Paragon Analytics

Radiochemistry Case Narrative

^{226}Radium by EPA Method 903.1(m)

CSU Dep't Ecological Radiological Health Sciences

Tissue Samples

Paragon WO 0805200

1. This report consists of the analytical results and supporting documentation for 10 tissue samples received by Paragon on 05/29/08.
2. These samples were prepared and analyzed according to procedure PA SOP783R8, with procedure modifications outlined on QASS 365713. The analyses were completed on 06/23/08.
3. The analysis results for these samples are reported on an 'as received' basis in units of pCi/gram.
4. Sample volume was insufficient to allow preparation of a duplicate. A Laboratory Control Sample Duplicate (LCSD) was prepared in lieu of a client sample duplicate.
5. Paragon Analytics follows the convention outlined in ANSI N42.23 for reporting significant digits in the TPU and MDC results. ANSI N42.23 states that the TPU result should be rounded to two significant digits and that the MDC result should be rounded to the same decimal place as the TPU result. In practice, this could result in an MDC result with a reported value of 0 for samples with significant activity, including the batch laboratory control sample.
6. No further anomalous situations were encountered during the preparation or analysis of these samples. All remaining quality control criteria were met.

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

Linda Arend — 06/25/08
Radiochemistry Primary Reviewer — Date

Radiochemistry Final Data Review — 6/26/08
Date

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 1

CHAIN OF CUSTODY

Paragon Analytics

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 0805200
Client Name: CSU Dep't Ecological Radiological Health Scie
Client Project Name: Tissue samples
Client Project Number:
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
CSUPR-1	0805200-1	liver	TISSUE	20-May-08	
CSUPR-2	0805200-2	lung	TISSUE	20-May-08	
CSUPR-3	0805200-3	muscle	TISSUE	20-May-08	
CSUPR-4	0805200-4	bone	TISSUE	20-May-08	
CSUPR-5	0805200-5	liver	TISSUE	20-May-08	
CSUPR-6	0805200-6	lung	TISSUE	20-May-08	
CSUPR-7	0805200-7	muscle	TISSUE	20-May-08	
CSUPR-8	0805200-8	bone	TISSUE	20-May-08	
CSUPR-9	0805200-9	liver	TISSUE	20-May-08	
CSUPR-10	0805200-10	lung	TISSUE	20-May-08	
CSUPR-11	0805200-11	muscle	TISSUE	20-May-08	
CSUPR-12	0805200-12	bone	TISSUE	20-May-08	
CSUPR-13	0805200-13	liver	TISSUE	19-May-08	
CSUPR-14	0805200-14	lung	TISSUE	19-May-08	
CSUPR-15	0805200-15	muscle	TISSUE	19-May-08	
CSUPR-16	0805200-16	bone	TISSUE	19-May-08	
CSUPR-17	0805200-17	liver	TISSUE	19-May-08	
CSUPR-18	0805200-18	lung	TISSUE	19-May-08	
CSUPR-19	0805200-19	muscle	TISSUE	19-May-08	
CSUPR-20	0805200-20	bone	TISSUE	19-May-08	
CSUPR-21	0805200-21	liver	TISSUE	19-May-08	
CSUPR-22	0805200-22	lung	TISSUE	19-May-08	
CSUPR-23	0805200-23	muscle	TISSUE	19-May-08	
CSUPR-24	0805200-24	bone	TISSUE	19-May-08	
CSUPR-25	0805200-25	carcass	TISSUE	20-May-08	
CSUPR-26	0805200-26	liver	TISSUE	07-Apr-08	
CSUPR-27	0805200-27	lung	TISSUE	07-Apr-08	
CSUPR-28	0805200-28	muscle	TISSUE	07-Apr-08	
CSUPR-29	0805200-29	bone	TISSUE	07-Apr-08	
CSUPR-30	0805200-30	liver	TISSUE	12-Apr-08	
CSUPR-31	0805200-31	lung	TISSUE	12-Apr-08	
CSUPR-32	0805200-32	muscle	TISSUE	12-Apr-08	

Paragon Analytics

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 0805200
Client Name: CSU Dep't Ecological Radiological Health Scie
Client Project Name: Tissue samples
Client Project Number:
Client PO Number:

Client Sample Number	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
CSUPR-33	0805200-33	bone	TISSUE	12-Apr-08	
CSUPR-34	0805200-34	liver	TISSUE	13-Apr-08	
CSUPR-35	0805200-35	lung	TISSUE	13-Apr-08	
CSUPR-36	0805200-36	muscle	TISSUE	13-Apr-08	
CSUPR-37	0805200-37	bone	TISSUE	13-Apr-08	

COC for CSU Tissue Samples received 5/27/08 0805200

Samples delivered from Ward Whicker at CSU to Paragon Analytics on May 27, 2009

Sample #	LabID	species	tissue	Collection Date	Analytes requested U-nat	Th-230	Ra-226	Po-210	Pb-210
CSUPR-1	1	CTAIL	liver	5/20/2008		X		X	X
CSUPR-2	2	CTAIL	lung	5/20/2008				X	X
CSUPR-3	3	CTAIL	muscle	5/20/2008	X			X	
CSUPR-4	4	‡ CTAIL	bone	5/20/2008	X	X	X		X
CSUPR-5	5	CTAIL	liver	5/20/2008		X		X	X
CSUPR-6	6	CTAIL	lung	5/20/2008				X	X
CSUPR-7	7	CTAIL	muscle	5/20/2008	X			X	
CSUPR-8	8	‡ CTAIL	bone	5/20/2008	X	X	X		X
CSUPR-9	9	CTAIL	liver	5/20/2008		X		X	X
CSUPR-10	10	CTAIL	lung	5/20/2008				X	X
CSUPR-11	11	CTAIL	muscle	5/20/2008	X			X	
CSUPR-12	12	‡ CTAIL	bone	5/20/2008	X	X	X		X
CSUPR-13	13	JACK	liver	5/19/2008		X		X	X
CSUPR-14	14	JACK	lung	5/19/2008				X	X
CSUPR-15	15	JACK	muscle	5/19/2008	X			X	
CSUPR-16	16	‡ JACK	bone	5/19/2008	X	X	X		X
CSUPR-17	17	JACK	liver	5/19/2008		X		X	X
CSUPR-18	18	JACK	lung	5/19/2008				X	X
CSUPR-19	19	JACK	muscle	5/19/2008	X			X	
CSUPR-20	20	‡ JACK	bone	5/19/2008	X	X	X		X
CSUPR-21	21	JACK	liver	5/19/2008		X		X	X
CSUPR-22	22	JACK	lung	5/19/2008				X	X
CSUPR-23	23	JACK	muscle	5/19/2008	X			X	
CSUPR-24	24	‡ JACK	bone	5/19/2008	X	X	X		X
CSUPR-25	25	K-RAT	carcass	5/20/2008	X	X	X		X
CSUPR-26	26	COW	liver	4/7/2008	X	X		X	X
CSUPR-27	27	COW	lung	4/7/2008				X	X
CSUPR-28	28	COW	muscle	4/7/2008	X			X	
CSUPR-29	29	COW	bone	4/7/2008	X	X	X		X
CSUPR-30	30	COW	liver	4/12/2008	X	X		X	X
CSUPR-31	31	COW	lung	4/12/2008				X	X
CSUPR-32	32	COW	muscle	4/12/2008	X			X	
CSUPR-33	33	COW	bone	4/12/2008	X	X	X		X
CSUPR-34	34	COW	liver	4/13/2008	X	X		X	X
CSUPR-35	35	COW	lung	4/13/2008				X	X
CSUPR-36	36	COW	muscle	4/13/2008	X			X	
CSUPR-37	37	COW	bone	4/13/2008	X	X	X		X

