.An1
898
Su 1/2/14

Eu-152		1.0123E+01	1.0158E+01	2.4903E+00	2.5066E+00	2.112E+00
Na-22	<	6.3794E-01	6.4927E-01			
Zn-65	<	1.0524E+00	1.1270E+00			
Ba-133	<	4.5619E-01	4.5819E-01			
Ru-103	B<	3.4628E-01	5.2967E-01			
Be-7	B<	2.6851E+00	3.6726E+00			
I-125	B<	4.5115E+00	5.9578E+00			
Tl-201	B<	3.2572E+00	7.9202E+02			
Pa-234	B<	1.31E+00	>12 Halflives			
Np-237	B<	3.8106E+00	3.8106E+00			
Ce-144	B<	2.4824E+00	2.6328E+00			
Eu-155	<	1.3509E+00	1.3634E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 4.9348993E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 6.4348962E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1115.52 % Zn-65 1173.00 % Co-60
1274.50 % Na-22 1274.54 % Eu-154 1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

898
C13110989.20dup.Rpt
Sw 1/2/14

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 08:14:12 Page 1
Energy Laboratory Spectrum name: C13110989.20dup.An1

898
Sample description
C13110989.20dup
Sw 1/2/14

898
Spectrum Filename: C:\User\C13110989.20dup.An1
1/2/14

Acquisition information
Start time: 19-Dec-2013 16:05:49
Live time: 3591
Real time: 3600
Dead time: 0.24 %
Detector ID: 2

Detector system
Det 1

Calibration
Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration
Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration
Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files
Main analysis library: Norman.lib
Library Match width: 0.500

Analysis parameters
Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.8787E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8787E+02) =
1.4372E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

Page 1

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C13110989:20dup.Rpt

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 08:14:12 Page 2
Energy Laboratory Spectrum name: C13110989:20dup.An1

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.0891

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pci/g	pci/g	pci/g	pci/g	
Ra-228 B<	2.7943E+00	2.8167E+00			
Ra-226	6.8421E+01	6.8423E+01	1.1331E+01	1.1493E+01	1.708E+01
Bi-214	8.1178E+01	8.1180E+01	2.5851E+00	3.4494E+00	1.216E+00
Pb-214	8.3966E+01	8.3968E+01	2.1039E+00	3.1633E+00	1.195E+00
Ir-192 B<	4.2168E-01	5.2879E-01			
Sb-124 B<	2.7941E-01	3.6907E-01			
Sc-46	1.1933E+01	1.4573E+01	1.0713E+00	1.1471E+00	6.188E-01
Pb-210 #	7.9190E+01	7.9353E+01	1.0038E+01	1.0204E+01	1.110E+01
Th-228 <	3.2865E+01	3.3664E+01			
Th-230 <	1.1886E+02	1.1886E+02			
Cs-137 <	3.6973E-01	3.7029E-01			
Co-60 B<	3.4255E-01	3.4555E-01			
Am-241 <	1.1425E+00	1.1427E+00			
K-40	2.0365E+01	2.0365E+01	6.8292E+00	6.8532E+00	5.793E+00
U-235	5.5574E+00	5.5574E+00	6.5599E-01	6.7436E-01	9.443E-01
Th-234 B<	8.4315E+01	1.6897E+02			
Cs-134 <	2.2168E-01	2.2667E-01			
Pb-212 <	7.4081E-01	7.4081E-01			
Ra-224 <	1.8804E+01	1.9241E+03			
I-131 B<	3.8944E-01	3.1292E+00			
Mn-54 <	2.4947E-01	2.6321E-01			
Tl-208 <	4.99E-01	>12 Halflives			
Bi-212 <	1.77E+00	>12 Halflives			
Ra-223	4.6714E+00	2.0231E+01	7.3995E+00	7.4214E+00	2.632E+00
Pa-234 <	1.17E+00	>12 Halflives			
Eu-154 <	1.3615E+00	1.3686E+00			

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 08:14:12 Page 3

Energy Laboratory

898
C13110989.20dup.Rpt
Spectrum name: C13110989.20dup.An1
898
Sw
12/14

Eu-152		1.1509E+01	1.1549E+01	2.4797E+00	2.5009E+00	1.901E+00
Na-22	<	3.3918E-01	3.4522E-01			
Zn-65	<	8.4850E-01	9.0871E-01			
Ba-133	<	3.7909E-01	3.8075E-01			
Ru-103	B<	3.6180E-01	5.5382E-01			
Be-7	B<	1.6964E+00	2.3216E+00			
I-125	B<	4.6823E+00	6.1865E+00			
Tl-201	B<	1.8502E+00	4.5436E+02			
Pa-234	B<	1.07E+00	>12 Halflives			
Np-237	B<	3.6954E+00	3.6954E+00			
Ce-144	B<	2.7923E+00	2.9617E+00			
Eu-155	<	1.2424E+00	1.2540E+00			

- # - All peaks for activity calculation had bad shape.
- * - Activity omitted from total
- & - Activity omitted from total and all peaks had bad shape.
- < - MDA value printed.
- A - Activity printed, but activity < MDA.
- B - Activity < MDA and failed test.
- C - Area < Critical level.
- F - Failed fraction or key line test.
- H - Half-life limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 3.6678961E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 3.8519922E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 & Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 & Na-22 1274.54 Eu-154 1333.00 % Co-60

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
- ? - Peak is too narrow.
- @ - Peak is too wide at FW25M, but ok at FWHM.
- % - Peak fails sensitivity test.
- \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
- + - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
- = - Peak outside analysis energy range.
- & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
- P - Peakbackground subtraction

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 08:14:12 Page 4
Energy Laboratory Spectrum name: C13110989.20dup.An1

Analyzed by: _____
Dave Blaida

Reviewed by: _____

898
C1311089.20dup.Rpt
SW
1/2/14

Supervisor

Laboratory: Energy Laboratory

898
C13110989.21.Rpt
SW 12/14

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 09:27:53 Page 1
Energy Laboratory Spectrum name: C13110989.21.An1

898
SW 12/14
Sample description
C13110989.21

898
SW 12/14
Spectrum Filename: C:\User\C13110989.21.An1

Acquisition information

Start time: 20-Dec-2013 08:15:14
Live time: 3591
Real time: 3600
Dead time: 0.26 %
Detector ID: 2

Detector system
Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.9179E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.9179E+02) =
1.4078E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

898
C13110989-21.Rpt
5/2/14

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 09:27:53 Page 2
Energy Laboratory Spectrum name: C13110989-21.An1

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.1282

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Activity	Corrected Activity	Uncertainty Counting	2 Sigma Total
	Activity	pCi/g	pCi/g	pCi/g	MDA
	pCi/g				
Ra-228 B<	3.3030E+00		3.3302E+00		
Ra-226	6.9093E+01		6.9095E+01	1.1146E+01	1.1314E+01 1.676E+01
Bi-214	8.7080E+01		8.7083E+01	2.6841E+00	3.6340E+00 1.158E+00
Pb-214	8.9608E+01		8.9611E+01	2.1727E+00	3.3280E+00 1.399E+00
Ir-192 B<	3.0737E-01		3.8789E-01		
Sb-124 B<	4.5196E-01		6.0164E-01		
Sc-46	1.2925E+01		1.5872E+01	1.0608E+00	1.1510E+00 4.463E-01
Pb-210	8.1500E+01		8.1673E+01	1.1046E+01	1.1206E+01 1.222E+01
Th-228 <	3.4161E+01		3.5015E+01		
Th-230 <	1.1939E+02		1.1939E+02		
Cs-137 <	4.8192E-01		4.8267E-01		
Co-60 B<	4.0842E-01		4.1209E-01		
Am-241 <	1.2776E+00		1.2778E+00		
K-40 #	2.1108E+01		2.1108E+01	6.3875E+00	6.4150E+00 5.601E+00
U-235	5.1931E+00		5.1931E+00	6.5766E-01	6.7370E-01 9.610E-01
Th-234 B<	7.0594E+01		1.4424E+02		
Cs-134 <	5.4955E-01		5.6226E-01		
Pb-212 <	8.2661E-01		8.2661E-01		
Ra-224 <	1.9510E+01		2.2710E+03		
I-131 B<	3.9255E-01		3.3427E+00		
Mn-54 <	2.1750E-01		2.2981E-01		
Tl-208 <	5.30E-01	>12 Halflives			
Bi-212 <	4.91E+00	>12 Halflives			
Ra-223 <	3.2233E+00		1.4541E+01		
Pa-234 <	1.38E+00	>12 Halflives			
Eu-154 <	1.3516E+00		1.3588E+00		

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 09:27:53 Page 3

Eu-152		1.3851E+01	1.3900E+01	3.4612E+00	3.4832E+00	2.762E+00
Na-22	<	5.0632E-01	5.1558E-01			
Zn-65	<	9.9484E-01	1.0675E+00			
Ba-133	<	4.5323E-01	4.5527E-01			
Ru-103	B<	4.9361E-01	7.6462E-01			
Be-7	B<	3.2117E+00	4.4338E+00			
I-125	B<	4.3654E+00	5.8128E+00			
Tl-201	B<	3.4250E+00	9.8043E+02			
Pa-234	B<	1.18E+00	>12 Halflives			
Np-237	B<	3.7822E+00	3.7822E+00			
Ce-144	B<	2.2831E+00	2.4256E+00			
Eu-155	<	1.1947E+00	1.2061E+00			

- # - All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----

Total Activity (19.0 to 1980.2 keV) 3.8035858E+02 pCi/g
 Total Decayed Activity (19.0 to 1980.2 keV) 3.8353513E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 & Ra-228	969.10 % Ra-228	1001.00 % Th-234	1115.52 % Zn-65
1173.00 % Co-60	1274.50 Na-22	1274.54 % Eu-154	1333.00 & Co-60

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 09:27:53 Page 4
 Energy Laboratory Spectrum name: C13110989.21.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

898
C13110989.21.Rpt
Sw
1/2/14

Supervisor

Laboratory: Energy Laboratory

898
C13110989.22.Rpt
SW 1/2/14

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 10:34:01 Page 1
Energy Laboratory Spectrum name: C13110989.22.An1

898
SW 1/2/14

Sample description
C13110989.22

898
Spectrum Filename: C:\User\C13110989.22.An1
SW 1/2/14

Acquisition information
Start time: 20-Dec-2013 09:30:35
Live time: 3593
Real time: 3600
Dead time: 0.19 %
Detector ID: 2

Detector system
Det 1

Calibration
Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration
Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel^2

Efficiency Calibration
Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files
Main analysis library: Norman.lib
Library Match Width: 0.500

Analysis parameters
Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.8850E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8850E+02) =
1.4324E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

Page 1

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 10:34:01 Page 2
Energy Laboratory Spectrum name: C13110989.22.An1

Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.1227

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
Time of Count Time Corrected Uncertainty 2 Sigma
Nuclide Activity Activity Counting Total MDA
pCi/g pCi/g pCi/g pCi/g

Ra-228	B<	2.0777E+00	2.0948E+00			
Ra-226		5.4172E+01	5.4173E+01	8.9361E+00	9.0651E+00	1.311E+01
Bi-214		6.0834E+01	6.0836E+01	2.1487E+00	2.7470E+00	7.814E-01
Pb-214		5.9752E+01	5.9754E+01	1.7342E+00	2.4152E+00	1.183E+00
Ir-192	B<	2.8633E-01	3.6150E-01			
Sb-124	B<	4.6074E-01	6.1369E-01			
Sc-46		9.2157E+00	1.1322E+01	9.1803E-01	9.7172E-01	4.479E-01
Pb-210		5.7939E+01	5.8062E+01	8.5167E+00	8.6216E+00	9.661E+00
Th-228	<	2.7956E+01	2.8656E+01			
Th-230	<	1.0028E+02	1.0028E+02			
Cs-137	<	2.7008E-01	2.7050E-01			
Co-60	B<	2.1814E-01	2.2011E-01			
Am-241	<	9.4324E-01	9.4334E-01			
K-40		1.9215E+01	1.9215E+01	5.6556E+00	5.6814E+00	5.009E+00
U-235		2.9074E+00	2.9074E+00	5.4212E-01	5.4825E-01	8.167E-01
Th-234	B<	6.2984E+01	1.2889E+02			
Cs-134	<	3.7598E-01	3.8469E-01			
Pb-212	<	6.7923E-01	6.7923E-01			
Ra-224	<	1.6261E+01	1.9119E+03			
I-131	B<	3.1302E-01	2.6775E+00			
Mn-54	<	3.7520E-01	3.9648E-01			
Tl-208	<	4.44E-01	>12 Halflives			
Bi-212	<	3.34E+00	>12 Halflives			
Ra-223	<	2.4072E+00	1.0894E+01			
Pa-234	<	1.33E+00	>12 Halflives			
Eu-154	<	7.9450E-01	7.9878E-01			

Energy Laboratory

898
C13110989.22.Rpt
Specimen Name: C13110989.22.An1
898
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Eu-152		1.0396E+01	1.0433E+01	2.3292E+00	2.3476E+00	1.756E+00
Na-22	<	2.5547E-01	2.6015E-01			
Zn-65	<	9.1553E-01	9.8251E-01			
Ba-133	<	5.6733E-01	5.6989E-01			
Ru-103	B<	1.8282E-01	2.8346E-01			
Be-7	B<	3.5092E+00	4.8479E+00			
I-125	B<	3.8700E+00	5.1562E+00			
Tl-201	B<	2.6518E+00	7.6818E+02			
Pa-234	B<	1.03E+00	>12 Half-lives			
Np-237	B<	3.1481E+00	3.1481E+00			
Ce-144	B<	2.2922E+00	2.4357E+00			
Eu-155	<	8.7547E-01	8.8385E-01			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 2.7443127E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 2.7670291E+02 pCi/g

The library has energies which are not separable.

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 % Na-22 1274.54 Eu-154 1333.00 ? Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

898
C13110989.23.Rpt
SW 12/14

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 14:09:47 Page 1
Energy Laboratory Spectrum name: C13110989.23.An1

898
12/14 SW

Sample description
C13110989.23

898
Spectrum Filename: C:\User\C13110989.23.An1
SW 12/14

Acquisition information

Start time: 20-Dec-2013 12:42:05
Live time: 3596
Real time: 3600
Dead time: 0.11 %
Detector ID: 2

Detector system
Det 1

Calibration

Filename: julycc_5th_det1_169218.clb
12/10/13 calibration energy/efficiency
IPL #1692-18 recal energy calibration perched

Energy Calibration

Created: 10-Dec-2013 10:50:03
Zero offset: -0.447 keV
Gain: 0.243 keV/channel
Quadratic: 1.476E-09 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 07:55:14
Type: Polynomial
Uncertainty: 1.391 %
Coefficients: -0.329484 -5.959887 0.633715
-0.076489 0.004220 -0.000092

Library Files

Main analysis library: Norman.lib
Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
Start channel: 80 (19.01keV)
Stop channel: 8144 (1980.24keV)
Peak rejection level: 20.000%
Peak search sensitivity: 3
Sample Size: 1.5065E+02
Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.5065E+02) =
1.7922E-01
Detection limit method: Nureg 4.16
Random error: 1.0000000E+00
Systematic error: 1.0000000E+00
Fraction Limit: 0.000%
Background width: best method (based on spectrum).
Half lives decay limit: 12.000

898
C13110989.23.Rpt
SW 1/21/14

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 14:09:47 Page 2
Energy Laboratory Spectrum name: C13110989.23.An1

898
SW 1/21/14
Activity range factor: 2.000
Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	011108bkg1000mindet1.Pbc 15-Jan-2008 17:02:27
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
Normalized diff: 0.0957

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.7314E+00	1.7458E+00			
Ra-226	2.7596E+01	2.7597E+01	8.1742E+00	8.2110E+00	1.249E+01
Bi-214	2.7713E+01 ✓	2.7714E+01	1.6371E+00 ✓	1.8133E+00	7.275E-01 ✓
Pb-214	2.9102E+01	2.9103E+01	1.4082E+00	1.6289E+00	8.824E-01
Ir-192 B<	1.8702E-01	2.3642E-01			
Sb-124 B<	3.0181E-01	4.0262E-01			
Sc-46	4.2102E+00	5.1782E+00	7.0670E-01	7.2156E-01	4.023E-01
Pb-210 #	3.1287E+01	3.1354E+01	7.7681E+00	7.8017E+00	8.533E+00
Th-228 <	2.3592E+01	2.4186E+01			
Th-230 <	6.7890E+01	6.7890E+01			
Cs-137 <	4.1703E-01	4.1768E-01			
Co-60 B<	2.3919E-01	2.4136E-01			
Am-241 <	7.2548E-01	7.2556E-01			
K-40	2.5066E+01	2.5066E+01	5.2905E+00	5.3373E+00	3.704E+00
U-235	2.2800E+00	2.2800E+00	4.6879E-01	4.7316E-01	6.894E-01
Th-234 B<	5.1261E+01	1.0530E+02			
Cs-134 <	2.4147E-01	2.4710E-01			
Pb-212 <	5.5564E-01	5.5564E-01			
Ra-224 <	1.2189E+01	1.4701E+03			
I-131 B<	3.7918E-01	3.2808E+00			
Mn-54 <	2.3342E-01	2.4673E-01			
Tl-208 <	3.80E-01	>12 Halflives			
Bi-212 <	3.91E+00	>12 Halflives			
Ra-223 <	1.9320E+00	8.8145E+00			
Pa-234 <	1.09E+00	>12 Halflives			
Eu-154 <	1.0280E+00	1.0336E+00			