‡ add'l bone (Femur and lower legs) received from Ward Whicker 6/5/08 ~ 4:30 pm 6/5/08

Note: original bone samples (all species) were scapula.

CONDITION OF SAMPLE UPON RECEIPT FORM **Paragon Analytics**

Client: CSU Workorder No: 0805200

Project Manager: LS Initials: CT Date: 5-29-08

1.	Does this project require any **special handling** in addition to standard Paragon procedures?		YES	(NO)
2.	Are custody **seals** on **shipping containers** intact?	(NONE)	(YES)	NO
3.	Are Custody seals on **sample containers** intact?	(NONE)	YES	NO
4.	Is there a **COC (Chain-of-Custody) present** or other representative documents?		(YES)	NO
5.	Are the **COC and bottle labels complete and legible**?		(YES)	NO
6.	Is the **COC in agreement** with samples received? (IDs, dates, times, no. of samples, no. of containers, matrix, requested analyses, etc.)		(YES)	NO
7.	Were **airbills / shipping documents** present and/or removable?	(DROP OFF)	~~YES~~ CT 5-29-08	NO
8.	Are all aqueous **samples requiring preservation preserved correctly?** (excluding volatiles)	(N/A)	(YES)	NO
9.	Are all aqueous **non-preserved samples pH 4-9**?	(N/A)	(YES)	NO
10.	Is there **sufficient sample** for the requested analyses?		(YES)	NO
11.	Were all samples placed in the **proper containers** for the requested analyses?		(YES)	NO
12.	Are all samples within **holding times** for the requested analyses?		(YES)	NO
13.	Were all sample containers received **intact**? (not broken or leaking, etc.)		(YES)	NO
14.	Are all samples requiring no headspace (VOC, GRO, Rx CN/S, radon), headspace free? **Size of bubble**: ____ < green pea ____> green pea	(N/A)	(YES)	NO
15.	Were samples checked for and free from the presence of **residual chlorine?** (Applicable when PM has indicated samples are from a chlorinated water source; note if field preservation with sodium thiosulfate was not observed.)	(N/A)	YES	NO
16.	Were the samples **shipped on ice**?		(YES)	NO
17.	Were cooler temperatures measured at 0.1-6.0°C? **IR gun used*:** (#2) #4	RAD ONLY	YES	(NO)

Cooler #:	1							
Temperature (°C):	~~13~~ CT 5-29-08							
No. of custody seals on cooler:	0							
DOT Survey/ Acceptance Information — External µR/hr reading:	NA							
DOT Survey/ Acceptance Information — Background µR/hr reading:	13							

Were external µR/hr readings ≤ two times background and within DOT acceptance criteria? **YES / NO / NA** (If no, see Form 008.)

Additional Information: PROVIDE DETAILS BELOW FOR A NO RESPONSE TO ANY QUESTION ABOVE, EXCEPT #1 AND #16

Samples received frozen

If applicable, was the client contacted? **YES / NO / NA** Contact: _____ Date/Time: _____

Project Manager Signature / Date: 5/29/08

*IR Gun #2: Oakton, SN 29922500201-0066 *IR Gun #4: Oakton, SN 2372220101-0002

Form 201r20.xls (12/27/07)

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 2

SAMPLE RESULTS SUMMARY

Ra-226 by Radon Emanation - Method 903.1 Sample Results Summary

Client Name: CSU Dep't Ecological Radiological Health Sciences
Client Project Name: Tissue samples
Client Project Number:

Laboratory Name: **Paragon Analytics**
PAI Work Order: 0805200

Reported on: Wednesday, June 25, 2008
8:49:41 AM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0805200-4	CSUPR-4	Sample	Ra-226	0.222 +/- 0.052	0.024	pCi/g	TISSUE	RE080605-1	6/23/2008	LT
0805200-8	CSUPR-8	Sample	Ra-226	0.63 +/- 0.13	0.04	pCi/g	TISSUE	RE080605-1	6/23/2008	LT
0805200-12	CSUPR-12	Sample	Ra-226	0.69 +/- 0.14	0.04	pCi/g	TISSUE	RE080605-1	6/23/2008	LT
0805200-16	CSUPR-16	Sample	Ra-226	0.81 +/- 0.16	0.03	pCi/g	TISSUE	RE080605-1	6/23/2008	LT
0805200-20	CSUPR-20	Sample	Ra-226	0.67 +/- 0.13	0.02	pCi/g	TISSUE	RE080605-1	6/23/2008	LT
0805200-24	CSUPR-24	Sample	Ra-226	0.60 +/- 0.12	0.02	pCi/g	TISSUE	RE080605-1	6/23/2008	LT
0805200-25	CSUPR-25	Sample	Ra-226	0.029 +/- 0.045	0.075	pCi/g	TISSUE	RE080605-1	6/23/2008	U
0805200-29	CSUPR-29	Sample	Ra-226	0.332 +/- 0.076	0.031	pCi/g	TISSUE	RE080605-1	6/23/2008	LT
0805200-33	CSUPR-33	Sample	Ra-226	0.182 +/- 0.047	0.031	pCi/g	TISSUE	RE080605-1	6/23/2008	LT

Comments:

Data Package ID: *RE0805200-1*

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

M - The requested MDC was not met.