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 14:09:47 Page 3

Energy Laboratory

898
C13110989.23.Rpt
Spectrum Name: C13110989.23.An1
898
Sw 12/14

Eu-152		7.1019E+00	7.1273E+00	2.3657E+00	2.3742E+00	1.863E+00
Na-22	<	1.5084E-01	1.5362E-01			
Zn-65	<	5.1073E-01	5.4831E-01			
Ba-133	<	4.2062E-01	4.2253E-01			
Ru-103	B<	3.2969E-01	5.1237E-01			
Be-7	B<	1.8411E+00	2.5478E+00			
I-125	B<	3.7641E+00	5.0228E+00			
Tl-201	B<	2.5812E+00	7.7073E+02			
Pa-234	B<	7.86E-01	>12 Halflives			
Np-237	B<	2.5362E+00	2.5362E+00			
Ce-144	B<	1.6760E+00	1.7814E+00			
Eu-155	<	8.3135E-01	8.3935E-01			

- # - All peaks for activity calculation had bad shape.
- * - Activity omitted from total
- & - Activity omitted from total and all peaks had bad shape.
- < - MDA value printed.
- A - Activity printed, but activity < MDA.
- B - Activity < MDA and failed test.
- C - Area < Critical level.
- F - Failed fraction or key line test.
- H - Half-life limit exceeded

----- S U M M A R Y -----
Total Activity (19.0 to 1980.2 keV) 1.5435606E+02 pCi/g
Total Decayed Activity (19.0 to 1980.2 keV) 1.5541876E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 & Co-60 1274.50 & Na-22 1274.54 Eu-154 1333.00 % Co-60

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
- ? - Peak is too narrow.
- @ - Peak is too wide at FW25M, but ok at FWHM.
- % - Peak fails sensitivity test.
- \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
- + - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
- = - Peak outside analysis energy range.
- & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
- P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 20-DEC-2013 14:09:47 Page 4
Energy Laboratory Spectrum name: C13110989.23.An1

Analyzed by: _____
Dave Blaida

Reviewed by: _____

Supervisor C13110989.23.Rpt
Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 10:35:29 Page 1
 Energy Laboratory Spectrum name: C13110898.24.An1

Sample description
 C13110898.24

Spectrum Filename: C:\User\C13110898.24.An1

Acquisition information

Start time: 16-Dec-2013 09:32:07
 Live time: 3597
 Real time: 3600
 Dead time: 0.09 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.9490E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.9490E+02) =
 1.3853E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 10:35:29 Page 2
 Energy Laboratory Spectrum name: C13110898.24.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1623

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count Activity pCi/g	Time Corrected Activity pCi/g	Uncertainty Counting pCi/g	2 Sigma Total pCi/g	MDA
Ra-228	B<	1.1357E+00	1.1436E+00			
Ra-226	<	7.9592E+00	7.9594E+00			
Bi-214		3.6345E+00 ✓	3.6346E+00	5.9009E-01 ✓	5.9659E-01	5.186E-01 ✓
Pb-214		3.9046E+00	3.9047E+00	4.7199E-01	4.8132E-01	4.926E-01
Ir-192	B<	8.0555E-02	9.7967E-02			
Sb-124	B<	1.2649E-01	1.6089E-01			
Sc-46		8.3833E-01	9.9646E-01	2.4218E-01	2.4337E-01	1.867E-01
Pb-210	<	3.9992E+00	4.0063E+00			
Th-228	<	1.1649E+01	1.1893E+01			
Th-230	<	3.3078E+01	3.3078E+01			
Cs-137	<	1.5477E-01	1.5497E-01			
Co-60	B<	1.7140E-01	1.7269E-01			
Am-241	<	2.3956E-01	2.3959E-01			
K-40		1.6364E+01	1.6364E+01	3.3790E+00	3.4021E+00	5.051E+00
U-235	#	1.8499E+00	1.8499E+00	2.5600E-01	2.5987E-01	2.753E-01
Th-234	B<	2.0926E+01	3.8168E+01			
Cs-134	<	1.7591E-01	1.7933E-01			
Pb-212		8.9757E-01	8.9757E-01	2.3961E-01	2.4064E-01	3.399E-01
Ra-224	<	4.9502E+00	2.7064E+02			
I-131	B<	1.7209E-01	1.0428E+00			
Mn-54	<	2.0619E-01	2.1597E-01			
Tl-208	<	2.24E-01	>12 Halflives			
Bi-212	<	1.83E+00	>12 Halflives			
Ra-223	<	1.0369E+00	3.6823E+00			
Pa-234	<	4.43E-01	>12 Halflives			
Eu-154	<	4.9734E-01	4.9958E-01			

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 10:35:29 Page 3

Eu-152	<	8.6197E-01	8.6454E-01
Na-22	<	9.0031E-02	9.1415E-02
Zn-65	<	3.3323E-01	3.5358E-01
Ba-133	<	2.0159E-01	2.0236E-01
Ru-103	B<	1.3994E-01	2.0221E-01
Be-7	B<	1.4156E+00	1.8567E+00
I-125	B<	2.5914E+00	3.2972E+00
Tl-201	B<	1.1459E+00	1.3354E+02
Pa-234	B<	5.40E-01	>12 Halflives
Np-237	B<	1.1736E+00	1.1736E+00
Ce-144	B<	8.3800E-01	8.8180E-01
Eu-155	<	4.6060E-01	4.6430E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.7488855E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.7647165E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 @ Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1173.00 % Co-60 1274.50 % Na-22 1274.54 Eu-154 1333.00 ? Co-60
 1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 10:35:29 Page 4
 Energy Laboratory Spectrum name: C13110898.24.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 12:02:58 Page 1
 Energy Laboratory Spectrum name: C13110898.25.An1

Sample description
 C13110898.25

Spectrum Filename: C:\User\C13110898.25.An1

Acquisition information

Start time: 16-Dec-2013 10:38:40
 Live time: 3597
 Real time: 3600
 Dead time: 0.09 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.6421E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6421E+02) =
 1.6442E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 12:02:58 Page 2
 Energy Laboratory Spectrum name: C13110898.25.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1839

```

***** S U M M A R Y   O F   N U C L I D E S   I N   S A M P L E *****
Time of Count   Time Corrected   Uncertainty   2 Sigma
Nuclide         Activity          Activity          Counting      Total          MDA
                pCi/g           pCi/g           pCi/g         pCi/g
-----
Ra-228 B<      1.3647E+00    1.3741E+00
Ra-226 <       9.1226E+00    9.1228E+00
Bi-214         1.6161E+00    1.6162E+00    4.9569E-01    4.9723E-01    5.722E-01
Pb-214         1.6354E+00    1.6354E+00    3.7536E-01    3.7744E-01    4.858E-01
Ir-192 B<     1.7418E-01    2.1192E-01
Sb-124 B<     1.2282E-01    1.5631E-01
Sc-46          5.2739E-01    6.2710E-01    2.2748E-01    2.2798E-01    2.165E-01
Pb-210 <      4.1504E+00    4.1578E+00
Th-228 <      1.3323E+01    1.3603E+01
Th-230 <      2.0575E+01    2.0575E+01
Cs-137 <      1.5753E-01    1.5773E-01
Co-60 B<      1.9205E-01    1.9350E-01
Am-241 <      4.8671E-01    4.8676E-01
K-40           1.9027E+01    1.9027E+01    3.9844E+00    4.0109E+00    5.995E+00
U-235          2.2419E+00    2.2419E+00    3.0748E-01    3.1221E-01    3.158E-01
Th-234         9.5443E+01    1.7432E+02    4.5009E+01    4.5485E+01    1.172E+01
Cs-134 <      2.9959E-01    3.0542E-01
Pb-212         1.1929E+00    1.1929E+00    2.9364E-01    2.9513E-01    4.097E-01
Ra-224 <      4.9214E+00    2.7146E+02
I-131 B<      1.1795E-01    7.1758E-01
Mn-54 <       1.6016E-01    1.6777E-01
Tl-208 <       2.39E-01    >12 Halflives
Bi-212 <       2.82E+00    >12 Halflives
Ra-223 <      8.7225E-01    3.1062E+00
Pa-234 <       5.21E-01    >12 Halflives
Eu-154 <      5.9027E-01    5.9295E-01
  
```

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 12:02:58 Page 3

Eu-152	<	1.0939E+00	1.0972E+00
Na-22	<	1.3967E-01	1.4182E-01
Zn-65	<	3.6307E-01	3.8529E-01
Ba-133	<	2.0976E-01	2.1055E-01
Ru-103	B<	2.1123E-01	3.0547E-01
Be-7	B<	1.7013E+00	2.2327E+00
I-125	B<	2.3026E+00	2.9313E+00
Tl-201	B<	1.1575E+00	1.3632E+02
Pa-234	B<	5.89E-01	>12 Halflives
Np-237	B<	1.3524E+00	1.3524E+00
Ce-144	B<	1.0313E+00	1.0853E+00
Eu-155	<	6.2516E-01	6.3019E-01

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

S U M M A R Y

Total Activity (19.4 to 1990.8 keV) 1.2168358E+02 pCi/g

Total Decayed Activity (19.4 to 1990.8 keV) 2.0066049E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 & Ra-228	969.10 & Ra-228	1115.52 % Zn-65	1173.00 % Co-60
1274.50 & Na-22	1274.54 Eu-154	1333.00 % Co-60	1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____

Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 14:05:04 Page 1
 Energy Laboratory Spectrum name: C13110898.26.An1

Sample description
 C13110898.26

Spectrum Filename: C:\User\C13110898.26.An1

Acquisition information

Start time: 16-Dec-2013 12:04:00
 Live time: 3580
 Real time: 3600
 Dead time: 0.55 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.c1b
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample size: 2.0602E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 2.0602E+02) =
 1.3106E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 14:05:04 Page 2
 Energy Laboratory Spectrum name: C13110898.26.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1565

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.5745E+00	1.5854E+00			
Ra-226 <	9.8778E+00	9.8781E+00			
Bi-214	2.1148E+01 ✓	2.1148E+01	1.0991E+00 ✓	1.2120E+00	5.540E-01 ✓
Pb-214	2.2695E+01	2.2696E+01	8.8854E-01	1.0441E+00	5.637E-01
Ir-192 B<	1.9388E-01	2.3602E-01			
Sb-124 B<	1.9262E-01	2.4532E-01			
Sc-46	3.2122E+00	3.8214E+00	4.3753E-01	4.4716E-01	2.505E-01
Pb-210	1.7323E+01	1.7354E+01	4.6772E+00	4.6944E+00	5.319E+00
Th-228 <	1.6067E+01	1.6406E+01			
Th-230 <	5.3261E+01	5.3261E+01			
Cs-137 <	2.0898E-01	2.0925E-01			
Co-60 B<	1.9420E-01	1.9567E-01			
Am-241 <	5.6375E-01	5.6381E-01			
K-40	1.6752E+01	1.6752E+01	3.8474E+00	3.8686E+00	5.176E+00
U-235	2.4276E+00	2.4276E+00	3.8406E-01	3.8851E-01	4.329E-01
Th-234	8.2158E+01	1.5031E+02	5.8971E+01	5.9242E+01	2.682E+01
Cs-134 <	2.7760E-01	2.8302E-01			
Pb-212	7.9794E-01	7.9794E-01	2.7463E-01	2.7534E-01	4.177E-01
Ra-224 <	8.6543E+00	4.8280E+02			
I-131 B<	2.1141E-01	1.2927E+00			
Mn-54 <	1.1048E-01	1.1575E-01			
Tl-208 <	2.83E-01	>12 Halflives			
Bi-212 <	2.33E+00	>12 Halflives			
Ra-223 <	1.3994E+00	5.0014E+00			
Pa-234 <	8.52E-01	>12 Halflives			
Eu-154 <	3.7131E-01	3.7299E-01			

Eu-152		3.5079E+00	3.5184E+00	1.1129E+00	1.1161E+00	1.099E+00
Na-22	<	1.0245E-01	1.0403E-01			
Zn-65	<	4.6739E-01	4.9608E-01			
Ba-133	<	3.3302E-01	3.3429E-01			
Ru-103	B<	2.2418E-01	3.2453E-01			
Be-7	B<	1.7108E+00	2.2469E+00			
I-125	B<	3.5285E+00	4.4949E+00			
Tl-201	B<	1.6769E+00	2.0018E+02			
Pa-234	B<	6.98E-01	>12 Halflives			
Np-237	B<	1.8365E+00	1.8365E+00			
Ce-144	B<	1.1433E+00	1.2034E+00			
Eu-155	<	6.5798E-01	6.6329E-01			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

S U M M A R Y

Total Activity (19.4 to 1990.8 keV) 1.7002229E+02 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 2.3882799E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1115.52 % Zn-65 1173.00 % Co-60
1274.50 % Na-22 1274.54 ? Eu-154 1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 15:20:54 Page 1
 Energy Laboratory Spectrum name: C13110898.27.An1

Sample description
 C13110898.27

Spectrum Filename: C:\User\C13110898.27.An1

Acquisition information

Start time: 16-Dec-2013 14:05:55
 Live time: 3587
 Real time: 3600
 Dead time: 0.36 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.2490E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.2490E+02) =
 2.1617E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 15:20:54 Page 2
 Energy Laboratory Spectrum name: C13110898.27.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1709

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide	Time of Count	Activity	Time Corrected	Uncertainty	2 Sigma	MDA
		pCi/g	Activity	Counting	Total	
		pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228	B<	1.6606E+00	1.6722E+00			
Ra-226	<	1.5880E+01	1.5881E+01			
Bi-214		2.3480E+01 ✓	2.3481E+01	1.5707E+00 ✓	1.6699E+00	9.237E-01 ✓
Pb-214		2.2111E+01	2.2111E+01	1.2657E+00	1.3737E+00	9.172E-01
Ir-192	B<	3.4367E-01	4.1870E-01			
Sb-124	B<	1.5730E-01	2.0052E-01			
Sc-46		3.4352E+00	4.0896E+00	6.1523E-01	6.2311E-01	4.507E-01
Pb-210		2.3360E+01	2.3402E+01	7.5799E+00	7.5991E+00	8.569E+00
Th-228	<	2.2562E+01	2.3040E+01			
Th-230	<	7.1600E+01	7.1600E+01			
Cs-137	<	2.0754E-01	2.0782E-01			
Co-60	B<	2.8199E-01	2.8414E-01			
Am-241	<	8.0209E-01	8.0216E-01			
K-40		1.8008E+01	1.8008E+01	4.7596E+00	4.7794E+00	7.894E+00
U-235		4.2590E+00	4.2590E+00	4.5617E-01	4.6763E-01	5.539E-01
Th-234		1.8595E+02	3.4103E+02	9.4960E+01	9.5824E+01	3.710E+01
Cs-134	<	3.6117E-01	3.6824E-01			
Pb-212		1.2325E+00	1.2325E+00	3.8675E-01	3.8796E-01	5.713E-01
Ra-224	<	1.1542E+01	6.5440E+02			
I-131	B<	3.8058E-01	2.3442E+00			
Mn-54	<	2.1385E-01	2.2408E-01			
Tl-208	<	4.58E-01	>12 Half-lives			
Bi-212	<	3.75E+00	>12 Half-lives			
Ra-223	<	2.2996E+00	8.2609E+00			
Pa-234	<	1.16E+00	>12 Half-lives			
Eu-154	<	5.6001E-01	5.6256E-01			

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 15:20:54 Page 3

Eu-152	<	1.7041E+00	1.7093E+00
Na-22	<	2.1975E-01	2.2316E-01
Zn-65	<	6.0186E-01	6.3895E-01
Ba-133	<	4.7217E-01	4.7397E-01
Ru-103	B<	3.1974E-01	4.6358E-01
Be-7	B<	2.5432E+00	3.3440E+00
I-125	B<	2.6463E+00	3.3744E+00
Tl-201	B<	1.3354E+00	1.6251E+02
Pa-234	B<	8.92E-01	>12 Halflives
Np-237	B<	2.6500E+00	2.6500E+00
Ce-144	B<	1.8165E+00	1.9123E+00
Eu-155	<	9.2901E-01	9.3653E-01

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

S U M M A R Y

Total Activity (19.4 to 1990.8 keV) 2.8183466E+02 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 4.3761453E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 ? Ra-228	1115.52 % Zn-65	1173.00 % Co-60
1274.50 Na-22	1274.54 % Eu-154	1333.00 % Co-60	1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 16:39:49 Page 1
 Energy Laboratory Spectrum name: C13110898.28.An1