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

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Ra-226 by Radon Emanation - Method 903.1 Sample Results Summary

Client Name: CSU Dep't Ecological Radiological Health Sciences
Client Project Name: Tissue samples
Client Project Number:

Laboratory Name: **Paragon Analytics**
PAI Work Order: 0805200

Reported on: Wednesday, June 25, 2008
8:49:41 AM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0805200-37	CSUPR-37	Sample	Ra-226	0.095 +/- 0.034	0.020	pCi/g	TISSUE	RE080605-1	6/23/2008	LT

Comments:

Data Package ID: *RE0805200-1*

Qualifiers/Flags:

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

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 3

QC RESULTS SUMMARY

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Method Blank Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Lab ID: RE080605-1MB

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 05-Jun-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes

Final Aliquot: 4.12 g
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.004 +/- 0.011	0.021	1	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

M - Requested MDC not met.

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Laboratory Control Sample(s)

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Lab ID: RE080605-1LCS

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 05-Jun-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes

Final Aliquot: 4.12 g
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	8.3 +/- 1.5	0	10.8	77.4	57 - 126	P

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.
LT - Result is less than Requested MDC, greater than sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS Recovery within control limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Laboratory Control Sample(s)

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Lab ID: RE080605-1LCSD

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 05-Jun-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes

Final Aliquot: 4.12 g
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Results +/- 2s TPU	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	8.6 +/- 1.6	0	10.8	80.0	57 - 126	P

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.
LT - Result is less than Requested MDC, greater than sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative Yield is assumed.
Y2 - Chemical Yield outside default limits.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS Recovery within control limits.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)
MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Duplicate Sample Results (DER)

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID:
Lab ID: RE080605-1LCSD

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 05-Jun-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes

Final Aliquot: 4.12 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Analyte	Sample Result +/- 2s TPU	Duplicate Result +/- 2s TPU	DER	Control Limit	Lab Qualifiers
13982-63-3	Ra-226	8.3 +/- 1.5	8.6 +/- 1.6	0.13	2.13	P

Comments:

Duplicate Qualifiers/Flags:

U - Result is less than the sample specific MDC.
Y1 - Chemical Yield is in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13
LT - Result is less than Request MDC, greater than sample specific MDC
M - Requested MDC not met.
M3 - The requested MDC was not met, but the reported activity is greater than the reported MDC.
L - LCS Recovery below lower control limit.
H - LCS Recovery above upper control limit.
P - LCS, Matrix Spike Recovery within control limits.
N - Matrix Spike Recovery outside control limits

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)
DER - Duplicate Error Ratio (see PAI SOP 715)
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *RE0805200-1*

PARAGON ANALYTICS
Radiochemistry Data Package

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Section 4

INDIVIDUAL SAMPLE RESULTS

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-4
Lab ID: 0805200-4

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 20-May-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 4.03 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.222 +/- 0.052	0.024	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-8
Lab ID: 0805200-8

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 20-May-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 4.22 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.63 +/- 0.13	0.04	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-12
Lab ID: 0805200-12

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 20-May-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 3.84 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.69 +/- 0.14	0.04	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-16
Lab ID: 0805200-16

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 19-May-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 5.04 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.81 +/- 0.16	0.03	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-20
Lab ID: 0805200-20

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 19-May-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 4.97 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.67 +/- 0.13	0.02	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-24
Lab ID: 0805200-24

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 19-May-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 5.17 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.60 +/- 0.12	0.02	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-25
Lab ID: 0805200-25

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 20-May-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 2.00 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.029 +/- 0.045	0.075	1	U

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-29
Lab ID: 0805200-29

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 07-Apr-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 3.29 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.332 +/- 0.076	0.031	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID: CSUPR-33
Lab ID: 0805200-33

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 12-Apr-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 4.87 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.182 +/- 0.047	0.031	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 8

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0805200
Client Name: CSU Dep't Ecological Radiological Health Sciences
ClientProject ID: Tissue samples

Field ID:	CSUPR-37
Lab ID:	0805200-37

Sample Matrix: TISSUE
Prep SOP: PAI 783 Rev 8
Date Collected: 13-Apr-08
Date Prepared: 05-Jun-08
Date Analyzed: 23-Jun-08

Prep Batch: RE080605-1
QCBatchID: RE080605-1-1
Run ID: RE080605-1A1
Count Time: 45 minutes
Report Basis: As Received

Final Aliquot: 3.73 g
Prep Basis: As Received
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Requested MDC	Lab Qualifier
13982-63-3	Ra-226	0.095 +/- 0.034	0.020	1	LT

Comments:

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

LT - Result is less than Requested MDC, greater than sample specific MDC.

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

M - The requested MDC was not met.

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *RE0805200-1*

PARAGON ANALYTICS
Radiochemistry Data Package

5

Section 5

RAW DATA

Ra-226 by Radon Emanation - Method 903.1 Raw Data Report

Laboratory Name: **Paragon Analytics** **Prep SOP:** PAI 783 **Reported on:** Tuesday, June 24, 2008