Sample description
 C13110898.28

Spectrum Filename: C:\User\C13110898.28.An1

Acquisition information

Start time: 16-Dec-2013 15:23:22
 Live time: 3580
 Real time: 3600
 Dead time: 0.54 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.6909E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6909E+02) =
 1.5968E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 16:39:49 Page 2
 Energy Laboratory Spectrum name: C13110898.28.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1298

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
		Activity pCi/g	Activity pCi/g	Counting pCi/g	Total pCi/g	
Ra-228	B<	2.5947E+00	2.6129E+00			
Ra-226	<	1.6586E+01	1.6587E+01			
Bi-214		7.0076E+01 ✓	7.0078E+01	2.1939E+00 ✓	2.7710E+00	9.183E-01 ✓
Pb-214		7.2243E+01	7.2245E+01	1.8788E+00	2.5642E+00	1.059E+00
Ir-192	B<	3.5610E-01	4.3406E-01			
Sb-124	B<	3.5575E-01	4.5380E-01			
Sc-46		1.1532E+01	1.3734E+01	8.9583E-01	9.5529E-01	4.211E-01
Pb-210		5.9111E+01	5.9218E+01	6.3781E+00	6.5231E+00	8.424E+00
Th-228	<	2.9424E+01	3.0049E+01			
Th-230	<	9.1852E+01	9.1853E+01			
Cs-137	<	3.5691E-01	3.5739E-01			
Co-60	B<	2.3948E-01	2.4131E-01			
Am-241	<	9.7753E-01	9.7762E-01			
K-40		2.3878E+01	2.3878E+01	5.6161E+00	5.6456E+00	6.988E+00
U-235		5.5874E+00	5.5874E+00	5.3830E-01	5.5496E-01	7.283E-01
Th-234	B<	5.7839E+01	1.0624E+02			
Cs-134	<	2.7856E-01	2.8403E-01			
Pb-212		1.5430E+00	1.5430E+00	4.4960E-01	4.5123E-01	6.842E-01
Ra-224		2.5641E+01	1.4689E+03	5.8157E+02	5.8265E+02	1.628E+01
I-131	B<	3.4933E-01	2.1617E+00			
Mn-54	<	4.5085E-01	4.7248E-01			
Tl-208	<	5.76E-01	>12 Half-lives			
Bi-212	<	4.25E+00	>12 Half-lives			
Ra-223	<	2.6343E+00	9.4942E+00			
Pa-234	<	1.42E+00	>12 Half-lives			
Eu-154	<	8.1284E-01	8.1656E-01			

□

ORTEC g v - i (143) wan32 G53W2.06 16-DEC-2013 16:39:49 Page 3

Eu-152		1.0507E+01	1.0539E+01	2.2395E+00	2.2540E+00	1.833E+00
Na-22	<	2.2058E-01	2.2401E-01			
Zn-65	<	7.1481E-01	7.5898E-01			
Ba-133	<	5.0590E-01	5.0784E-01			
Ru-103	B<	4.0053E-01	5.8126E-01			
Be-7	B<	1.9914E+00	2.6203E+00			
I-125	B<	5.9830E+00	7.6338E+00			
Tl-201	B<	2.3042E+00	2.8387E+02			
Pa-234	B<	1.29E+00	>12 Halflives			
Np-237	B<	3.4159E+00	3.4159E+00			
Ce-144	B<	2.1330E+00	2.2458E+00			
Eu-155	<	1.1119E+00	1.1209E+00			

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (19.4 to 1990.8 keV) 2.8011911E+02 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 1.7257196E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 % Na-22 1274.54 Eu-154 1333.00 % Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:39:07 Page 1
 Energy Laboratory Spectrum name: C13110898.29.An1

Sample description
 C13110898.29

Spectrum Filename: C:\User\C13110898.29.An1

Acquisition information

Start time: 16-Dec-2013 16:41:02
 Live time: 3596
 Real time: 3600
 Dead time: 0.10 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.Clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.4883E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.4883E+02) =
 1.8142E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:39:07 Page 2
 Energy Laboratory Spectrum name: C13110898.29.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1251

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228	3.4109E+00	3.4349E+00	8.9471E-01	8.9855E-01	1.554E+00
Ra-226 <	9.6802E+00	9.6804E+00			
Bi-214	1.3186E+01 ✓	1.3187E+01	1.2194E+00 ✓	1.2603E+00	8.519E-01 ✓
Pb-214	1.4396E+01	1.4397E+01	9.3395E-01	9.9659E-01	6.668E-01
Ir-192 B<	2.4879E-01	3.0340E-01			
Sb-124 B<	2.7332E-01	3.4886E-01			
Sc-46 #	2.7792E+00	3.3115E+00	4.9024E-01	4.9672E-01	1.822E-01
Pb-210	1.2220E+01	1.2242E+01	4.8653E+00	4.8735E+00	5.766E+00
Th-228 <	1.8737E+01	1.9136E+01			
Th-230 <	4.8858E+01	4.8858E+01			
Cs-137 <	2.3239E-01	2.3270E-01			
Co-60 B<	2.2447E-01	2.2619E-01			
Am-241 <	4.7992E-01	4.7997E-01			
K-40	2.0852E+01	2.0852E+01	4.3871E+00	4.4159E+00	6.615E+00
U-235	1.5847E+00	1.5847E+00	2.9770E-01	3.0015E-01	4.140E-01
Th-234 B<	3.8975E+01	7.1703E+01			
Cs-134 <	2.2585E-01	2.3030E-01			
Pb-212	1.3587E+00	1.3587E+00	3.6841E-01	3.6995E-01	5.365E-01
Ra-224 <	8.9971E+00	5.2076E+02			
I-131 B<	2.5897E-01	1.6100E+00			
Mn-54 <	2.3487E-01	2.4617E-01			
Tl-208 #H	8.6075E-01	>12 Halflives	3.0405E-01	3.0476E-01	3.363E-01
Bi-212 <	2.92E+00	>12 Halflives			
Ra-223 <	1.7022E+00	6.1548E+00			
Pa-234 <	8.52E-01	>12 Halflives			
Eu-154 <	7.8649E-01	7.9010E-01			

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:39:07 Page 3

Eu-152	<	1.4039E+00	1.4082E+00
Na-22	<	1.0324E-01	1.0485E-01
Zn-65	<	5.2111E-01	5.5339E-01
Ba-133	<	3.0788E-01	3.0906E-01
Ru-103	B<	1.6565E-01	2.4062E-01
Be-7	B<	1.7573E+00	2.3138E+00
I-125	B<	2.8517E+00	3.6408E+00
Tl-201	B<	1.6460E+00	2.0529E+02
Pa-234	B<	4.99E-01	>12 Halflives
Np-237	B<	1.8990E+00	1.8990E+00
Ce-144	B<	1.5338E+00	1.6151E+00
Eu-155	<	6.5664E-01	6.6199E-01

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Half-life limit exceeded

----- S U M M A R Y -----
Total Activity (19.4 to 1990.8 keV) 6.9787239E+01 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 7.0366325E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
1001.00 & Th-234 1115.52 Zn-65 1173.00 & Co-60 1274.50 & Na-22
1274.54 Eu-154 1333.00 % Co-60 1408.00 & Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 08:39:07 Page 4
Energy Laboratory Spectrum name: C13110898.29.An1

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:19:20 Page 1
 Energy Laboratory Spectrum name: C13110898.30.An1

Sample description
 C13110898.30

Spectrum Filename: C:\User\C13110898.30.An1

Acquisition information

Start time: 17-Dec-2013 08:43:11
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.Clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 2.0020E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 2.0020E+02) =
 1.3487E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:19:20 Page 2
 Energy Laboratory Spectrum name: C13110898.30.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1893

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****
 Time of Count Time Corrected Uncertainty 2 Sigma
 Nuclide Activity Activity Counting Total MDA
 pCi/g pCi/g pCi/g pCi/g

Ra-228	B<	1.2392E+00	1.2482E+00			
Ra-226	<	4.5701E+00	4.5702E+00			
Bi-214		2.1115E+00	2.1115E+00	4.8753E-01	4.9019E-01	4.841E-01
Pb-214		1.8934E+00	1.8935E+00	3.4302E-01	3.4606E-01	4.395E-01
Ir-192	B<	8.2747E-02	1.0155E-01			
Sb-124	B<	1.1502E-01	1.4795E-01			
Sc-46		4.2070E-01	5.0406E-01	1.8104E-01	1.8145E-01	1.650E-01
Pb-210	<	2.9748E+00	2.9803E+00			
Th-228	<	9.3150E+00	9.5196E+00			
Th-230	<	2.2032E+01	2.2032E+01			
Cs-137	<	1.8095E-01	1.8119E-01			
Co-60	B<	1.5752E-01	1.5877E-01			
Am-241	<	2.1381E-01	2.1383E-01			
K-40		1.8520E+01	1.8520E+01	3.4553E+00	3.4841E+00	4.917E+00
U-235	<	2.9039E-01	2.9039E-01			
Th-234	B<	1.4910E+01	2.7962E+01			
Cs-134	<	1.9294E-01	1.9686E-01			
Pb-212		1.1256E+00	1.1256E+00	2.2983E-01	2.3153E-01	2.976E-01
Ra-224	<	4.0773E+00	2.6821E+02			
I-131	B<	7.7633E-02	5.1126E-01			
Mn-54	<	1.4993E-01	1.5737E-01			
Tl-208	#H	4.2716E-01	>12 Halflives	1.6855E-01	1.6886E-01	1.980E-01
Bi-212	<	1.59E+00	>12 Halflives			
Ra-223	<	1.0731E+00	4.0406E+00			
Pa-234	<	4.90E-01	>12 Halflives			
Eu-154	<	2.6901E-01	2.7028E-01			

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:19:20 Page 3

Eu-152	<	1.1379E+00	1.1415E+00
Na-22	<	9.6834E-02	9.8391E-02
Zn-65	<	3.7534E-01	3.9936E-01
Ba-133	<	2.0990E-01	2.1073E-01
Ru-103	B<	1.0392E-01	1.5275E-01
Be-7	B<	1.0262E+00	1.3630E+00
I-125	B<	1.6330E+00	2.1010E+00
Tl-201	B<	1.0617E+00	1.5418E+02
Pa-234	B<	3.63E-01	>12 Halflives
Np-237	B<	8.9398E-01	8.9398E-01
Ce-144	B<	9.0409E-01	9.5359E-01
Eu-155	<	4.2969E-01	4.3329E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.4071396E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.4154861E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 Ra-228 969.10 % Ra-228 1001.00 & Th-234 1115.52 % Zn-65
 1173.00 % Co-60 1274.50 Na-22 1274.54 % Eu-154 1333.00 & Co-60
 1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 10:19:20 Page 4
 Energy Laboratory Spectrum name: C13110898.30.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

C13110898.30.Rpt

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 11:27:04 Page 1
 Energy Laboratory Spectrum name: C13110898.30dup.An1

Sample description
 C13110898.30dup

Spectrum Filename: C:\User\C13110898.30dup.An1

Acquisition information

Start time: 17-Dec-2013 10:22:06
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 2.0020E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 2.0020E+02) =
 1.3487E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 11:27:04 Page 2
 Energy Laboratory Spectrum name: C13110898.30dup.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1416

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide	Time of Count	Activity	Time Corrected	Uncertainty	2 Sigma	MDA
		pCi/g	Activity	Counting	Total	
		pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	9.1667E-01	9.2333E-01				
Ra-226 <	4.7685E+00	4.7687E+00				
Bi-214	2.2404E+00	2.2405E+00	4.5704E-01	4.6023E-01	4.521E-01	
Pb-214	1.9157E+00	1.9158E+00	3.5493E-01	3.5794E-01	4.309E-01	
Ir-192 B<	1.3970E-01	1.7155E-01				
Sb-124 B<	1.5686E-01	2.0192E-01				
Sc-46	4.3381E-01	5.2007E-01	1.9313E-01	1.9354E-01	1.886E-01	
Pb-210 <	3.0458E+00	3.0515E+00				
Th-228 <	9.2674E+00	9.4715E+00				
Th-230 <	1.6525E+01	1.6525E+01				
Cs-137 <	1.7748E-01	1.7773E-01				
Co-60 B<	1.7559E-01	1.7699E-01				
Am-241 <	2.4115E-01	2.4118E-01				
K-40	1.7117E+01	1.7117E+01	3.3665E+00	3.3918E+00	4.918E+00	
U-235 <	2.5785E-01	2.5785E-01				
Th-234 B<	9.6157E+00	1.8069E+01				
Cs-134 <	1.6444E-01	1.6779E-01				
Pb-212	1.2098E+00	1.2098E+00	2.2891E-01	2.3088E-01	2.861E-01	
Ra-224 <	4.1715E+00	2.7804E+02				
I-131 B<	1.7447E-01	1.1558E+00				
Mn-54 <	1.4993E-01	1.5740E-01				
Tl-208 H	4.7055E-01	>12 Halflives	1.8094E-01	1.8130E-01	2.111E-01	
Bi-212 <	1.98E+00	>12 Halflives				
Ra-223 <	1.0570E+00	3.9966E+00				
Pa-234 <	4.72E-01	>12 Halflives				
Eu-154 <	3.2494E-01	3.2648E-01				

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 11:27:04 Page 3

Eu-152	<	8.3912E-01	8.4174E-01
Na-22	<	8.4244E-02	8.5603E-02
Zn-65	<	3.4042E-01	3.6227E-01
Ba-133	<	2.2915E-01	2.3006E-01
Ru-103	B<	1.8047E-01	2.6557E-01
Be-7	B<	1.2812E+00	1.7032E+00
I-125	B<	2.0707E+00	2.6662E+00
Tl-201	B<	1.0596E+00	1.5630E+02
Pa-234	B<	3.47E-01	>12 Halflives
Np-237	B<	9.2056E-01	9.2056E-01
Ce-144	B<	6.6248E-01	6.9887E-01
Eu-155	<	4.5932E-01	4.6319E-01

< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Halflife limit exceeded

----- S U M M A R Y -----
Total Activity (19.4 to 1990.8 keV) 2.2916775E+01 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 2.3003138E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 ? Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 ? Co-60 1274.50 % Na-22 1274.54 % Eu-154 1333.00 ? Co-60
1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 14:10:27 Page 1
 Energy Laboratory Spectrum name: C13110898.31.An1

Sample description
 C13110898.31

Spectrum Filename: C:\User\C13110898.31.An1

Acquisition information

Start time: 17-Dec-2013 12:13:09
 Live time: 3597
 Real time: 3600
 Dead time: 0.09 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.8614E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8614E+02) =
 1.4505E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 14:10:27 Page 2
 Energy Laboratory Spectrum name: C13110898.31.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0969

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide	Time of Count	Activity	Corrected Activity	Uncertainty Counting	2 Sigma Total	MDA
	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.0792E+00	1.0871E+00				
Ra-226 <	5.5583E+00	5.5584E+00				
Bi-214	3.1868E+00 ✓	3.1869E+00	4.9438E-01 ✓	5.0034E-01	4.474E-01 ✓	
Pb-214	3.1958E+00	3.1958E+00	4.3032E-01	4.3719E-01	4.739E-01	
Ir-192 B<	1.5185E-01	1.8661E-01				
Sb-124 B<	1.3303E-01	1.7140E-01				
Sc-46 <	2.6360E-01	3.1622E-01				
Pb-210 <	3.4540E+00	3.4605E+00				
Th-228 <	1.0004E+01	1.0225E+01				
Th-230 <	3.3916E+01	3.3916E+01				
Cs-137 <	1.9462E-01	1.9489E-01				
Co-60 B<	1.6942E-01	1.7077E-01				
Am-241 <	3.3384E-01	3.3387E-01				
K-40	1.8991E+01	1.8991E+01	3.6579E+00	3.6865E+00	5.289E+00	
U-235 <	2.6630E-01	2.6630E-01				
Th-234 B<	2.5160E+01	4.7384E+01				
Cs-134 <	2.4440E-01	2.4940E-01				
Pb-212	1.2226E+00	1.2226E+00	2.4904E-01	2.5088E-01	3.228E-01	
Ra-224 <	4.7151E+00	3.1894E+02				
I-131 B<	1.6187E-01	1.0795E+00				
Mn-54 <	1.2515E-01	1.3141E-01				
Tl-208 #H	6.7644E-01 >12	Halfives	1.9600E-01	1.9668E-01	2.157E-01	
Bi-212 <	2.09E+00 >12	Halfives				
Ra-223 <	1.2031E+00	4.5703E+00				
Pa-234 <	2.74E-01 >12	Halfives				
Eu-154 <	8.6809E-01	8.7222E-01				

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 14:10:27 Page 3

Eu-152	<	9.9451E-01	9.9763E-01
Na-22	<	1.1557E-01	1.1744E-01
Zn-65	<	4.1386E-01	4.4052E-01
Ba-133	<	2.0647E-01	2.0729E-01
Ru-103	B<	1.6322E-01	2.4051E-01
Be-7	B<	8.6618E-01	1.1526E+00
I-125	B<	2.5237E+00	3.2523E+00
Tl-201	B<	8.4271E-01	1.2650E+02
Pa-234	B<	4.34E-01	>12 Halfives
Np-237	B<	9.3690E-01	9.3690E-01
Ce-144	B<	7.9898E-01	8.4302E-01
Eu-155	<	5.4838E-01	5.5302E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Half-life limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.6596266E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.6596434E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1120.51 % Sc-46 1173.00 % Co-60 1274.50 % Na-22 1274.54 Eu-154
 1333.00 % Co-60 1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 14:10:27 Page 4
 Energy Laboratory Spectrum name: C13110898.31.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:37:18 Page 1
 Energy Laboratory Spectrum name: C13110898.32.An1

Sample description
 C13110898.32

Spectrum Filename: C:\User\C13110898.32.An1

Acquisition information

Start time: 17-Dec-2013 14:16:36
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7208E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7208E+02) =
 1.5690E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:37:18 Page 2
 Energy Laboratory Spectrum name: C13110898.32.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1743

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228	2.7788E+00	2.7992E+00	7.1125E-01	7.1446E-01	9.218E-01
Ra-226 <	4.9012E+00	4.9014E+00			
Bi-214 #	1.2230E+00 ✓	1.2231E+00	4.7805E-01 ✓	4.7896E-01	5.342E-01 ✓
Pb-214	9.0229E-01	9.0231E-01	3.2861E-01	3.2933E-01	4.906E-01
Ir-192 B<	9.1231E-02	1.1220E-01			
Sb-124 B<	1.1128E-01	1.4352E-01			
Sc-46 <	2.2404E-01	2.6894E-01			
Pb-210 <	1.7243E+00	1.7275E+00			
Th-228 <	9.7070E+00	9.9225E+00			
Th-230 <	2.6481E+01	2.6481E+01			
Cs-137 <	1.4327E-01	1.4347E-01			
Co-60 B<	1.8326E-01	1.8472E-01			
Am-241 <	1.7594E-01	1.7595E-01			
K-40	2.1923E+01	2.1923E+01	4.0434E+00	4.0779E+00	5.721E+00
U-235 <	2.7406E-01	2.7406E-01			
Th-234 B<	1.7027E+01	3.2147E+01			
Cs-134 <	2.6435E-01	2.6979E-01			
Pb-212	1.4039E+00	1.4039E+00	2.6740E-01	2.6966E-01	3.357E-01
Ra-224 <	4.8068E+00	3.3053E+02			
I-131 B<	2.1298E-01	1.4309E+00			
Mn-54 <	1.4441E-01	1.5166E-01			
Tl-208 #H	6.8246E-01 >12	Half-lives	2.2243E-01	2.2304E-01	2.433E-01
Bi-212 <	2.44E+00 >12	Half-lives			
Ra-223 <	8.9154E-01	3.4045E+00			
Pa-234 <	5.09E-01 >12	Half-lives			
Eu-154 <	3.4757E-01	3.4923E-01			

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:37:18 Page 3

Eu-152	<	9.7623E-01	9.7930E-01
Na-22	<	1.9249E-01	1.9561E-01
Zn-65	<	4.6209E-01	4.9198E-01
Ba-133	<	2.5620E-01	2.5722E-01
Ru-103	B<	1.1644E-01	1.7185E-01
Be-7	B<	1.1939E+00	1.5905E+00
I-125	B<	1.6947E+00	2.1861E+00
Tl-201	B<	1.1993E+00	1.8358E+02
Pa-234	B<	3.70E-01	>12 Halflives
Np-237	B<	1.0435E+00	1.0435E+00
Ce-144	B<	8.2270E-01	8.6824E-01
Eu-155	<	4.6345E-01	4.6739E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.8231236E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.8251629E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 - Ra-228 1001.00 % Th-234 1115.52 % Zn-65 1120.51 % Sc-46
 1173.00 % Co-60 1274.50 Na-22 1274.54 & Eu-154 1333.00 % Co-60
 1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 □

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 15:37:18 Page 4
 Energy Laboratory Spectrum name: C13110898.32.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:12 Page 1
 Energy Laboratory Spectrum name: C13110898.33.An1

Sample description
 C13110898.33

Spectrum Filename: C:\User\C13110898.33.An1

Acquisition information

Start time: 17-Dec-2013 15:40:06
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7916E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7916E+02) =
 1.5070E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:12 Page 2
 Energy Laboratory Spectrum name: C13110898.33.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1401

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.3386E+00	1.3485E+00			
Ra-226 <	4.9239E+00	4.9240E+00			
Bi-214 #	2.0026E+00 ✓	2.0027E+00	4.9516E-01 ✓	4.9752E-01	5.202E-01 ✓
Pb-214	1.9964E+00	1.9964E+00	3.8539E-01	3.8840E-01	4.818E-01
Ir-192 B<	1.4976E-01	1.8429E-01			
Sb-124 B<	9.9923E-02	1.2896E-01			
Sc-46	4.7488E-01	5.7034E-01	2.2597E-01	2.2639E-01	2.345E-01
Pb-210 <	2.8557E+00	2.8611E+00			
Th-228 <	9.7492E+00	9.9662E+00			
Th-230 <	2.8296E+01	2.8296E+01			
Cs-137 <	1.3459E-01	1.3477E-01			
Co-60 B<	1.9934E-01	2.0094E-01			
Am-241 <	2.9441E-01	2.9444E-01			
K-40	1.9489E+01	1.9489E+01	3.7849E+00	3.8141E+00	5.495E+00
U-235 <	2.8690E-01	2.8690E-01			
Th-234 B<	1.7539E+01	3.3167E+01			
Cs-134 <	1.8375E-01	1.8753E-01			
Pb-212	1.0044E+00	1.0044E+00	2.4376E-01	2.4503E-01	3.322E-01
Ra-224 <	4.5861E+00	3.1887E+02			
I-131 B<	1.5054E-01	1.0165E+00			
Mn-54 <	1.7002E-01	1.7858E-01			
Tl-208 <	2.31E-01	>12 Halflives			
Bi-212 <	1.75E+00	>12 Halflives			
Ra-223 <	1.0219E+00	3.9159E+00			
Pa-234 <	2.93E-01	>12 Halflives			
Eu-154 <	5.1502E-01	5.1748E-01			

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:12 Page 3

Eu-152	<	9.3766E-01	9.4062E-01
Na-22	<	1.1435E-01	1.1621E-01
Zn-65	<	3.6529E-01	3.8898E-01
Ba-133	<	2.2744E-01	2.2836E-01
Ru-103	B<	1.0735E-01	1.5859E-01
Be-7	B<	1.5202E+00	2.0267E+00
I-125	B<	2.5636E+00	3.3093E+00
Tl-201	B<	1.3193E+00	2.0463E+02
Pa-234	B<	3.36E-01	>12 Halflives
Np-237	B<	1.0668E+00	1.0668E+00
Ce-144	B<	8.0311E-01	8.4768E-01
Eu-155	<	5.0041E-01	5.0467E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.4966923E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.5062487E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
 1173.00 ? Co-60 1274.50 % Na-22 1274.54 Eu-154 1333.00 % Co-60
 1408.00 ? Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 17-DEC-2013 16:42:12 Page 4
 Energy Laboratory Spectrum name: C13110898.33.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (2191) wan32 G53W2.06 18-DEC-2013 08:36:50 Page 1
 Energy Laboratory Spectrum name: C13110898.34.An1

Sample description
 C13110898.34

Spectrum Filename: C:\User\C13110898.34.An1

Acquisition information

Start time: 17-Dec-2013 16:45:28
 Live time: 3597
 Real time: 3600
 Dead time: 0.09 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.Clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7219E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7219E+02) =
 1.5680E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 18-DEC-2013 08:36:50 Page 2
 Energy Laboratory Spectrum name: C13110898.34.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1673

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	pCi/g
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 #B	1.2545E+00	1.2637E+00	6.0220E-01	6.0297E-01	1.774E+00
Ra-226 #A	0.0000E+00	0.0000E+00	2.3980E+04	2.3980E+04	1.038E+01
Bi-214 F	1.2676E+00	1.2676E+00	5.6450E-01	5.6533E-01	6.197E-01
Pb-214	1.0312E+00	1.0313E+00	3.7388E-01	3.7471E-01	5.619E-01
Ir-192 #B	1.8521E-02	2.2801E-02	1.1301E-01	1.1301E-01	1.459E-01
Sb-124 B	1.7681E-01	2.2830E-01	2.3582E-01	2.3588E-01	2.093E-01
Sc-46	4.0060E-01	4.8131E-01	2.1216E-01	2.1248E-01	2.234E-01
Pb-210 #	5.7607E+00	5.7716E+00	3.0782E+00	3.0811E+00	3.970E+00
Th-228 A	1.3008E+01	1.3298E+01	8.7473E+00	8.7526E+00	1.378E+01
Th-230 #	6.6289E+01	6.6289E+01	4.2835E+01	4.2862E+01	5.269E+01
Cs-137 #A	-3.5015E-02	-3.5064E-02	-4.0698E-01	-4.0698E-01	1.784E-01
Co-60 #B	1.0465E-02	1.0549E-02	9.7967E-03	9.8000E-03	2.008E-01
Am-241 #A	1.8303E-01	1.8305E-01	3.8994E-01	3.8996E-01	5.671E-01
K-40	1.5007E+01	1.5007E+01	3.5865E+00	3.6048E+00	5.718E+00
U-235	3.0953E+00	3.0953E+00	3.5121E-01	3.5908E-01	3.406E-01
Th-234	1.2238E+02	2.3172E+02	7.1809E+01	7.2337E+01	2.791E+01
Cs-134 #	3.3412E-01	3.4101E-01	2.1885E-01	2.1901E-01	2.467E-01
Pb-212	1.3950E+00	1.3950E+00	2.6888E-01	2.7111E-01	3.401E-01
Ra-224 A	2.9144E+00	2.0441E+02	1.8937E+02	1.8944E+02	4.392E+00
I-131 #F	3.5847E-01	2.4299E+00	1.5715E+00	1.5726E+00	2.039E-01
Mn-54 #A	1.6017E-02	1.6825E-02	1.3158E-01	1.3158E-01	1.970E-01
Tl-208 H	4.0336E-01	>12 Halflives	1.8344E-01	1.8370E-01	2.341E-01
Bi-212	3.1423E+00	>12 Halflives	2.4630E+00	2.4642E+00	2.633E+00
Ra-223 #A	-1.8676E-01	-7.1766E-01	3.9703E+03	3.9703E+03	6.117E-01
Pa-234 A	2.3203E-01	>12 Halflives	3.9086E-01	3.9090E-01	6.550E-01
Eu-154 #A	-6.6790E-02	-6.7111E-02	4.2038E+02	4.2038E+02	3.128E-01

ORTEC g v - i (2191) wan32 G53W2.06 18-DEC-2013 08:36:50 Page 3

Eu-152	#A	-6.9297E-04	-6.9516E-04	-9.8785E-04	-9.8799E-04	1.091E+00
Na-22	#A	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	8.923E-02
Zn-65	A	2.0495E-02	2.1827E-02	1.4417E-01	1.4417E-01	3.000E-01
Ba-133	A	4.0053E-02	4.0214E-02	1.6471E-01	1.6471E-01	2.862E-01
Ru-103	B	1.3532E-01	2.0007E-01	1.9275E-01	1.9290E-01	1.677E-01
Be-7	B	6.4085E-01	8.5486E-01	1.1587E+00	1.1591E+00	1.513E+00
I-125	#B	1.0589E+00	1.3676E+00	2.7577E+00	2.7581E+00	2.857E+00
Tl-201	#B	4.1784E-01	6.5484E+01	1.1710E+02	1.1713E+02	1.105E+00
Pa-234	#F	8.9208E-01	>12 Halflives	5.1547E-01	5.1652E-01	5.889E-01
Np-237	#B	0.0000E+00	0.0000E+00	2.0913E+03	2.0913E+03	1.396E+00
Ce-144	B	1.1215E+00	1.1839E+00	1.3614E+00	1.3617E+00	1.212E+00
Eu-155		1.0803E+00	1.0895E+00	5.7440E-01	5.7495E-01	6.461E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 1.4290472E+02 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.5225325E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 18-DEC-2013 08:36:50 Page 4
 Energy Laboratory Spectrum name: C13110898.34.An1

Laboratory: Energy Laboratory C13110898.34.Rpt

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:47:18 Page 1
 Energy Laboratory Spectrum name: C13110898.35.An1

Sample description
 C13110898.35

Spectrum Filename: C:\User\C13110898.35.An1

Acquisition information

Start time: 18-Dec-2013 08:38:36
 Live time: 3518
 Real time: 3600
 Dead time: 2.27 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.6087E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6087E+02) =
 1.6784E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:47:18 Page 2
 Energy Laboratory Spectrum name: C13110898.35.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1563

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.9250E+00	1.9396E+00			
Ra-226 <	5.5877E+00	5.5878E+00			
Bi-214 #	2.1785E+00 ✓	2.1785E+00	6.4879E-01 ✓	6.5092E-01	6.365E-01 ✓
Pb-214	1.4989E+00	1.4989E+00	3.8990E-01	3.9158E-01	5.304E-01
Ir-192 B<	1.2274E-01	1.5204E-01			
Sb-124 B<	2.0166E-01	2.6238E-01			
Sc-46	4.3901E-01	5.3035E-01	1.9945E-01	1.9986E-01	1.650E-01
Pb-210 <	3.6542E+00	3.6614E+00			
Th-228 <	1.0864E+01	1.1113E+01			
Th-230 <	2.5930E+01	2.5930E+01			
Cs-137 <	1.5229E-01	1.5251E-01			
Co-60 B<	1.9862E-01	2.0026E-01			
Am-241 <	2.6484E-01	2.6487E-01			
K-40	1.6400E+01	1.6400E+01	3.9053E+00	3.9253E+00	6.192E+00
U-235 <	2.9824E-01	2.9824E-01			
Th-234 B<	3.3956E+01	6.5532E+01			
Cs-134 <	2.4974E-01	2.5505E-01			
Pb-212	1.8938E+00	1.8938E+00	3.0949E-01	3.1304E-01	3.663E-01
Ra-224 <	4.7851E+00	3.8096E+02			
I-131 B<	1.8997E-01	1.3633E+00			
Mn-54 <	1.3936E-01	1.4661E-01			
Tl-208 H	6.8292E-01	>12 Halflives	2.5617E-01	2.5670E-01	2.857E-01
Bi-212 <	2.62E+00	>12 Halflives			
Ra-223 <	1.3139E+00	5.2558E+00			
Pa-234 <	5.82E-01	>12 Halflives			
Eu-154 <	3.3961E-01	3.4129E-01			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:47:18 Page 3

Eu-152	<	1.0579E+00	1.0614E+00
Na-22	<	1.4283E-01	1.4523E-01
Zn-65	<	4.6508E-01	4.9623E-01
Ba-133	<	2.8348E-01	2.8465E-01
Ru-103	B<	1.2624E-01	1.8883E-01
Be-7	B<	1.1221E+00	1.5097E+00
I-125	B<	2.4176E+00	3.1464E+00
Tl-201	B<	1.2531E+00	2.2833E+02
Pa-234	B<	4.66E-01	>12 Halflives
Np-237	B<	1.2465E+00	1.2465E+00
Ce-144	B<	8.3955E-01	8.8767E-01
Eu-155	<	5.2604E-01	5.3066E-01

- All peaks for activity calculation had bad shape.
* - Activity omitted from total
& - Activity omitted from total and all peaks had bad shape.
< - MDA value printed.
A - Activity printed, but activity < MDA.
B - Activity < MDA and failed test.
C - Area < Critical level.
F - Failed fraction or key line test.
H - Half-life limit exceeded

----- S U M M A R Y -----
Total Activity (19.4 to 1990.8 keV) 2.2410149E+01 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 2.2501591E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 Ra-228 969.10 & Ra-228 1001.00 & Th-234 1115.52 % Zn-65
1173.00 % Co-60 1274.50 Na-22 1274.54 % Eu-154 1333.00 % Co-60
1408.00 % Eu-152

! - Peak is part of a multiplet and this area went
negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
\$ - Peak identified, but first peak of this nuclide
failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the
library energy centroid for positive identification.
P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 09:47:18 Page 4
Energy Laboratory Spectrum name: C13110898.35.An1

Analyzed by: _____
Dave Blaida

Reviewed by: _____

C13110898.35.Rpt

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 10:57:08 Page 1
 Energy Laboratory Spectrum name: C13110898.36.An1

Sample description
 C13110898.36

Spectrum Filename: C:\User\C13110898.36.An1

Acquisition information

Start time: 18-Dec-2013 09:50:58
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7541E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7541E+02) =
 1.5393E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 10:57:08 Page 2
 Energy Laboratory Spectrum name: C13110898.36.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0778