PAI Work Order: 0805200 **Analytical SOP:** PAI 783 10:39:48 AM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date /Time	Decay Date/Time	Matrix %Moist.	Samp Alq Analy Alq	Inst ID Det ID	AnRunID File Name	Count Date/Time	Gr Cnts Bkg Cnts	BaseEff ProgEff	CntDur(min) Yield	Activity +/- 2 s TPU	MDC DecLev	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
0805200-4	Ra-226	5/20/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	4.03 g	Alpha Scin	RE080605-1A1	6/23/2008	219.000	254.87%	45	0.222	0.024	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	12:15:00 PM	NA	4.03 g	C25	Manual Entry	4:15 PM	17.000	NA	NA	0.052	NA	As Received	NA	LT
0805200-8	Ra-226	5/20/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	4.22 g	Alpha Scin	RE080605-1A1	6/23/2008	423.000	171.15%	45	0.63	0.04	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	10:26:00 AM	NA	4.22 g	B10	Manual Entry	2:26 PM	18.000	NA	NA	0.13	NA	As Received	NA	LT
0805200-12	Ra-226	5/20/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	3.84 g	Alpha Scin	RE080605-1A1	6/23/2008	367.000	152.01%	45	0.69	0.04	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	10:26:00 AM	NA	3.84 g	C22	Manual Entry	2:26 PM	12.000	NA	NA	0.14	NA	As Received	NA	LT
0805200-16	Ra-226	5/19/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	5.04 g	Alpha Scin	RE080605-1A1	6/23/2008	783.000	209.05%	45	0.81	0.03	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	10:26:00 AM	NA	5.04 g	D30	Manual Entry	2:26 PM	26.000	NA	NA	0.16	NA	As Received	NA	LT
0805200-20	Ra-226	5/19/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	4.97 g	Alpha Scin	RE080605-1A1	6/23/2008	526.000	176.57%	45	0.67	0.02	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	10:26:00 AM	NA	4.97 g	F48	Manual Entry	2:26 PM	8.000	NA	NA	0.13	NA	As Received	NA	LT
0805200-24	Ra-226	5/19/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	5.17 g	Alpha Scin	RE080605-1A1	6/23/2008	560.000	201.28%	45	0.60	0.02	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	10:26:00 AM	NA	5.17 g	A50	Manual Entry	2:26 PM	9.000	NA	NA	0.12	NA	As Received	NA	LT
0805200-25	Ra-226	5/20/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	2 g	Alpha Scin	RE080605-1A1	6/23/2008	23.000	155.62%	45	0.029	0.075	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	11:17:00 AM	NA	2 g	B12	Manual Entry	3:17 PM	15.000	NA	NA	0.045	NA	As Received	NA	U
0805200-29	Ra-226	4/7/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	3.29 g	Alpha Scin	RE080605-1A1	6/23/2008	235.000	227.15%	45	0.332	0.031	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:13:00 PM	11:17:00 AM	NA	3.29 g	C24	Manual Entry	3:17 PM	15.000	NA	NA	0.076	NA	As Received	NA	LT
0805200-33	Ra-226	4/12/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	4.87 g	Alpha Scin	RE080605-1A1	6/23/2008	176.000	193.33%	45	0.182	0.031	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:33:00 PM	11:17:00 AM	NA	4.87 g	D31	Manual Entry	3:17 PM	24.000	NA	NA	0.047	NA	As Received	NA	LT
0805200-37	Ra-226	4/13/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	3.73 g	Alpha Scin	RE080605-1A1	6/23/2008	47.000	143.38%	45	0.095	0.020	pCi/g	NA	
SMP	Trg. Analyte		RE080605-1-1	4:33:00 PM	11:17:00 AM	NA	3.73 g	F51	Manual Entry	3:17 PM	2.000	NA	NA	0.034	NA	As Received	NA	LT
RE080605-1	Ra-226	6/5/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	4.12 g	Alpha Scin	RE080605-1A1	6/23/2008	9.000	186.06%	45	0.004	0.021	pCi/g	NA	
MB	Trg. Analyte	12:39:01 PM	RE080605-1-1	4:33:00 PM	11:17:00 AM	NA	4.12 g	A40	Manual Entry	3:17 PM	6.000	NA	NA	0.011	NA	As Received	NA	U

Comments:

Data Package ID: *RE0805200-1*

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

+ - Duplicate RPD not within limits.

LT - Result is less than Request MDC, greater than sample specific MDC

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'

M - Requested MDC not met.

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

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

1) The Tracer results are not yield corrected (i.e. activity measured not activity added).

2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR- Tracer TA - Target Analyte

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

DER - Duplicate Error Ratio

BDL - Below Detection Limit

Ra-226 by Radon Emanation - Method 903.1 Raw Data Report

Laboratory Name: **Paragon Analytics**
PAI Work Order: 0805200

Prep SOP: PAI 783
Analytical SOP: PAI 783

Reported on: Tuesday, June 24, 2008
10:39:48 AM

Sample ID QC Type	Nuclide Type	Sample Date/Time	Prep Batch QCBatchID	Ingrowth Date /Time	Decay Date/Time	Matrix %Moist.	Samp Alq Analy Alq	Inst ID Det ID	AnRunID File Name	Count Date/Time	Gr Cnts Bkg Cnts	BaseEff ProgEff	CntDur(min) Yield	Activity +/- 2 s TPU	MDC DecLev	ReportUnits ReportBasis	DER RPD	%Spk. Recov Flags
RE080605-1	Ra-226	6/5/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	4.12 g	Alpha Scin	RE080605-1A1	6/23/2008	4252.000	139.38%	45	8.3	0	pCi/g	NA	77.4
LCS	Trg. Analyte	12:39:01 PM	RE080605-1-1	4:33:00 PM	12:15:00 PM	NA	4.12 g	F41	Manual Entry	4:15 PM	11.000	NA	NA	1.5	NA	As Received	NA	P
RE080605-1	Ra-226	6/5/2008	RE080605-1	6/09/2008	6/23/2008	TISSUE	4.12 g	Alpha Scin	RE080605-1A1	6/23/2008	4069.000	129.12%	45	8.6	0	pCi/g	0.13	80.0
LCSD	Trg. Analyte	12:39:01 PM	RE080605-1-1	4:33:00 PM	12:15:00 PM	NA	4.12 g	A42	Manual Entry	4:15 PM	4.000	NA	NA	1.6	NA	As Received	NA	P

Comments:

Data Package ID: *RE0805200-1*

Qualifiers/Flags:

U - Result is less than the sample specific MDC.

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

Y2 - Chemical Yield outside default limits.

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

+ - Duplicate RPD not within limits.

LT - Result is less than Request MDC, greater than sample specific MDC

* - Aliquot Basis is 'As Received' while the Report Basis is 'Dry Weight'.

- Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Received'

M - Requested MDC not met.

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

L - LCS Recovery below lower control limit.

H - LCS Recovery above upper control limit.

P - LCS, Matrix Spike Recovery within control limits.

N - Matrix Spike Recovery outside control limits

NC - Not Calculated for duplicate results less than 5 times MDC

B - Analyte concentration greater than MDC.

B3 - Analyte concentration greater than MDC but less than Requested MDC.

Notes:

1) The Tracer results are not yield corrected (i.e. activity measured not activity added).

2) Where sample time is not available, 12:00 PM (Mountain) is used for decay correction.