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 B<	1.2243E+00	1.2336E+00			
Ra-226 <	5.0796E+00	5.0798E+00			
Bi-214	1.4778E+00	1.4778E+00	4.8086E-01	4.8218E-01	5.292E-01
Pb-214	1.5308E+00	1.5308E+00	3.6070E-01	3.6259E-01	4.754E-01
Ir-192 B<	8.5208E-02	1.0560E-01			
Sb-124 B<	1.8095E-01	2.3557E-01			
Sc-46 <	2.2944E-01	2.7730E-01			
Pb-210 <	4.5846E+00	4.5935E+00			
Th-228 <	1.0107E+01	1.0340E+01			
Th-230 <	1.6910E+01	1.6910E+01			
Cs-137 <	1.5850E-01	1.5873E-01			
Co-60 B<	1.7978E-01	1.8127E-01			
Am-241 <	2.8176E-01	2.8179E-01			
K-40	1.9659E+01	1.9659E+01	3.8500E+00	3.8792E+00	5.612E+00
U-235 <	2.7674E-01	2.7674E-01			
Th-234 B<	1.6054E+01	3.1028E+01			
Cs-134 <	1.8567E-01	1.8963E-01			
Pb-212	9.6861E-01	9.6861E-01	2.3029E-01	2.3154E-01	3.061E-01
Ra-224 <	4.1385E+00	3.3267E+02			
I-131 B<	9.9366E-02	7.1621E-01			
Mn-54 <	1.5482E-01	1.6289E-01			
Tl-208 <	2.66E-01	>12 Halflives			
Bi-212 <	2.39E+00	>12 Halflives			
Ra-223 <	1.1352E+00	4.5548E+00			
Pa-234 <	5.38E-01	>12 Halflives			
Eu-154 <	4.6741E-01	4.6973E-01			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 10:57:08 Page 3

Eu-152	<	9.5770E-01	9.6083E-01
Na-22	<	1.1052E-01	1.1238E-01
Zn-65	<	4.3956E-01	4.6907E-01
Ba-133	<	2.7586E-01	2.7700E-01
Ru-103	B<	1.5068E-01	2.2558E-01
Be-7	B<	9.8360E-01	1.3242E+00
I-125	B<	1.7199E+00	2.2396E+00
Tl-201	B<	1.0568E+00	1.9478E+02
Pa-234	B<	4.46E-01	>12 Halflives
Np-237	B<	1.0560E+00	1.0560E+00
Ce-144	B<	5.4426E-01	5.7553E-01
Eu-155	<	5.2606E-01	5.3070E-01

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Halflife limit exceeded

S U M M A R Y

Total Activity (19.4 to 1990.8 keV) 2.3635859E+01 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 2.3635941E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

911.07 % Ra-228	969.10 % Ra-228	1001.00 ? Th-234	1115.52 % Zn-65
1120.51 % Sc-46	1173.00 ? Co-60	1274.50 % Na-22	1274.54 Eu-154
1333.00 % Co-60	1408.00 % Eu-152		

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 12:49:07 Page 1
 Energy Laboratory Spectrum name: C13110898.37.An1

Sample description
 C13110898.37

Spectrum Filename: C:\User\C13110898.37.An1

Acquisition information

Start time: 18-Dec-2013 11:46:21
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7690E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7690E+02) =
 1.5263E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 12:49:07 Page 2
 Energy Laboratory Spectrum name: C13110898.37.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0980

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide	Time of Count	Activity	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	pCi/g	Activity	Counting	Total	
		pCi/g		pCi/g	pCi/g	
Ra-228 B<	1.2032E+00		1.2124E+00			
Ra-226 <	4.8519E+00		4.8520E+00			
Bi-214	1.3889E+00		1.3890E+00	4.6471E-01	4.6592E-01	5.269E-01
Pb-214	1.4072E+00		1.4072E+00	3.0859E-01	3.1046E-01	4.913E-01
Ir-192 B<	1.4574E-01		1.8075E-01			
Sb-124 B<	1.1158E-01		1.4540E-01			
Sc-46	4.7300E-01		5.7203E-01	2.0486E-01	2.0533E-01	1.832E-01
Pb-210 <	3.7264E+00		3.7337E+00			
Th-228 <	9.4026E+00		9.6198E+00			
Th-230 <	2.0155E+01		2.0155E+01			
Cs-137 <	2.0478E-01		2.0508E-01			
Co-60 B<	1.8883E-01		1.9040E-01			
Am-241 <	1.7256E-01		1.7258E-01			
K-40	1.7294E+01		1.7294E+01	3.6742E+00	3.6978E+00	5.565E+00
U-235 <	2.5548E-01		2.5548E-01			
Th-234 B<	2.0620E+01		3.9945E+01			
Cs-134 <	1.7486E-01		1.7860E-01			
Pb-212	1.4148E+00		1.4148E+00	2.6523E-01	2.6755E-01	3.327E-01
Ra-224 <	4.8050E+00		3.9222E+02			
I-131 B<	1.6637E-01		1.2074E+00			
Mn-54 <	1.2938E-01		1.3614E-01			
Tl-208 H	4.3923E-01	>12 Half-lives		1.4168E-01	1.4208E-01	1.749E-01
Bi-212 <	1.98E+00	>12 Half-lives				
Ra-223 <	1.0216E+00		4.1187E+00			
Pa-234 <	5.35E-01	>12 Half-lives				
Eu-154 <	3.5334E-01		3.5509E-01			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 12:49:07 Page 3

Eu-152	<	9.4964E-01	9.5275E-01
Na-22	<	8.6844E-02	8.8314E-02
Zn-65	<	3.7598E-01	4.0131E-01
Ba-133	<	2.6970E-01	2.7082E-01
Ru-103	B<	9.4403E-02	1.4154E-01
Be-7	B<	1.1050E+00	1.4892E+00
I-125	B<	3.1030E+00	4.0445E+00
Tl-201	B<	9.1497E-01	1.7174E+02
Pa-234	B<	4.30E-01	>12 Halflives
Np-237	B<	8.5615E-01	8.5615E-01
Ce-144	B<	6.1352E-01	6.4889E-01
Eu-155	<	4.5084E-01	4.5482E-01

< - MDA value printed.

A - Activity printed, but activity < MDA.

B - Activity < MDA and failed test.

C - Area < Critical level.

F - Failed fraction or key line test.

H - Half-life limit exceeded

S U M M A R Y

Total Activity (19.4 to 1990.8 keV) 2.1977863E+01 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 2.2076971E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 % Zn-65
1173.00 & Co-60 1274.50 ? Na-22 1274.54 ? Eu-154 1333.00 ? Co-60
1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.

? - Peak is too narrow.

@ - Peak is too wide at FW25M, but ok at FWHM.

% - Peak fails sensitivity test.

\$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.

+ - Peak activity higher than counting uncertainty range.

- - Peak activity lower than counting uncertainty range.

= - Peak outside analysis energy range.

& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.

P - Peakbackground subtraction

Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 14:38:15 Page 1
 Energy Laboratory Spectrum name: C13110898.38.An1

Sample description
 C13110898.38

Spectrum Filename: C:\User\C13110898.38.An1

Acquisition information

Start time: 18-Dec-2013 12:50:03
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7397E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7397E+02) =
 1.5520E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 14:38:15 Page 2
 Energy Laboratory Spectrum name: C13110898.38.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.2113

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
		Activity pCi/g	Activity pCi/g	Counting pCi/g	Total pCi/g	
Ra-228	B<	1.2562E+00	1.2658E+00			
Ra-226	<	6.1329E+00	6.1330E+00			
Bi-214	#	2.1331E+00	2.1331E+00	4.9133E-01	4.9402E-01	4.901E-01
Pb-214		1.9992E+00	1.9993E+00	4.0879E-01	4.1163E-01	4.710E-01
Ir-192	B<	1.6392E-01	2.0338E-01			
Sb-124	B<	1.9767E-01	2.5770E-01			
Sc-46	<	1.6378E-01	1.9814E-01			
Pb-210	<	3.3051E+00	3.3116E+00			
Th-228	<	1.0758E+01	1.1007E+01			
Th-230	<	3.1122E+01	3.1122E+01			
Cs-137	<	1.7010E-01	1.7035E-01			
Co-60	B<	1.9027E-01	1.9186E-01			
Am-241	<	1.9437E-01	1.9439E-01			
K-40		1.9449E+01	1.9449E+01	3.8580E+00	3.8865E+00	5.659E+00
U-235	#	6.0399E-01	6.0399E-01	2.3401E-01	2.3447E-01	2.961E-01
Th-234	B<	2.0227E+01	3.9233E+01			
Cs-134	<	2.0728E-01	2.1172E-01			
Pb-212		1.0584E+00	1.0584E+00	2.5184E-01	2.5320E-01	3.411E-01
Ra-224	<	4.5186E+00	3.7198E+02			
I-131	B<	9.4343E-02	6.8733E-01			
Mn-54	<	1.2670E-01	1.3333E-01			
Tl-208	<	2.72E-01	>12 Halflives			
Bi-212	<	2.64E+00	>12 Halflives			
Ra-223	<	1.0800E+00	4.3661E+00			
Pa-234	<	5.13E-01	>12 Halflives			
Eu-154	<	3.0957E-01	3.1112E-01			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 14:38:15 Page 3

Eu-152	<	9.6563E-01	9.6881E-01
Na-22	<	1.4414E-01	1.4659E-01
Zn-65	<	4.4574E-01	4.7583E-01
Ba-133	<	2.3630E-01	2.3729E-01
Ru-103	B<	1.3053E-01	1.9585E-01
Be-7	B<	9.6285E-01	1.2984E+00
I-125	B<	2.2208E+00	2.8961E+00
Tl-201	B<	6.6935E-01	1.2691E+02
Pa-234	B<	4.66E-01	>12 Halflives
Np-237	B<	1.1081E+00	1.1081E+00
Ce-144	B<	8.7738E-01	9.2806E-01
Eu-155	<	6.0212E-01	6.0745E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.5243752E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.5243864E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 Zn-65
 1120.51 % Sc-46 1173.00 % Co-60 1274.50 Na-22 1274.54 % Eu-154
 1333.00 % Co-60 1408.00 % Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 14:38:15 Page 4
 Energy Laboratory Spectrum name: C13110898.38.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 15:51:56 Page 1
 Energy Laboratory Spectrum name: C13110898.39.An1

Sample description
 C13110898.39

Spectrum Filename: C:\User\C13110898.39.An1

Acquisition information

Start time: 18-Dec-2013 14:43:09
 Live time: 3467
 Real time: 3600
 Dead time: 3.68 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.8897E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.8897E+02) =
 1.4288E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 15:51:56 Page 2
 Energy Laboratory Spectrum name: C13110898.39.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1733

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count Activity pCi/g	Time Corrected Activity pCi/g	Uncertainty Counting pCi/g	2 Sigma Total pCi/g	MDA
Ra-228	B<	1.0929E+00	1.1012E+00			
Ra-226	<	6.8705E+00	6.8706E+00			
Bi-214		1.9871E+00 ✓	1.9872E+00	5.5468E-01 ✓	5.5676E-01	5.427E-01 ✓
Pb-214		2.2021E+00	2.2022E+00	4.9268E-01	4.9554E-01	5.373E-01
Ir-192	B<	1.6217E-01	2.0135E-01			
Sb-124	B<	2.2875E-01	2.9849E-01			
Sc-46		6.5302E-01	7.9054E-01	1.9764E-01	1.9856E-01	7.520E-02
Pb-210	<	2.9691E+00	2.9749E+00			
Th-228	<	1.1314E+01	1.1576E+01			
Th-230	<	2.9218E+01	2.9219E+01			
Cs-137	<	2.0300E-01	2.0330E-01			
Co-60	B<	1.9073E-01	1.9233E-01			
Am-241	<	2.8683E-01	2.8686E-01			
K-40		1.6918E+01	1.6918E+01	3.5522E+00	3.5756E+00	5.312E+00
U-235		1.0951E+00	1.0951E+00	2.4181E-01	2.4325E-01	2.987E-01
Th-234	B<	2.6381E+01	5.1285E+01			
Cs-134	<	2.0946E-01	2.1397E-01			
Pb-212		1.1675E+00	1.1675E+00	2.5125E-01	2.5292E-01	3.313E-01
Ra-224	<	4.5475E+00	3.8003E+02			
I-131	B<	1.3821E-01	1.0138E+00			
Mn-54	<	1.6156E-01	1.7005E-01			
Tl-208	#H	5.5925E-01	>12 Halflives	1.9589E-01	1.9635E-01	2.189E-01
Bi-212	<	1.72E+00	>12 Halflives			
Ra-223	<	9.6379E-01	3.9148E+00			
Pa-234	<	5.89E-01	>12 Halflives			
Eu-154	<	5.7762E-01	5.8050E-01			

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 15:51:56 Page 3

Eu-152	<	9.0836E-01	9.1135E-01
Na-22	<	1.0950E-01	1.1137E-01
Zn-65	<	3.4545E-01	3.6886E-01
Ba-133	<	2.1756E-01	2.1847E-01
Ru-103	B<	8.8440E-02	1.3288E-01
Be-7	B<	1.0076E+00	1.3602E+00
I-125	B<	2.2512E+00	2.9383E+00
Tl-201	B<	1.2171E+00	2.3494E+02
Pa-234	B<	4.43E-01	>12 Halflives
Np-237	B<	1.1120E+00	1.1120E+00
Ce-144	B<	7.9781E-01	8.4406E-01
Eu-155	<	4.9972E-01	5.0416E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Half-life limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.402311E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.4160749E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 % Ra-228 969.10 % Ra-228 1001.00 % Th-234 1115.52 Zn-65
 1173.00 % Co-60 1274.50 % Na-22 1274.54 Eu-154 1333.00 ? Co-60
 1408.00 & Eu-152

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

□

ORTEC g v - i (143) wan32 G53W2.06 18-DEC-2013 15:51:56 Page 4
 Energy Laboratory Spectrum name: C13110898.39.An1

Analyzed by: _____
 Dave Blaida

Reviewed by: _____

Supervisor

Laboratory: Energy Laboratory

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 10:02:17 Page 1
 Energy Laboratory Spectrum name: C13110898.40.An1

Sample description
 C13110898.40

Spectrum Filename: C:\User\C13110898.40.An1

Acquisition information

Start time: 18-Dec-2013 15:52:40
 Live time: 3598
 Real time: 3600
 Dead time: 0.07 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel^2

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.6689E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6689E+02) =
 1.6178E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 10:02:17 Page 2
 Energy Laboratory Spectrum name: C13110898.40.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1630

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	pCi/g
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 F	2.2808E+00	2.2983E+00	7.0444E-01	7.0662E-01	1.172E+00
Ra-226 #A	0.0000E+00	0.0000E+00	1.0130E+04	1.0130E+04	4.853E+00
Bi-214 #F	1.2215E+00	1.2216E+00	4.9732E-01	4.9820E-01	5.352E-01
Pb-214	1.2003E+00	1.2003E+00	3.3919E-01	3.4043E-01	4.880E-01
Ir-192 #B	2.6119E-02	3.2446E-02	1.2716E-01	1.2716E-01	1.564E-01
Sb-124 #B	1.7087E-01	2.2309E-01	2.0647E-01	2.0654E-01	1.835E-01
Sc-46	3.2338E-01	3.9164E-01	1.8483E-01	1.8507E-01	1.855E-01
Pb-210 #A	2.2778E+00	2.2823E+00	2.7380E+00	2.7385E+00	3.442E+00
Th-228 A	5.0234E+00	5.1404E+00	5.9950E+00	5.9962E+00	9.737E+00
Th-230 #A	2.3389E+00	2.3389E+00	1.5648E+01	1.5649E+01	2.522E+01
Cs-137 #A	9.5278E-02	9.5418E-02	1.2896E-01	1.2898E-01	1.873E-01
Co-60 #B	-7.4589E-02	-7.5214E-02	-5.9111E-01	-5.9111E-01	2.019E-01
Am-241 #A	-2.6439E-02	-2.6442E-02	-9.0465E-01	-9.0465E-01	2.329E-01
K-40	1.9578E+01	1.9578E+01	4.1667E+00	4.1934E+00	6.039E+00
U-235 A	2.5482E-01	2.5482E-01	2.0058E-01	2.0068E-01	2.651E-01
Th-234 F	4.3294E+01	8.4282E+01	5.8245E+01	5.8331E+01	2.768E+01
Cs-134 #A	1.2642E-01	1.2915E-01	2.3471E-01	2.3473E-01	2.934E-01
Pb-212	1.1299E+00	1.1299E+00	2.6463E-01	2.6612E-01	3.572E-01
Ra-224 A	1.6909E+00	1.4262E+02	2.3149E+02	2.3151E+02	4.589E+00
I-131 #F	2.2857E-01	1.6836E+00	8.6610E-01	8.6705E-01	1.773E-01
Mn-54 #A	-4.0704E-02	-4.2848E-02	-8.0397E-01	-8.0397E-01	1.807E-01
Tl-208 H	9.1823E-01	>12 Halflives	2.7138E-01	2.7229E-01	2.635E-01
Bi-212 #	2.2261E+00	>12 Halflives	1.7508E+00	1.7517E+00	2.215E+00
Ra-223 #A	1.0150E+00	4.1350E+00	4.0018E+00	4.0030E+00	1.165E+00
Pa-234 A	1.3597E-01	>12 Halflives	3.2603E-01	3.2605E-01	5.559E-01
Eu-154 #A	-6.8912E-02	-6.9257E-02	5.3234E+02	5.3234E+02	3.745E-01

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 10:02:17 Page 3

Eu-152	#A	1.9144E-01	1.9207E-01	2.3153E-01	2.3157E-01	1.006E+00
Na-22	#A	0.0000E+00	0.0000E+00	1.1193E+02	1.1193E+02	9.204E-02
Zn-65	A	2.2395E-02	2.3916E-02	2.0954E-01	2.0954E-01	3.967E-01
Ba-133	A	7.7217E-02	7.7541E-02	1.5923E-01	1.5924E-01	2.720E-01
Ru-103	#B	4.7599E-02	7.1578E-02	1.6068E-01	1.6070E-01	1.560E-01
Be-7	#B	-3.5873E-01	-4.8454E-01	2.2823E+03	2.2823E+03	1.040E+00
I-125	#B	8.8133E-01	1.1510E+00	2.1983E+00	2.1987E+00	2.386E+00
Tl-201	#B	7.3856E-02	1.4414E+01	1.2450E+02	1.2450E+02	1.012E+00
Pa-234	#B	8.6441E-02	>12 Halflives	1.9646E-01	1.9649E-01	3.109E-01
Np-237	B	4.4146E-01	4.4146E-01	5.5906E-01	5.5929E-01	9.218E-01
Ce-144	B	3.3078E-01	3.5000E-01	8.2198E-01	8.2203E-01	1.087E+00
Eu-155	A	4.8771E-01	4.9205E-01	4.1079E-01	4.1095E-01	4.926E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Half-life limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.4189030E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.4206564E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.00 + Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 10:02:17 Page 4
 Energy Laboratory Spectrum name: C13110898.40.An1

Laboratory: Energy Laboratory C13110898.40.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 11:30:51 Page 1
 Energy Laboratory Spectrum name: C13110898.40dup.An1

Sample description
 C13110898.40dup

Spectrum Filename: C:\User\C13110898.40dup.An1

Acquisition information

Start time: 19-Dec-2013 10:03:15
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.Clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.6689E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6689E+02) =
 1.6178E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 11:30:51 Page 2
 Energy Laboratory Spectrum name: C13110898.40dup.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1675

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	pCi/g
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 F	2.1737E+00	2.1909E+00	6.6057E-01	6.6269E-01	1.293E+00
Ra-226 #A	0.0000E+00	0.0000E+00	1.2577E+04	1.2577E+04	5.054E+00
Bi-214 F	1.2733E+00	1.2734E+00	5.3624E-01	5.3712E-01	5.829E-01
Pb-214	1.2941E+00	1.2941E+00	3.5892E-01	3.6028E-01	4.983E-01
Ir-192 #B	4.0950E-02	5.1231E-02	1.4387E-01	1.4388E-01	1.642E-01
Sb-124 #F	3.2967E-01	4.3420E-01	2.1601E-01	2.1627E-01	1.561E-01
Sc-46 A	7.0769E-02	8.6245E-02	8.0994E-02	8.1021E-02	2.378E-01
Pb-210 A	3.0045E+00	3.0107E+00	2.3416E+00	2.3426E+00	3.008E+00
Th-228 A	6.3418E-01	6.4943E-01	5.9279E+00	5.9279E+00	1.004E+01
Th-230 #A	1.0679E+01	1.0679E+01	1.5581E+01	1.5583E+01	2.499E+01
Cs-137 #A	-4.8986E-02	-4.9059E-02	-4.9115E-01	-4.9115E-01	1.477E-01
Co-60 #B	7.7356E-02	7.8025E-02	6.9291E-02	6.9317E-02	1.890E-01
Am-241 #A	-1.2986E-02	-1.2987E-02	-2.9563E-01	-2.9563E-01	1.868E-01
K-40	1.9108E+01	1.9108E+01	3.9458E+00	3.9727E+00	5.899E+00
U-235 A	1.4710E-01	1.4710E-01	2.0277E-01	2.0280E-01	2.833E-01
Th-234 F	1.6173E+01	3.2177E+01	2.5340E+01	2.5369E+01	1.615E+01
Cs-134 #A	-5.3747E-02	-5.4943E-02	-2.3221E-01	-2.3221E-01	2.024E-01
Pb-212	1.2766E+00	1.2766E+00	2.5623E-01	2.5819E-01	3.217E-01
Ra-224 #A	-1.7207E-01	-1.6778E+01	6.6991E+05	6.6991E+05	4.662E+00
I-131 #F	2.1504E-01	1.6908E+00	1.6404E+00	1.6409E+00	1.949E-01
Mn-54 #A	1.7988E-02	1.8968E-02	6.8218E-02	6.8220E-02	1.321E-01
Tl-208 #H	5.0070E-01	>12 Halflives	2.4824E-01	2.4853E-01	2.702E-01
Bi-212 #	2.0881E+00	>12 Halflives	1.3658E+00	1.3667E+00	1.823E+00
Ra-223 #A	1.0400E+00	4.4360E+00	4.4575E+00	4.4588E+00	1.177E+00
Pa-234 A	2.3893E-01	>12 Halflives	2.9597E-01	2.9602E-01	4.922E-01
Eu-154 #A	2.4458E-01	2.4584E-01	2.1007E-01	2.1016E-01	3.227E-01

Eu-152	#A	-4.9303E-01	-4.9472E-01	1.5777E+03	1.5777E+03	1.007E+00
Na-22	#A	0.0000E+00	0.0000E+00	4.8814E+02	4.8814E+02	2.085E-01
Zn-65	A	7.3197E-02	7.8335E-02	1.9877E-01	1.9877E-01	3.608E-01
Ba-133	A	1.0879E-01	1.0927E-01	1.5638E-01	1.5640E-01	2.621E-01
Ru-103	#F	2.0389E-01	3.1073E-01	2.5868E-01	2.5895E-01	1.859E-01
Be-7	#B	3.9597E-01	5.4013E-01	1.0923E+00	1.0925E+00	1.260E+00
I-125	#B	1.0246E+00	1.3498E+00	2.2777E+00	2.2783E+00	2.315E+00
Tl-201	#B	4.8265E-01	1.1192E+02	1.7954E+02	1.7959E+02	1.055E+00
Pa-234	#B	3.7092E-01	>12 Halflives	4.0372E-01	4.0395E-01	4.948E-01
Np-237	#B	0.0000E+00	0.0000E+00	1.4669E+03	1.4669E+03	9.932E-01
Ce-144	B	9.6348E-01	1.0213E+00	1.2275E+00	1.2277E+00	1.051E+00
Eu-155	#A	4.6194E-01	4.6619E-01	3.6571E-01	3.6587E-01	4.672E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.3852074E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.3869337E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 11:30:51 Page 4
 Energy Laboratory Spectrum name: C13110898.40dup.An1

Laboratory: Energy Laboratory C13110898.40dup.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 16:08:11 Page 1
 Energy Laboratory Spectrum name: C13110898.41.An1

Sample description
 C13110898.41

Spectrum Filename: C:\User\C13110898.41.An1

Acquisition information

Start time: 19-Dec-2013 15:06:19
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.7108E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.7108E+02) =
 1.5782E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 16:08:11 Page 2
 Energy Laboratory Spectrum name: C13110898.41.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.2312

*****		S U M M A R Y O F N U C L I D E S I N			S A M P L E	*****
		Time of Count	Time Corrected	Uncertainty	2 Sigma	
Nuclide		Activity pCi/g	Activity pCi/g	Counting pCi/g	Total pCi/g	MDA pCi/g
Ra-228	F	3.2359E+00	3.2618E+00	1.5108E+00	1.5129E+00	1.412E+00
Ra-226	A	5.9090E-02	5.9091E-02	2.8457E+00	2.8457E+00	4.892E+00
Bi-214	#F	1.0912E+00	1.0913E+00	5.3423E-01	5.3488E-01	5.873E-01
Pb-214		8.9581E-01	8.9584E-01	3.2379E-01	3.2451E-01	4.763E-01
Ir-192	#B	2.3203E-02	2.9085E-02	1.0555E-01	1.0555E-01	1.381E-01
Sb-124	#B	1.6895E-01	2.2306E-01	2.4251E-01	2.4257E-01	1.983E-01
Sc-46	#A	1.0321E-01	1.2600E-01	1.4549E-01	1.4552E-01	1.585E-01
Pb-210	#	3.1993E+00	3.2059E+00	2.6495E+00	2.6506E+00	3.196E+00
Th-228	A	3.4382E+00	3.5216E+00	5.6161E+00	5.6167E+00	9.247E+00
Th-230		4.1276E+01	4.1276E+01	3.3115E+01	3.3128E+01	3.515E+01
Cs-137	#A	1.1247E-01	1.1265E-01	1.3867E-01	1.3870E-01	1.949E-01
Co-60	#B	3.7261E-02	3.7586E-02	2.6347E-02	2.6362E-02	1.843E-01
Am-241	#A	3.5454E-02	3.5458E-02	1.8360E-01	1.8360E-01	2.801E-01
K-40		1.4470E+01	1.4470E+01	3.5649E+00	3.5820E+00	5.754E+00
U-235	A	1.2194E-01	1.2194E-01	1.5756E-01	1.5759E-01	2.744E-01
Th-234	B	0.0000E+00	0.0000E+00	4.6639E+04	4.6639E+04	1.646E+01
Cs-134	#A	2.4012E-03	2.4551E-03	1.1995E-01	1.1995E-01	2.316E-01
Pb-212		1.2427E+00	1.2427E+00	2.6262E-01	2.6443E-01	3.425E-01
Ra-224	A	1.8075E+00	1.8349E+02	2.6008E+02	2.6012E+02	4.264E+00
I-131	#F	1.8142E-01	1.4525E+00	1.3450E+00	1.3455E+00	1.534E-01
Mn-54	#A	1.2204E-01	1.2874E-01	9.7626E-02	9.7675E-02	1.276E-01
Tl-208	#H	6.5216E-01	>12 Halflives	2.1738E-01	2.1795E-01	2.376E-01
Bi-212	#	2.1719E+00	>12 Halflives	1.4517E+00	1.4526E+00	1.916E+00
Ra-223	#A	5.4644E-01	2.3607E+00	3.1901E+00	3.1906E+00	9.989E-01
Pa-234	A	2.2546E-01	>12 Halflives	2.9850E-01	2.9855E-01	4.981E-01
Eu-154	#A	1.5305E-02	1.5385E-02	2.8315E-02	2.8318E-02	3.496E-01

Eu-152	#A	3.5439E-02	3.5561E-02	4.2455E-02	4.2463E-02	1.017E+00
Na-22	#A	0.0000E+00	0.0000E+00	1.2079E+02	1.2079E+02	8.980E-02
Zn-65	#A	-6.0411E-02	-6.4690E-02	7.8890E+02	7.8890E+02	4.274E-01
Ba-133	A	2.7133E-02	2.7252E-02	1.2025E-01	1.2025E-01	2.147E-01
Ru-103	B	1.2862E-01	1.9674E-01	1.8250E-01	1.8265E-01	1.567E-01
Be-7	#B	7.0177E-01	9.5989E-01	9.5422E-01	9.5490E-01	1.081E+00
I-125	B	1.2567E+00	1.6597E+00	1.6665E+00	1.6677E+00	1.845E+00
Tl-201	#B	2.3849E-03	5.8018E-01	9.9812E+01	9.9812E+01	7.552E-01
Pa-234	#B	1.4691E-01	>12 Halflives	2.7411E-01	2.7416E-01	3.789E-01
Np-237	#B	0.0000E+00	0.0000E+00	1.4610E+03	1.4610E+03	9.883E-01
Ce-144	B	3.8522E-01	4.0856E-01	5.8438E-01	5.8446E-01	9.452E-01
Eu-155	A	2.7873E-01	2.8131E-01	1.9185E-01	1.9196E-01	4.806E-01

- # - All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 1.9844093E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 1.9869991E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 - Ra-228

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 19-DEC-2013 16:08:11 Page 4
 Energy Laboratory Spectrum name: C13110898.41.An1

Laboratory: Energy Laboratory C13110898.41.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 08:16:25 Page 1
 Energy Laboratory Spectrum name: C13110898.42.An1

Sample description
 C13110898.42

Spectrum Filename: C:\User\C13110898.42.An1

Acquisition information

Start time: 19-Dec-2013 16:09:24
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.c1b
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.6682E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6682E+02) =
 1.6185E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 08:16:25 Page 2
 Energy Laboratory Spectrum name: C13110898.42.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1022

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
		Time of Count	Time Corrected	Uncertainty	2 Sigma	
Nuclide		Activity pCi/g	Activity pCi/g	Counting pCi/g	Total pCi/g	MDA pCi/g
Ra-228	B	1.3605E+00	1.3714E+00	5.6904E-01	5.7000E-01	1.820E+00
Ra-226	A	4.2290E-01	4.2292E-01	3.0169E+00	3.0169E+00	5.148E+00
Bi-214		1.9542E+00	1.9543E+00	4.6335E-01	4.6575E-01	4.710E-01
Pb-214		1.5979E+00	1.5979E+00	4.2160E-01	4.2337E-01	5.304E-01
Ir-192	#B	7.9212E-02	9.9335E-02	1.2326E-01	1.2329E-01	1.438E-01
Sb-124	#B	-6.2958E-03	-8.3163E-03	1.9544E+02	1.9544E+02	9.697E-02
Sc-46		3.7040E-01	4.5236E-01	1.9387E-01	1.9418E-01	1.838E-01
Pb-210	#A	2.8847E+00	2.8906E+00	2.6036E+00	2.6045E+00	3.383E+00
Th-228	A	2.3288E-01	2.3854E-01	6.3673E+00	6.3673E+00	1.077E+01
Th-230	A	2.4973E+01	2.4973E+01	2.6593E+01	2.6600E+01	3.335E+01
Cs-137	#A	-5.3294E-02	-5.3375E-02	2.2971E+02	2.2971E+02	1.445E-01
Co-60	#B	1.5865E-01	1.6003E-01	1.1292E-01	1.1298E-01	1.890E-01
Am-241	#A	4.4212E-02	4.4216E-02	1.6990E-01	1.6990E-01	2.851E-01
K-40		1.7042E+01	1.7042E+01	3.8089E+00	3.8311E+00	5.901E+00
U-235		2.9361E-01	2.9361E-01	1.6695E-01	1.6711E-01	2.743E-01
Th-234	B	3.9965E+00	8.0099E+00	5.5766E+00	5.5847E+00	2.422E+01
Cs-134	#A	-6.8655E-02	-7.0199E-02	-3.8329E-01	-3.8329E-01	2.055E-01
Pb-212		1.2514E+00	1.2514E+00	2.6491E-01	2.6672E-01	3.441E-01
Ra-224	A	2.1960E+00	2.2481E+02	2.8545E+02	2.8550E+02	4.615E+00
I-131	#F	3.4707E-01	2.7893E+00	1.3870E+00	1.3886E+00	9.516E-02
Mn-54	#A	-3.0446E-02	-3.2122E-02	-3.3039E-01	-3.3039E-01	1.359E-01
Tl-208	H	6.3759E-01	>12 Halflives	2.3535E-01	2.3586E-01	2.663E-01
Bi-212	#	2.8738E+00	>12 Halflives	1.4422E+00	1.4439E+00	1.853E+00
Ra-223	#A	1.3002E-01	5.6318E-01	2.4807E+00	2.4808E+00	9.078E-01
Pa-234	A	1.1317E-01	>12 Halflives	3.0985E-01	3.0987E-01	5.314E-01
Eu-154	#A	-6.8940E-02	-6.9301E-02	9.7483E+02	9.7483E+02	5.810E-01

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 08:16:25 Page 3

Eu-152	#A	-4.9324E-01	-4.9494E-01	1.6786E+03	1.6786E+03	1.060E+00
Na-22	#A	6.6641E-02	6.7827E-02	7.9535E-02	7.9552E-02	1.090E-01
Zn-65	#A	-2.2846E-02	-2.4467E-02	-3.5499E-01	-3.5499E-01	3.484E-01
Ba-133	A	6.4351E-02	6.4633E-02	1.3980E-01	1.3981E-01	2.411E-01
Ru-103	#B	9.4201E-02	1.4420E-01	1.6493E-01	1.6502E-01	1.414E-01
Be-7	#B	9.6239E-01	1.3171E+00	1.7135E+00	1.7142E+00	1.549E+00
I-125	#B	3.0902E-01	4.0831E-01	1.4433E+00	1.4434E+00	1.811E+00
Tl-201	#B	4.9079E-01	1.2059E+02	1.7641E+02	1.7647E+02	1.028E+00
Pa-234	#F	4.9802E-01	>12 Halflives	3.6990E-01	3.7035E-01	4.544E-01
Np-237	B	6.8894E-01	6.8894E-01	5.9810E-01	5.9864E-01	9.662E-01
Ce-144	B	4.9909E-01	5.2939E-01	1.0007E+00	1.0008E+00	1.067E+00
Eu-155	#A	4.7183E-01	4.7621E-01	4.2827E-01	4.2841E-01	5.157E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 2.1845942E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.1846043E+01 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.00 - Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 08:16:25 Page 4
 Energy Laboratory Spectrum name: C13110898.42.An1