Abbreviations:

TR- Tracer TA - Target Analyte

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

DER - Duplicate Error Ratio

BDL - Below Detection Limit

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Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
Check Source	N/A	1F	Th	N/A						5/22/08	15:41	9423	1	EMF
Check Source	N/A	3E	Th	N/A						6/17/08	9:31	9427	1	DBC
		2B									9:32	9312		DBC
		6C									9:33	9336		DBC
		5D									9:34	9561		DBC
		1F									9:35	9526		DBC
		7A									9:36	9507		DBC
0806039-1	RE080616-1	3E	2	12	6/17/08	9:41	32	15	DBC	6/17/08	14:58	38	15	DBC
-2		2B	DBC 6/17/08 13	8 11			3		DBC			8		DBC
0806040-1		6C	27	10			0		DBC			8		DBC
-2		5D	28	10			7		DBC			16		DBC
0806043-1		1F	42	9			0		DBC			4		DBC
RE080616-1MB		7A	44	9			1		DBC			2		DBC
LCS		1F	45	9		10:42	1		DBC		15:21	1273		DBC
LCSD		7A	47	9			3		DBC			1615		DBC
Check Source	N/A	3E	Th	N/A						6/17/08	15:53	9399	1	DBC
		2B									15:54	9620		DBC
		6C									15:55	9469		DBC
		5D									15:56	9545		DBC
		1F									15:57	9607		DBC
		7A									15:58	9528		DBC
Check Source	N/A	3E	Th	N/A						6/23/08	9:09	9575	1	DBC
		2B									9:10	9528		DBC

Comments:

Reviewed by/date: DBC 6/23/08

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Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
Check Source	N/A	6C	Th	N/A						6/23/08	9:11	9402	1	DBC
		5D									9:12	9523		DBC
		1F									9:13	9488		DBC
		7A									9:14	9537		DBC
0805200-4	RE080605-1	3E	2	13	6/23/08	9:18	DBC 6/23/08	45						
0805200-8	RE080605-1	2B	10	11	6/23/08	9:18	18	45	DBC	6/23/08	14:26	423	45	DBC
-12		6C	22	11			12		DBC			367		DBC
-16		5D	30	10			26		DBC			783		DBC
-20		1F	48	9			8		DBC			526		DBC
-24		7A	50	9			9		DBC			560		DBC
-25		2B	12	11		10:05	15		DBC		15:17	23		DBC
-29		6C	29	11			15		DBC			235		DBC
-33		5D	31	10			24		DBC			176		DBC
-37		1F	51	9			2		DBC			47		DBC
RE080605-1MB		7A	40	10			6		DBC			9		DBC
LCS		1F	41	10		10:53	11		DBC		16:15	4252		DBC
LCSD		7A	42	10			4		DBC			4069		DBC
0805200-4	RE080605-1	6C	25	11	6/23/08		17	45	DBC			219		DBC
Check Source	N/A	3E	Th	N/A						6/23/08	17:06	9591	1	DBC
		2B									17:07	9381		DBC
		6C									17:08	9499		DBC
		5D								DBC 6/23/08	17:09	9451		DBC
		1F									17:10	9508		DBC

Comments:

Reviewed by/date: DBC 6/24/08

Logbook No./Page 359638

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
Check Source	N/A	7A	Th	N/A	~~6/23/05~~	DBC ~~6/23/08~~			→	6/23/08	17:11	9478	1	DBC

DBC 6/24/08

Comments:

Reviewed by/date: DBC 6/24/08

Form 795r3.xls (11/14/05)

PARAGON ANALYTICS
Radiochemistry Data Package

Section 6

QUALITY ASSURANCE SUMMARY REPORTS

6

Paragon Analytics

QUALITY ASSURANCE SUMMARY SHEET

PAR W.O. # / BATCH 0805200
TEST various
METHOD Prep
SOP/REV (PREP) Various
SOP/REV (ANAL) _____

Briefly document any QA or other problems or deviations associated with the analysis of samples. Problems could result from: log-in, color, odor, dilution, consistency, scheduling, equipment, or instrumentation, or may include documentation of minor deviations necessary due to unique DQO's or sample characteristics.

TE 6/7/08

The following applies to animal tissue samples 0805200-1 to –37:

1. The entire sample was placed in a drying oven for %moisture analysis.
2. The entire dried sample was then placed into a 220mL polypropylene cup.
3. A common digestion was performed by adding 25mL each of HCl and HNO_3 to the sample cups. The samples were capped, placed on the steambath, uncapped after four hours, and allowed to dry.
4. Step 3 was repeated to ensure a total digestion of the samples.
5. After the second digestion, the dried samples were brought up in 10mL HNO_3 and ~80mL DI water and placed on the steambath for 30minutes.
6. The samples were removed from the steambath and diluted with DI water to a total volume of 100ml. TE 6/7/08
7. At this time, Paragon received extra volume from the client for bone samples 4, 8, 12, 16, 20, and 24. Steps 1-6 were performed on the extra volumes. These extra sample volumes were then combined with the original sample. The samples were evaporated to less than 100ml on the steambath and then brought to a total volume of 100ml with DI water. TE 6/7/08 TE 6/7/08
8. The sample digestates were then split to target the necessary analyses aliquots provided by the project manager using the following equation:

$$\text{Sample Size(g)} = \frac{\text{(Original Sample Wet Weight(g))} * \text{(Digestate Volume Taken for Analysis(ml))}}{\text{(Total Volume of Digestate(ml))}}$$

All wet weights and digestate splits are listed on the "Animal Tissue Digestate Splits" spreadsheets.

9. All samples were spike/traced for the individual analyses following the digestate splits.
10. Two sets of reagent blanks, LCS's, and LCSD's were created at step 3 for analyses containing more than 20 samples. As all samples were prepped together, the QC are interchangeable. Due to limited sample volume, the LCSD's were created to meet QC requirements.

TE 6/7/08

TECHNICIAN/ANALYST T Elliot DATE 6/7/08

DEPARTMENT MANAGER [signature] DATE 6/7/08

365713

FORM 302r6.doc (4/22/04)

PARAGON ANALYTICS
Radiochemistry Data Package

Section 7

LABORATORY BENCH SHEETS

7

Radiochemistry Instrument Worksheet

Paragon Analytics

Prep Batch: RE080605-1

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? Y / (N) N/A

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Report Units	Cnt Date Time	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts		Notes
1	0805200-4	SMP	4.03	4.03	g	pCi/g	6/23/08 16:15	6C	25	17	2.5487	45	219		
1	0805200-8	SMP	4.22	4.22	g	pCi/g	14:26	2D	10	18	1.7115		423		
1	0805200-12	SMP	3.84	3.84	g	pCi/g		6C	22	12	1.5201		367		
1	0805200-16	SMP	5.0424	5.0424	g	pCi/g		5D	30	26	2.0905		783		
1	0805200-20	SMP	4.973	4.973	g	pCi/g		1F	48	8	1.7657		524		
1	0805200-24	SMP	5.1651	5.1651	g	pCi/g		7A	50	9	2.0128		560		
1	0805200-25	SMP	2.0025	2.0025	g	pCi/g	15:17	2B	12	15	1.5562		23		
1	0805200-29	SMP	3.2915	3.2915	g	pCi/g		6C	24	15	2.2715		235		
1	0805200-33	SMP	4.8659	4.8659	g	pCi/g		5D	31	24	1.9333		176		
1	0805200-37	SMP	3.7271	3.7271	g	pCi/g		1F	51	2	1.4338		47		
1	RE080605-1	MB	4.1158	4.1158	g	pCi/g		7A	40	6	1.8606		9		
1	RE080605-1	LCS	4.1158	4.1158	g	pCi/g	16:15	1F	41	11	1.3938		4252		
1	RE080605-1	LCSD	4.1158	4.1158	g	pCi/g		7A	42	4	1.2912		4069		