Laboratory: Energy Laboratory C13110898.42.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 09:26:05 Page 1
 Energy Laboratory Spectrum name: C13110898.43.An1

Sample description
 C13110898.43

Spectrum Filename: C:\User\C13110898.43.An1

Acquisition information

Start time: 20-Dec-2013 08:18:08
 Live time: 3597
 Real time: 3600
 Dead time: 0.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.6726E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.6726E+02) =
 1.6143E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 09:26:05 Page 2
 Energy Laboratory Spectrum name: C13110898.43.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.2322

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Time of Count		Time Corrected	Uncertainty	2 Sigma	
Nuclide	Activity	Activity	Counting	Total	MDA
	pCi/g	pCi/g	pCi/g	pCi/g	pCi/g
Ra-228	F	1.7236E+00	1.7378E+00	5.3378E-01	5.3543E-01
Ra-226	#A	0.0000E+00	0.0000E+00	1.5810E+04	7.455E+00
Bi-214	#F	9.5942E-01	9.5945E-01	3.8804E-01	4.979E-01
Pb-214		9.0008E-01	9.0011E-01	3.3539E-01	4.870E-01
Ir-192	#B	-2.0638E-02	-2.6044E-02	-4.2274E-01	9.531E-02
Sb-124	#F	2.3481E-01	3.1258E-01	2.5445E-01	2.110E-01
Sc-46		2.9656E-01	3.6419E-01	2.1020E-01	2.393E-01
Pb-210	#A	2.9870E+00	2.9933E+00	2.4214E+00	3.290E+00
Th-228	#A	-1.1817E+00	-1.2112E+00	1.7077E+04	1.124E+01
Th-230	#A	8.2645E+00	8.2645E+00	1.5527E+01	2.434E+01
Cs-137	#	2.4619E-01	2.4658E-01	1.6698E-01	2.067E-01
Co-60	#B	-4.6674E-02	-4.7094E-02	-1.5352E-01	1.885E-01
Am-241	#A	8.2983E-03	8.2992E-03	1.3701E-01	2.559E-01
K-40		1.4672E+01	1.4672E+01	3.6372E+00	5.886E+00
U-235	#	1.2728E+00	1.2728E+00	2.5232E-01	2.730E-01
Th-234	F	5.3096E+01	1.0849E+02	6.7942E+01	3.146E+01
Cs-134	#A	-1.0147E-01	-1.0381E-01	3.1230E+02	1.883E-01
Pb-212		8.6624E-01	8.6624E-01	2.4232E-01	3.404E-01
Ra-224	A	1.2456E+00	1.4505E+02	2.9173E+02	4.227E+00
I-131	F	1.5358E-01	1.3080E+00	1.0291E+00	1.395E-01
Mn-54	#A	3.2590E-02	3.4436E-02	6.6214E-02	1.265E-01
Tl-208	H	5.4634E-01	>12 Halflives	1.7951E-01	2.057E-01
Bi-212	A	1.8993E+00	>12 Halflives	1.4972E+00	1.932E+00
Ra-223	A	8.9741E-01	4.0490E+00	4.0720E+00	1.098E+00
Pa-234	A	1.1966E-01	>12 Halflives	2.8132E-01	4.825E-01
Eu-154	#A	-6.8759E-02	-6.9129E-02	2.8868E+03	8.873E-01

Eu-152	#A	-4.9194E-01	-4.9369E-01	1.5744E+03	1.5744E+03	1.004E+00
Na-22	#	2.6379E-01	2.6862E-01	1.5991E-01	1.6004E-01	1.475E-01
Zn-65	A	3.1247E-02	3.3528E-02	1.6037E-01	1.6038E-01	3.196E-01
Ba-133	A	3.0428E-02	3.0565E-02	1.1212E-01	1.1212E-01	2.376E-01
Ru-103	#B	-1.0006E-02	-1.5500E-02	-3.5987E-01	-3.5987E-01	1.229E-01
Be-7	#B	5.4444E-02	7.5164E-02	8.0591E-01	8.0591E-01	1.148E+00
I-125	#B	1.0825E+00	1.4414E+00	2.7233E+00	2.7238E+00	2.671E+00
Tl-201	#B	9.1321E-01	2.6153E+02	2.4136E+02	2.4156E+02	1.089E+00
Pa-234	#B	3.2697E-01	>12 Halflives	3.9909E-01	3.9928E-01	4.810E-01
Np-237	B	3.8000E-01	3.8000E-01	6.3987E-01	6.4002E-01	1.066E+00
Ce-144	B	1.3703E-01	1.4559E-01	6.4028E-01	6.4029E-01	9.265E-01
Eu-155	A	5.6085E-01	5.6620E-01	5.9562E-01	5.9577E-01	6.424E-01

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 7.0806793E+01 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 1.2620560E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.00 & Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 09:26:05 Page 4
 Energy Laboratory Spectrum name: C13110898.43.An1

Laboratory: Energy Laboratory C13110898.43.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 10:33:18 Page 1
 Energy Laboratory Spectrum name: C13110898.44.An1

Sample description
 C13110898.44

Spectrum Filename: C:\User\C13110898.44.An1

Acquisition information

Start time: 20-Dec-2013 09:30:40
 Live time: 3586
 Real time: 3600
 Dead time: 0.40 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 2.0193E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 2.0193E+02) =
 1.3371E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 10:33:18 Page 2
 Energy Laboratory Spectrum name: C13110898.44.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.0889

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide		Time of Count Activity pCi/g	Time Corrected Activity pCi/g	Uncertainty Counting pCi/g	2 Sigma Total pCi/g
					MDA pCi/g
Ra-228	F	5.0019E+00	5.0432E+00	3.0016E+00	3.0040E+00
Ra-226	A	2.0158E+01	2.0159E+01	1.3525E+01	1.3534E+01
Bi-214		1.4449E+02	1.4449E+02	2.9890E+00	4.5951E+00
Pb-214		1.4758E+02	1.4758E+02	2.1695E+00	4.1730E+00
Ir-192	#B	1.1487E-01	1.4503E-01	3.0965E-01	3.0966E-01
Sb-124	#B	9.1150E-02	1.2141E-01	2.3957E-01	2.3959E-01
Sc-46		2.2506E+01	2.7650E+01	1.1769E+00	1.3532E+00
Pb-210		1.2317E+02	1.2343E+02	8.3515E+00	8.8246E+00
Th-228	#A	-9.7880E-01	-1.0033E+00	6.2631E+04	6.2631E+04
Th-230	#	2.1908E+02	2.1908E+02	1.0693E+02	1.0705E+02
Cs-137	A	2.7429E-01	2.7472E-01	3.0173E-01	3.0180E-01
Co-60	#B	1.8540E-01	1.8707E-01	1.7513E-01	1.7519E-01
Am-241	#A	3.7972E-01	3.7976E-01	7.1818E-01	7.1823E-01
K-40		1.9129E+01	1.9129E+01	5.2059E+00	5.2264E+00
U-235		1.2477E+01	1.2477E+01	6.8786E-01	7.5099E-01
Th-234	F	1.8427E+02	3.7707E+02	1.7789E+02	1.7846E+02
Cs-134	#A	1.5172E-01	1.5524E-01	2.5940E-01	2.5943E-01
Pb-212	A	7.6559E-01	7.6559E-01	5.4346E-01	5.4379E-01
Ra-224		3.2399E+01	3.8093E+03	1.5527E+03	1.5554E+03
I-131	#F	4.8927E-01	4.1851E+00	3.8357E+00	3.8370E+00
Mn-54	#A	-1.4191E-02	-1.4997E-02	-4.8496E-01	-4.8496E-01
Tl-208	#A	9.5036E-02	>12 Halflives	2.6791E-01	2.6792E-01
Bi-212	#A	3.3779E+00	>12 Halflives	4.2024E+00	4.2032E+00
Ra-223		7.0031E+00	3.1694E+01	9.1782E+00	9.2101E+00
Pa-234	A	1.0503E+00	>12 Halflives	1.1004E+00	1.1007E+00
Eu-154	#A	-5.6954E-02	-5.7260E-02	2.8252E+03	2.8252E+03

Eu-152		1.5550E+01	1.5606E+01	3.1483E+00	3.1707E+00	2.874E+00
Na-22	A	3.2448E-01	3.3043E-01	3.7742E-01	3.7751E-01	4.221E-01
Zn-65	A	5.8641E-01	6.2932E-01	6.7482E-01	6.7499E-01	1.033E+00
Ba-133	A	2.3363E-01	2.3469E-01	4.1385E-01	4.1389E-01	6.845E-01
Ru-103	#B	4.4664E-02	6.9249E-02	7.3422E-01	7.3422E-01	5.352E-01
Be-7	B	1.0477E+00	1.4474E+00	2.6484E+00	2.6490E+00	3.221E+00
I-125	#B	2.6985E+00	3.5954E+00	5.7591E+00	5.7607E+00	6.202E+00
Tl-201	#B	2.6281E+00	7.6132E+02	1.0532E+03	1.0536E+03	4.349E+00
Pa-234	F	1.4891E+00	>12 Halflives	1.0478E+00	1.0492E+00	1.365E+00
Np-237		2.5697E+01	2.5697E+01	2.4359E+00	2.6146E+00	3.562E+00
Ce-144	F	3.9905E+00	4.2403E+00	3.0098E+00	3.0115E+00	3.032E+00
Eu-155	#A	1.1490E+00	1.1600E+00	1.5228E+00	1.5231E+00	1.802E+00

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 7.0186194E+02 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 9.2482678E+02 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 & Ra-228

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

 Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 10:33:18 Page 4
 Energy Laboratory Spectrum name: C13110898.44.An1

Laboratory: Energy Laboratory c13110898.44.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 14:12:23 Page 1
 Energy Laboratory Spectrum name: C13110898.45.An1

Sample description
 C13110898.45

Spectrum Filename: C:\User\C13110898.45.An1

Acquisition information

Start time: 20-Dec-2013 12:41:45
 Live time: 3561
 Real time: 3600
 Dead time: 1.08 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.Clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.0067E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.0067E+02) =
 2.6820E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 14:12:23 Page 2
 Energy Laboratory Spectrum name: C13110898.45.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1656

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
		Activity pCi/g	Activity pCi/g	Counting pCi/g	Total pCi/g	
Ra-228	B	-7.9636E-01	-8.0297E-01	1.0249E+04	1.0249E+04	6.921E+00
Ra-226	#A	0.0000E+00	0.0000E+00	1.9841E+05	1.9841E+05	8.941E+01
Bi-214		8.9492E+02	8.9495E+02	1.0052E+01	2.3840E+01	4.069E+00
Pb-214		9.3144E+02	9.3147E+02	8.0129E+00	2.3884E+01	4.080E+00
Ir-192	#B	8.5539E-01	1.0813E+00	1.2402E+00	1.2404E+00	1.362E+00
Sb-124	B	1.0126E+00	1.3508E+00	1.7223E+00	1.7226E+00	1.547E+00
Sc-46		1.3727E+02	1.6884E+02	4.1481E+00	5.8170E+00	1.806E+00
Pb-210		8.2085E+02	8.2260E+02	2.9455E+01	3.5050E+01	3.717E+01
Th-228	A	9.9801E+01	1.0231E+02	8.9096E+01	8.9127E+01	1.429E+02
Th-230		1.2882E+03	1.2882E+03	3.3192E+02	3.3325E+02	4.273E+02
Cs-137	A	4.6128E-02	4.6201E-02	7.4676E-01	7.4676E-01	1.270E+00
Co-60	#B	1.2697E+00	1.2812E+00	1.1238E+00	1.1242E+00	1.812E+00
Am-241	A	1.4298E+00	1.4300E+00	2.5796E+00	2.5798E+00	3.814E+00
K-40		2.8187E+01	2.8187E+01	2.0919E+01	2.0930E+01	2.332E+01
U-235		1.2758E+02	1.2758E+02	3.0010E+00	4.3015E+00	3.035E+00
Th-234		1.7882E+03	3.6732E+03	8.9509E+01	1.6471E+02	3.506E+02
Cs-134		2.0034E+00	2.0501E+00	1.5027E+00	1.5035E+00	1.861E+00
Pb-212	A	1.7719E+00	1.7719E+00	1.7844E+00	1.7850E+00	2.937E+00
Ra-224		1.7862E+02	2.1542E+04	5.6060E+03	5.6301E+03	7.527E+01
I-131	F	1.6375E+00	1.4168E+01	1.5906E+01	1.5909E+01	8.712E-01
Mn-54	A	2.4352E-01	2.5741E-01	9.2802E-01	9.2805E-01	1.476E+00
Tl-208	A	3.4403E-01	>12 Halflives	1.0951E+00	1.0952E+00	1.834E+00
Bi-212	#A	1.1341E+01	>12 Halflives	1.6575E+01	1.6577E+01	2.016E+01
Ra-223		4.8349E+01	2.2058E+02	3.2000E+01	3.2441E+01	1.069E+01
Pa-234	A	1.6851E+00	>12 Halflives	3.1339E+00	3.1342E+00	5.182E+00
Eu-154	A	2.6015E+00	2.6156E+00	2.5840E+00	2.5848E+00	4.202E+00

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 14:12:23 Page 3

Eu-152		1.0764E+02	1.0803E+02	8.8094E+00	9.1877E+00	9.443E+00
Na-22	#A	0.0000E+00	0.0000E+00	2.4743E+03	2.4743E+03	1.646E+00
Zn-65	A	2.0514E+00	2.2023E+00	2.4697E+00	2.4702E+00	3.786E+00
Ba-133		9.3926E+00	9.4352E+00	1.1123E+00	1.1354E+00	2.301E+00
Ru-103	#B	1.0041E-01	1.5605E-01	1.8954E+00	1.8954E+00	1.548E+00
Be-7	B	2.4409E+00	3.3779E+00	8.9185E+00	8.9194E+00	1.078E+01
I-125	#B	1.7787E+01	2.3735E+01	2.3529E+01	2.3545E+01	2.372E+01
Tl-201	#B	-1.5384E-01	-4.5934E+01	3.3261E+06	3.3261E+06	6.059E+00
Pa-234	#	2.7799E+01	>12 Halflives	4.2894E+00	4.4108E+00	5.031E+00
Np-237	#B	0.0000E+00	0.0000E+00	2.4331E+04	2.4331E+04	1.599E+01
Ce-144	F	1.8104E+01	1.9243E+01	1.2068E+01	1.2077E+01	1.031E+01
Eu-155		4.6152E+01	4.6596E+01	2.0415E+00	2.3092E+00	5.419E+00

- # - All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 6.3786260E+03 pci/g
 Total Decayed Activity (19.4 to 1990.8 keV) 2.9833408E+04 pci/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 911.07 & Ra-228

- ! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 14:12:23 Page 4
 Energy Laboratory Spectrum name: C13110898.45.An1

Laboratory: Energy Laboratory C13110898.45.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 15:31:48 Page 1
 Energy Laboratory Spectrum name: C13110898.46.An1

Sample description
 C13110898.46

Spectrum Filename: C:\User\C13110898.46.An1

Acquisition information

Start time: 20-Dec-2013 14:13:21
 Live time: 3553
 Real time: 3600
 Dead time: 1.30 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample size: 1.2284E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.2284E+02) =
 2.1980E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 15:31:48 Page 2
 Energy Laboratory Spectrum name: C13110898.46.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1313

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****						
Nuclide		Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
		Activity pCi/g	Activity pCi/g	Counting pCi/g	Total pCi/g	
Ra-228	#B	3.2665E+00	3.2937E+00	2.5226E+00	2.5238E+00	5.526E+00
Ra-226	A	5.3550E+01	5.3551E+01	3.5975E+01	3.5998E+01	5.903E+01
Bi-214		5.9186E+02	5.9188E+02	7.3760E+00	1.6087E+01	2.868E+00
Pb-214		6.1285E+02	6.1286E+02	5.7931E+00	1.5897E+01	2.956E+00
Ir-192	B	1.0782E+00	1.3638E+00	1.2005E+00	1.2009E+00	1.156E+00
Sb-124	#B	4.0764E-01	5.4419E-01	8.0359E-01	8.0370E-01	8.417E-01
Sc-46		9.2805E+01	1.1420E+02	3.1021E+00	4.1512E+00	1.389E+00
Pb-210		5.4626E+02	5.4743E+02	2.1588E+01	2.5018E+01	2.710E+01
Th-228	A	7.1797E+01	7.3610E+01	6.1555E+01	6.1578E+01	9.865E+01
Th-230		7.8216E+02	7.8216E+02	2.5895E+02	2.5958E+02	3.265E+02
Cs-137	A	7.7920E-01	7.8044E-01	7.5855E-01	7.5878E-01	1.243E+00
Co-60	#B	5.8731E-01	5.9264E-01	9.2946E-01	9.2957E-01	1.132E+00
Am-241	#A	3.5880E-01	3.5884E-01	2.0052E+00	2.0052E+00	2.882E+00
K-40		3.0811E+01	3.0811E+01	1.8038E+01	1.8053E+01	1.860E+01
U-235		5.8004E+01	5.8004E+01	1.7736E+00	2.2603E+00	2.138E+00
Th-234	F	4.7288E+02	9.7314E+02	4.0983E+01	5.4967E+01	2.829E+02
Cs-134	A	3.6382E-01	3.7232E-01	8.8619E-01	8.8624E-01	1.452E+00
Pb-212	A	7.2620E-01	7.2620E-01	1.3399E+00	1.3400E+00	2.220E+00
Ra-224		9.8485E+01	1.2023E+04	4.1831E+03	4.1931E+03	5.572E+01
I-131	#B	-4.0574E-02	-3.5299E-01	-1.0507E+00	-1.0508E+00	5.805E-01
Mn-54	A	1.7530E-01	1.8533E-01	6.6251E-01	6.6253E-01	1.057E+00
Tl-208	A	1.5083E-01	>12 Halflives	7.6436E-01	7.6437E-01	1.289E+00
Bi-212	#A	1.9290E+00	>12 Halflives	1.5157E+01	1.5158E+01	1.450E+01
Ra-223		3.1890E+01	1.4605E+02	2.3566E+01	2.3829E+01	7.848E+00
Pa-234	A	3.1924E-01	>12 Halflives	2.0804E+00	2.0804E+00	3.462E+00
Eu-154	A	-9.3623E-02	-9.4131E-02	1.0082E+04	1.0082E+04	3.825E+00