DBC 6/24/08

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Ra-226	818.3020.76	98.375	DPM/ml	06/05/08	1	ml	RS-005
S1	Rn-222	818.3020.76	98.375	DPM/ml	06/05/08	1	ml	RS-005

Supersedes: N/A

Sample Barcodes

0805200-4 RE080605-1PS1	0805200-8 RE080605-1PS2
0805200-12 RE080605-1PS3	0805200-16 RE080605-1PS4
0805200-20 RE080605-1PS5	0805200-24 RE080605-1PS6
0805200-25 RE080605-1PS7	0805200-29 RE080605-1PS8
0805200-33 RE080605-1PS9	0805200-37 RE080605-1PS10
RE080605-1MB RE080605-1PS11	RE080605-1LCS RE080605-1PS12
RE080605-1LCSD RE080605-1PS13	

Radiochemistry Prep Worksheet

Paragon Analytics

Prep Batch: RE080605-1

Prep Procedure: Ra226_RnE

Reviewed By: DBC DBC **Review Date:** 6/24/2008

Non-Routine Pre-Treatment? (Y) / N **Batch:** QASS# 365713 **Re-Prep?** Y / (N) **Batch:** N/A **Prep** (QASS) / **NCR?** (Y) / N 365713

Prep SOP: PAI 783 **Rev:** 8
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Derek B. Caduff
Prep Date: 6/5/2008
Prep Dept: RS

Balance:
Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Ingrowth Date/Time	Decay Date/Time	Standards	Prep Notes
1	1	0805200-4	SMP		4.03	4.03	As Received	06/09/08 16:13	06/23/08 12:15		
2	1	0805200-8	SMP		4.22	4.22	As Received	06/09/08 16:13	06/23/08 10:26		
3	1	0805200-12	SMP		3.84	3.84	As Received	06/09/08 16:13	06/23/08 10:26		
4	1	0805200-16	SMP		5.0424	5.0424	As Received	06/09/08 16:13	06/23/08 10:26		
5	1	0805200-20	SMP		4.973	4.973	As Received	06/09/08 16:13	06/23/08 10:26		
6	1	0805200-24	SMP		5.1651	5.1651	As Received	06/09/08 16:13	06/23/08 10:26		
7	1	0805200-25	SMP		2.0025	2.0025	As Received	06/09/08 16:13	06/23/08 11:17		
8	1	0805200-29	SMP		3.2915	3.2915	As Received	06/09/08 16:13	06/23/08 11:17		
9	1	0805200-33	SMP		4.8659	4.8659	As Received	06/09/08 16:33	06/23/08 11:17		
10	1	0805200-37	SMP		3.7271	3.7271	As Received	06/09/08 16:33	06/23/08 11:17		
11	1	RE080605-1	MB		4.11575	4.11575	As Received	06/09/08 16:33	06/23/08 11:17		
12	1	RE080605-1	LCS		4.11575	4.11575	As Received	06/09/08 16:33	06/23/08 12:15	S1	
13	1	RE080605-1	LCSD		4.11575	4.11575	As Received	06/09/08 16:33	06/23/08 12:15	S1	

DBC 6/24/08

DBC 6/24/08

DBC 6/24/08

Comments

DUE TO LIMITED SAMPLE VOLUME A CLIENT DUPLICATE WAS NOT PREPARED. A LCS DUPLICATE WAS PREPARED INSTEAD.

Spiked By: Derek B. Caduff **Date:** 6/9/2008

Witnessed By: Jeff Kujawa **Date:** 6/9/2008

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Ra-226	818.3020.76	98.375	DPM/ml	06/05/08	1	ml	RS-005
S1	Rn-222	818.3020.76	98.375	DPM/ml	06/05/08	1	ml	RS-005

Radiochemistry Prep Worksheet

Paragon Analytics

Prep Batch: RE080605-1

Prep Procedure: Ra226_RnE

Prep Batch Not Validated!!!

Reviewed By:

Review Date:

Non-Routine Pre-Treatment? Y / N **Batch:** _____ **Re-Prep? Y / N** **Batch:** _____ **Prep QASS / NCR? Y / N** _____

Prep SOP: PAI 783 **Rev:** 8
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Derek B. Caduff DBC
Prep Date: 6/5/2008
Prep Dept: RS

Balance:
Balance:

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Ingrowth Date/Time	Decay Date/Time	Standards	Prep Notes
1	1	0805200-4	SMP		5	5	As Received	6/9/08 16:13	6/23/08 12:13		
2	1	0805200-8	SMP		5	5			10:36		
3	1	0805200-12	SMP		5	5					
4	1	0805200-16	SMP		5	5					
5	1	0805200-20	SMP		5	5					
6	1	0805200-24	SMP		5	5					
7	1	0805200-25	SMP		5	5			11:17		
8	1	0805200-29	SMP		5	5					
9	1	0805200-33	SMP		5	5		16:33			
10	1	0805200-37	SMP		5	5					
11	1	RE080605-1	MB		5	5					
12	1	RE080605-1	LCS		5	5			12:15	S1	
13	1	RE080605-1	LCSD		5	5				S1	

Comments

DUE TO LIMITED SAMPLE VOLUME A CLIENT DUPLICATE WAS NOT PREPARED. A LCS DUPLICATE WAS PREPARED INSTEAD.

Spiked By: DBC **Date:** 6/9/08
Witnessed By: JLG **Date:** 6/9/08

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	Ra-226	818.3020.76	98.375	DPM/ml	06/05/08	1	ml	RS-005
S1	Rn-222	818.3020.76	98.375	DPM/ml	06/05/08	1	ml	RS-005

Exp. 4/8/09

Supersedes: N/A

SAMPLE CONDITION FORM (SOLIDS)

ANALYST: TC

ANALYSIS DATE: 5/30/08 METHOD: Prep

WORK ORDER	SAMPLE ID	SAMPLE CONDITION		
		Dry/Wet	TEXTURE	Remarks
0805200	1	wet	As Rec'd	soft animal tissue
	2			↓
	3			
	4			bone
	5			soft animal tissue
	6			↓
	7			
	8			bone
	9			soft animal tissue
	10			↓
	11			
	12			bone
	13			soft animal tissue
	14			↓
	15			
	16			bone
	17			soft animal tissue
	18			↓
	19			
✓	20	✓	✓	bone

SAMPLE CONDITION FORM (SOLIDS)

ANALYST: TE

ANALYSIS DATE: 5/30/08 METHOD: Prep

WORK ORDER	SAMPLE ID	SAMPLE CONDITION		
		Dry/Wet	TEXTURE	Remarks
0805200	21	wet	As Rec'd	Soft animal tissue
	22			↓
	23			
	24			bone
	25			carcass
	26			Soft animal tissue
	27			↓
	28			
	29			bone
	30			Soft animal tissue
	31			↓
	32			
	33			bone
	34			Soft animal tissue
	35			↓
	36			
	37	✓	✓	bone
			TE 5/30/08	

Percent Moisture

Method SOP642M Revision 0

Lab Name: Paragon Analytics

Date Extracted: 06/02/2008
Date Analyzed: 06/02/2008
Analyst: Tambrae Elhart

Balance ID: 25
Oven ID: 18
In Oven: 5/30/2008 @ 6:00:00 PM
Out of Oven: 6/1/2008 @ 12:00:00 PM

Validated By: tde
Validation Date: 06/02/2008
Validation Time: 5:30:37 PM

Run ID	Prep Batch ID	QC Batch ID	Lab ID	QC Type	Dish Wt	Wet Wt	Dry Wt	Dry Wt-Dish Wt	Percent Moisture	Percent Solids	RPD
MOI080602-1A	MOI080602-1	MOI080602-1-1	MOI080602-1	MB	0	2.22	2.22	2.22	0.0	100.0	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-1	SMP	2.25	13.96	5.93	3.68	73.6	26.4	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-2	SMP	2.25	4.6	3.28	1.03	77.6	22.4	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-3	SMP	2.24	21.08	7.16	4.92	76.7	23.3	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-4	SMP	2.23	1.18	2.95	0.72	39.0	61.0	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-5	SMP	2.23	12.5	5.49	3.26	73.9	26.1	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-6	SMP	2.22	3.74	2.97	0.75	79.9	20.1	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-7	SMP	2.24	26.79	8.91	6.67	75.1	24.9	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-8	SMP	2.24	1.2	2.96	0.72	40.0	60.0	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-9	SMP	2.24	7.7	4.06	1.82	76.4	23.6	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-10	SMP	2.23	7.85	3.76	1.53	80.5	19.5	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-11	SMP	2.25	26.77	8.59	6.34	76.3	23.7	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-12	SMP	2.22	1.45	2.97	0.75	48.3	51.7	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-13	SMP	2.25	13.59	5.82	3.57	73.7	26.3	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-14	SMP	2.25	12.64	5.05	2.80	77.8	22.2	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-15	SMP	2.26	33.65	10.31	8.05	76.1	23.9	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-16	SMP	2.26	4.1	4.69	2.43	40.7	59.3	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-17	SMP	2.25	18.8	7.08	4.83	74.3	25.7	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-18	SMP	2.25	11.43	4.87	2.62	77.1	22.9	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-19	SMP	2.26	42.59	12.87	10.61	75.1	24.9	
MOI080602-1A	MOI080602-1	MOI080602-1-1	0805200-20	SMP	2.25	3.48	4.42	2.17	37.6	62.4	

Percent Moisture

Method SOP642M Revision 0

Lab Name: Paragon Analytics

Date Extracted: 06/02/2008
Date Analyzed: 06/02/2008
Analyst: Tambrae Elhart

Balance ID: 25
Oven ID: 18
In Oven: 5/30/2008 @ 6:00:00 PM
Out of Oven: 6/1/2008 @ 12:00:00 PM

Validated By: tde
Validation Date: 06/02/2008
Validation Time: 5:30:37 PM

Run ID	Prep Batch ID	QC Batch ID	Lab ID	QC Type	Dish Wt	Wet Wt	Dry Wt	Dry Wt-Dish Wt	Percent Moisture	Percent Solids	RPD

QC Types

CAR	Carrier reference sample
LCS	Laboratory Control Sample
MB	Method Blank
MSD	Laboratory Matrix Spike Duplicate
SMP	Field Sample

DUP	Laboratory Duplicate
LCSD	Laboratory Control Sample Duplicate
MS	Laboratory Matrix Spike
REP	Sample replicate
SYS	Sample Yield Spike

Comments:

DUP = Sample Duplicate
Wet Wt = Sample Wet Wt - Dish Wt
Dry Wt = Sample Dry Wt + Dish Wt
Dry Wt - Dish Wt = Sample Dry Wt - Dish Wt
All weight values shown above are expressed in grams.

$$RPD = \frac{(\text{Sample Value - Duplicate Value})}{2} \times 100$$

$$\% \text{ Solids} = \frac{\text{Dry Weight}}{\text{Wet Weight}} \times 100$$

$$\% \text{ Moisture} = \frac{(\text{Wet Weight - Dry Weight})}{\text{Wet Weight}} \times 100$$

Percent Moisture

Method SOP642M Revision 0

Lab Name: Paragon Analytics

Date Extracted: 06/02/2008
Date Analyzed: 06/02/2008
Analyst: Tambrae Elhart

Balance ID: 25
Oven ID: 18
In Oven: 5/30/2008 @ 6:00:00 PM
Out of Oven: 6/1/2008 @ 12:00:00 PM