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 15:31:48 Page 3

Eu-152		6.3946E+01	6.4175E+01	6.6678E+00	6.8456E+00	7.909E+00
Na-22	#A	5.4971E-01	5.5987E-01	6.5650E-01	6.5664E-01	9.235E-01
Zn-65	A	9.7818E-01	1.0503E+00	1.8020E+00	1.8021E+00	2.793E+00
Ba-133	C	5.7036E+00	5.7295E+00	7.4960E-01	7.6227E-01	1.523E+00
Ru-103	#B	1.3284E-01	2.0667E-01	6.2551E-01	6.2556E-01	6.789E-01
Be-7	B	2.1777E-01	3.0161E-01	6.0385E+00	6.0385E+00	7.399E+00
I-125	B	1.3388E+01	1.7877E+01	1.5683E+01	1.5697E+01	1.623E+01
Tl-201	B	3.0558E+00	9.2571E+02	1.6647E+03	1.6651E+03	9.085E+00
Pa-234		8.6879E+00	>12 Halflives	2.9331E+00	2.9506E+00	3.598E+00
Np-237	#B	0.0000E+00	0.0000E+00	1.7561E+04	1.7561E+04	1.157E+01
Ce-144	F	1.8487E+01	1.9654E+01	1.2262E+01	1.2271E+01	7.456E+00
Eu-155	C	2.9964E+01	3.0253E+01	1.4375E+00	1.5991E+00	2.350E+00

- All peaks for activity calculation had bad shape.
 * - Activity omitted from total
 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 3.3868000E+03 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 1.5948709E+04 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.00 - Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 20-DEC-2013 15:31:48 Page 4
 Energy Laboratory Spectrum name: C13110898.46.An1

Laboratory: Energy Laboratory C13110898.46.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 23-DEC-2013 08:51:40 Page 1
 Energy Laboratory Spectrum name: C13110898.47.An1

Sample description
 C13110898.47

Spectrum Filename: C:\User\C13110898.47.An1

Acquisition information

Start time: 20-Dec-2013 15:32:48
 Live time: 3588
 Real time: 3600
 Dead time: 0.33 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.1191E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.1191E+02) =
 2.4127E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 23-DEC-2013 08:51:40 Page 2
 Energy Laboratory Spectrum name: C13110898.47.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1596

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Time of Count		Time Corrected		2 Sigma	
Nuclide	Activity pci/g	Activity pci/g	Uncertainty Counting pci/g	Total pci/g	MDA pci/g
Ra-228 B	3.9151E+00	3.9477E+00	2.1382E+00	2.1403E+00	3.967E+00
Ra-226 #A	0.0000E+00	0.0000E+00	1.0548E+05	1.0548E+05	3.881E+01
Bi-214	2.1087E+02	2.1088E+02	4.8227E+00	7.0146E+00	1.778E+00
Pb-214	2.1134E+02	2.1134E+02	3.8775E+00	6.4106E+00	2.119E+00
Ir-192 B	5.1150E-01	6.4732E-01	7.1630E-01	7.1648E-01	7.107E-01
Sb-124 B	3.9104E-01	5.2237E-01	7.0568E-01	7.0580E-01	7.049E-01
Sc-46	3.0524E+01	3.7579E+01	1.8618E+00	2.0713E+00	8.759E-01
Pb-210	1.8991E+02	1.9032E+02	1.3477E+01	1.4176E+01	1.722E+01
Th-228 A	2.1965E+01	2.2521E+01	3.8904E+01	3.8907E+01	6.275E+01
Th-230	2.5486E+02	2.5486E+02	1.6748E+02	1.6758E+02	2.076E+02
Cs-137 A	1.0706E-01	1.0723E-01	3.8024E-01	3.8025E-01	6.571E-01
Co-60 #B	-1.2718E-01	-1.2834E-01	6.2826E+02	6.2826E+02	3.821E-01
Am-241 #A	6.4479E-02	6.4486E-02	1.1755E+00	1.1755E+00	1.759E+00
K-40 #	1.8859E+01	1.8859E+01	1.1856E+01	1.1865E+01	1.321E+01
U-235	2.5154E+01	2.5154E+01	1.6751E+00	1.7819E+00	1.564E+00
Th-234	3.2328E+02	6.6634E+02	3.7894E+01	4.5443E+01	1.253E+02
Cs-134 #A	3.1299E-01	3.2032E-01	6.0468E-01	6.0473E-01	7.968E-01
Pb-212	1.7310E+00	1.7310E+00	8.4991E-01	8.5099E-01	1.365E+00
Ra-224	4.0401E+01	4.9845E+03	2.6128E+03	2.6156E+03	3.447E+01
I-131 #F	1.2501E+00	1.0927E+01	8.0794E+00	8.0838E+00	8.079E-01
Mn-54 A	9.2419E-02	9.7717E-02	4.1581E-01	4.1581E-01	6.791E-01
Tl-208 A	7.9214E-01	>12 Halflives	5.4907E-01	5.4940E-01	7.933E-01
Bi-212 #A	4.9861E+00	>12 Halflives	3.9701E+00	3.9719E+00	5.824E+00
Ra-223	9.4876E+00	4.3598E+01	1.4021E+01	1.4061E+01	4.744E+00
Pa-234 A	1.8503E+00	>12 Halflives	1.6777E+00	1.6783E+00	2.750E+00
Eu-154	2.3099E+00	2.3225E+00	1.2086E+00	1.2099E+00	1.346E+00

ORTEC g v - i (2191) wan32 G53W2.06 23-DEC-2013 08:51:40 Page 3

Eu-152	#	2.9292E+01	2.9398E+01	5.2718E+00	5.3195E+00	4.122E+00
Na-22	#A	0.0000E+00	0.0000E+00	2.2197E+03	2.2197E+03	7.734E-01
Zn-65	A	4.2680E-01	4.5835E-01	1.0649E+00	1.0650E+00	1.686E+00
Ba-133	A	3.2829E-01	3.2978E-01	5.5858E-01	5.5863E-01	9.260E-01
Ru-103	#F	1.5559E+00	2.4231E+00	1.2063E+00	1.2097E+00	7.007E-01
Be-7	#B	3.3332E+00	4.6199E+00	6.9119E+00	6.9141E+00	6.211E+00
I-125	#B	3.8181E+00	5.1018E+00	7.0410E+00	7.0436E+00	8.368E+00
Tl-201	#B	-2.3332E-01	-7.1573E+01	-2.0839E+03	-2.0839E+03	3.238E+00
Pa-234	#F	4.2400E+00	>12 Halflives	1.8672E+00	1.8737E+00	2.287E+00
Np-237		4.3011E+01	4.3011E+01	3.8456E+00	4.1614E+00	5.455E+00
Ce-144	F	6.0358E+00	6.4175E+00	6.5786E+00	6.5804E+00	4.077E+00
Eu-155	#A	6.2780E-01	6.3386E-01	1.4592E+00	1.4593E+00	2.083E+00

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 & - Activity omitted from total and all peaks had bad shape.
 < - MDA value printed.
 A - Activity printed, but activity < MDA.
 B - Activity < MDA and failed test.
 C - Area < Critical level.
 F - Failed fraction or key line test.
 H - Halflife limit exceeded

----- S U M M A R Y -----
 Total Activity (19.4 to 1990.8 keV) 1.0728729E+03 pCi/g
 Total Decayed Activity (19.4 to 1990.8 keV) 1.4576254E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
 1173.00 + Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
 ? - Peak is too narrow.
 @ - Peak is too wide at FW25M, but ok at FWHM.
 % - Peak fails sensitivity test.
 \$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
 + - Peak activity higher than counting uncertainty range.
 - - Peak activity lower than counting uncertainty range.
 = - Peak outside analysis energy range.
 & - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
 P - Peakbackground subtraction

Analyzed by: _____
 Dave Blaida

Reviewed by: _____
 Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 23-DEC-2013 08:51:40 Page 4
 Energy Laboratory Spectrum name: C13110898.47.An1

Laboratory: Energy Laboratory C13110898.47.Rpt

ORTEC g v - i (2191) wan32 G53W2.06 23-DEC-2013 11:05:54 Page 1
 Energy Laboratory Spectrum name: C13110898.47dup.An1

Sample description
 c13110898.47dup

Spectrum Filename: C:\User\C13110898.47dup.An1

Acquisition information

Start time: 23-Dec-2013 10:19:37
 Live time: 3588
 Real time: 3600
 Dead time: 0.33 %
 Detector ID: 1

Detector system
 Det 2

Calibration

Filename: julycc_5th_det2_169218.clb
 12/10/13 calibration energy det2
 IPL #1692-18 recal calibration perched

Energy Calibration

Created: 10-Dec-2013 16:47:09
 Zero offset: -0.166 keV
 Gain: 0.245 keV/channel
 Quadratic: -2.815E-08 keV/channel²

Efficiency Calibration

Created: 26-Jul-2013 08:05:07
 Type: Polynomial
 Uncertainty: 0.613 %
 Coefficients: -0.361975 -5.553226 0.556215
 -0.064968 0.003465 -0.000073

Library Files

Main analysis library: Norman.lib
 Library Match Width: 0.500

Analysis parameters

Analysis engine: wan32 G53W2.06
 Start channel: 80 (19.41keV)
 Stop channel: 8144 (1990.83keV)
 Peak rejection level: 20.000%
 Peak search sensitivity: 3
 Sample Size: 1.1191E+02
 Activity scaling factor: 2.7000E+01/(1.0000E+00* 1.1191E+02) =
 2.4127E-01
 Detection limit method: Nureg 4.16
 Random error: 1.0000000E+00
 Systematic error: 1.0000000E+00
 Fraction Limit: 0.000%
 Background width: best method (based on spectrum).
 Half lives decay limit: 12.000

ORTEC g v - i (2191) wan32 G53W2.06 23-DEC-2013 11:05:54 Page 2
 Energy Laboratory Spectrum name: C13110898.47dup.An1

Activity range factor: 2.000
 Min. step backg. energy 0.000

Corrections	Status	Comments
Decay correct to date:	YES	25-Nov-2013 12:00:00
Decay during acquisition:	YES	
Decay during collection:	NO	
True coincidence correction:	NO	
Peaked background correction:	YES	020711bkg1000mindet2.Pbc 07-Feb-2011 12:45:23
Absorption (Internal):	NO	
Geometry correction:	NO	
Random summing:	YES	Slope 1.0000E+00 Net factor 1.0000E+00

Energy Calibration
 Normalized diff: 0.1494

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****					
Nuclide	Time of Count	Time Corrected	Uncertainty	2 Sigma	MDA
	Activity	Activity	Counting	Total	pCi/g
	pCi/g	pCi/g	pCi/g	pCi/g	
Ra-228 #F	4.8941E+00	4.9394E+00	3.4069E+00	3.4090E+00	4.601E+00
Ra-226 A	8.6490E+00	8.6493E+00	2.3446E+01	2.3447E+01	3.880E+01
Bi-214	2.0926E+02	2.0927E+02	4.6666E+00	6.8796E+00	2.044E+00
Pb-214	2.1347E+02	2.1348E+02	3.9710E+00	6.5084E+00	2.044E+00
Ir-192 #B	-6.3438E-03	-8.2403E-03	-3.1483E-01	-3.1483E-01	3.400E-01
Sb-124 #B	-9.3849E-03	-1.2945E-02	6.9561E+02	6.9561E+02	2.953E-01
Sc-46	3.0521E+01	3.8450E+01	1.9282E+00	2.1402E+00	9.625E-01
Pb-210	1.8922E+02	1.8967E+02	1.3570E+01	1.4259E+01	1.743E+01
Th-228 #A	-1.7661E+00	-1.8158E+00	9.7847E+04	9.7847E+04	6.247E+01
Th-230	3.0516E+02	3.0516E+02	1.4932E+02	1.4948E+02	1.932E+02
Cs-137 A	4.2520E-01	4.2594E-01	4.2853E-01	4.2866E-01	7.045E-01
Co-60 #F	1.1968E+00	1.2089E+00	8.8593E-01	8.8641E-01	8.244E-01
Am-241 #A	2.9578E-01	2.9582E-01	8.6169E-01	8.6171E-01	1.437E+00
K-40	2.8025E+01	2.8025E+01	8.6511E+00	8.6776E+00	1.078E+01
U-235	2.3682E+01	2.3682E+01	1.1380E+00	1.2737E+00	1.335E+00
Th-234 F	3.1622E+02	7.0609E+02	4.3657E+01	5.1110E+01	1.506E+02
Cs-134	1.4054E+00	1.4420E+00	9.8935E-01	9.8996E-01	9.627E-01
Pb-212 A	1.3962E+00	1.3962E+00	8.6909E-01	8.6978E-01	1.411E+00
Ra-224	4.4512E+01	9.3559E+03	4.5003E+03	4.5059E+03	3.479E+01
I-131 F	1.2826E+00	1.4251E+01	1.4094E+01	1.4098E+01	8.673E-01
Mn-54 #A	2.5954E-01	2.7612E-01	4.5088E-01	4.5093E-01	6.248E-01
Tl-208 A	5.3768E-01	>12 Halflives	5.4073E-01	5.4089E-01	8.966E-01
Bi-212 #A	3.5145E+00	>12 Halflives	4.3553E+00	4.3561E+00	6.389E+00
Ra-223	1.0289E+01	5.5972E+01	1.7113E+01	1.7166E+01	4.879E+00
Pa-234 A	5.7698E-01	>12 Halflives	1.6835E+00	1.6836E+00	2.801E+00
Eu-154 A	1.9454E+00	1.9572E+00	2.1364E+00	2.1369E+00	2.347E+00

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Eu-152		2.6976E+01	2.7083E+01	5.5754E+00	5.6137E+00	4.707E+00
Na-22	#A	0.0000E+00	0.0000E+00	3.5320E+03	3.5320E+03	1.073E+00
Zn-65	A	7.6430E-01	8.2730E-01	1.2333E+00	1.2334E+00	1.901E+00
Ba-133	C	1.4155E+00	1.4226E+00	5.0578E-01	5.0694E-01	1.143E+00
Ru-103	#B	6.1142E-01	1.0000E+00	9.9710E-01	9.9781E-01	7.165E-01
Be-7	#B	9.9084E-01	1.4238E+00	4.8025E+00	4.8028E+00	5.253E+00
I-125	#B	1.0069E+01	1.3893E+01	1.2559E+01	1.2570E+01	1.161E+01
Tl-201	#B	1.5347E+00	8.8710E+02	2.0022E+03	2.0025E+03	5.000E+00
Pa-234	#	5.2949E+00	>12 Halflives	1.7377E+00	1.7487E+00	2.152E+00
Np-237		4.1580E+01	4.1580E+01	3.8656E+00	4.1601E+00	5.528E+00
Ce-144	B	2.6339E+00	2.8196E+00	4.7964E+00	4.7968E+00	4.926E+00
Eu-155	#A	2.3180E-01	2.3429E-01	9.9230E-01	9.9231E-01	1.645E+00

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----- S U M M A R Y -----
Total Activity (19.4 to 1990.8 keV) 1.0906581E+03 pCi/g
Total Decayed Activity (19.4 to 1990.8 keV) 1.5347216E+03 pCi/g

***** S U M M A R Y O F D I S C A R D E D P E A K S *****
911.07 - Ra-228 1173.00 & Co-60

! - Peak is part of a multiplet and this area went negative during deconvolution.
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Analyzed by: _____
Dave Blaida

Reviewed by: _____
Supervisor

□

ORTEC g v - i (2191) wan32 G53W2.06 23-DEC-2013 11:05:54 Page 4
Energy Laboratory Spectrum name: C13110898.47dup.An1

Laboratory: Energy Laboratory C13110898.47dup.Rpt