Validated By: tde
Validation Date: 06/02/2008
Validation Time: 5:49:18 PM

Run ID	Prep Batch ID	QC Batch ID	Lab ID	QC Type	Dish Wt	Wet Wt	Dry Wt	Dry Wt-Dish Wt	Percent Moisture	Percent Solids	RPD
MOI080602-3A	MOI080602-3	MOI080602-3-1	MOI080602-3	MB	0	2.25	2.25	2.25	0.0	100.0	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-21	SMP	2.2	18.34	6.89	4.69	74.4	25.6	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-22	SMP	2.25	15.44	5.44	3.19	79.3	20.7	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-23	SMP	2.21	44.29	12.69	10.48	76.3	23.7	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-24	SMP	2.21	4.04	4.89	2.68	33.7	66.3	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-25	SMP	2.21	8.01	4.16	1.95	75.7	24.3	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-26	SMP	2.21	23.53	7.33	5.12	78.2	21.8	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-27	SMP	2.23	11.89	4.92	2.69	77.4	22.6	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-28	SMP	2.23	26.13	5.42	3.19	87.8	12.2	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-29	SMP	2.26	9.22	9.88	7.62	17.4	82.6	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-30	SMP	2.25	20.07	7.54	5.29	73.6	26.4	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-31	SMP	2.26	15.71	5.34	3.08	80.4	19.6	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-32	SMP	2.25	19.9	6.3	4.05	79.6	20.4	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-33	SMP	2.22	13.63	12.52	10.30	24.4	75.6	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-34	SMP	2.22	13.88	5.09	2.87	79.3	20.7	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-35	SMP	2.26	14.96	5.11	2.85	80.9	19.1	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-36	SMP	2.24	25.8	7.5	5.26	79.6	20.4	
MOI080602-3A	MOI080602-3	MOI080602-3-1	0805200-37	SMP	2.22	10.44	10.66	8.44	19.2	80.8	

QC Types

CAR	Carrier reference sample
LCS	Laboratory Control Sample
MB	Method Blank
MSD	Laboratory Matrix Spike Duplicate
SMP	Field Sample

DUP	Laboratory Duplicate
LCSD	Laboratory Control Sample Duplicate
MS	Laboratory Matrix Spike
REP	Sample replicate
SYS	Sample Yield Spike

Comments:

DUP = Sample Duplicate
Wet Wt = Sample Wet Wt - Dish Wt
Dry Wt = Sample Dry Wt + Dish Wt
Dry Wt - Dish Wt = Sample Dry Wt - Dish Wt
All weight values shown above are expressed in grams.

$$RPD = \frac{(\text{Sample Value - Duplicate Value})}{2} \times 100$$

$$\% \text{ Solids} = \frac{\text{Dry Weight}}{\text{Wet Weight}} \times 100$$

$$\% \text{ Moisture} = \frac{(\text{Wet Weight - Dry Weight})}{\text{Wet Weight}} \times 100$$

Percent Moisture

Method SOP642M Revision 0

Lab Name: Paragon Analytics

Balance ID: 25

Date Extracted: 06/05/2008
Date Analyzed: 06/05/2008
Analyst: Tambrae Elhart

Oven ID: 5
In Oven: 6/5/2008 @ 9:35:00 AM
Out of Oven: 6/6/2008 @ 5:15:00 AM

Validated By: tde
Validation Date: 06/06/2008
Validation Time: 8:47:06 AM

Run ID	Prep Batch ID	QC Batch ID	Lab ID	QC Type	Dish Wt	Wet Wt	Dry Wt	Dry Wt-Dish Wt	Percent Moisture	Percent Solids	RPD
MOI080606-1A	MOI080606-1	MOI080606-1-1	MOI080606-1	MB	0	2.24	2.24	2.24	0.0	100.0	
MOI080606-1A	MOI080606-1	MOI080606-1-1	0805200-4	SMP	2.25	6.88	6.89	4.64	32.6	67.4	
MOI080606-1A	MOI080606-1	MOI080606-1-1	0805200-8	SMP	2.26	7.24	6.68	4.42	39.0	61.0	
MOI080606-1A	MOI080606-1	MOI080606-1-1	0805200-12	SMP	2.24	6.23	5.95	3.71	40.4	59.6	
MOI080606-1A	MOI080606-1	MOI080606-1-1	0805200-16	SMP	2.24	11.18	9.85	7.61	31.9	68.1	
MOI080606-1A	MOI080606-1	MOI080606-1-1	0805200-20	SMP	2.21	10.45	10.03	7.82	25.2	74.8	
MOI080606-1A	MOI080606-1	MOI080606-1-1	0805200-24	SMP	2.24	15.09	13.06	10.82	28.3	71.7	

QC Types

CAR	Carrier reference sample
LCS	Laboratory Control Sample
MB	Method Blank
MSD	Laboratory Matrix Spike Duplicate
SMP	Field Sample

DUP	Laboratory Duplicate
LCSD	Laboratory Control Sample Duplicate
MS	Laboratory Matrix Spike
REP	Sample replicate
SYS	Sample Yield Spike

Comments:

DUP = Sample Duplicate
Wet Wt = Sample Wet Wt - Dish Wt
Dry Wt = Sample Dry Wt + Dish Wt
Dry Wt - Dish Wt = Sample Dry Wt - Dish Wt
All weight values shown above are expressed in grams.

$$RPD = \frac{(\text{Sample Value - Duplicate Value})}{2} \times 100$$

$$\% \text{ Solids} = \frac{\text{Dry Weight}}{\text{Wet Weight}} \times 100$$

$$\% \text{ Moisture} = \frac{(\text{Wet Weight - Dry Weight})}{\text{Wet Weight}} \times 100$$

Animal Tissue Digestate Splits

Sample ID	Original Wet Wt (g)	Total Digest. Volume (ml)	Digestate Volume Taken for Analysis (ml)				
			Po-210	Pb-210	Th-ISO	Ra-226	U6020
0805200-1	13.96	100	4	36	36	NA	NA
0805200-2	4.6	100	10	90	NA	NA	NA
0805200-3	21.08	100	3	NA	NA	NA	24
0805200-4	8.06	100	NA	5	28	50	17
0805200-5	12.5	100	4	40	40	NA	NA
0805200-6	3.74	100	10	90	NA	NA	NA
0805200-7	26.79	100	2	NA	NA	NA	19
0805200-8	8.44	100	NA	5	28	50	17
0805200-9	7.7	100	4	48	48	NA	NA
0805200-10	7.85	100	7	64	NA	NA	NA
0805200-11	26.77	100	2	NA	NA	NA	19
0805200-12	7.68	100	NA	5	28	50	17
0805200-13	13.59	100	4	37	37	NA	NA
0805200-14	12.64	100	4	40	NA	NA	NA
0805200-15	33.65	100	2	NA	NA	NA	15
0805200-16	15.28	100	NA	7	33	33	20
0805200-17	18.8	100	3	27	27	NA	NA
0805200-18	11.43	100	5	44	NA	NA	NA
0805200-19	42.59	100	2	NA	NA	NA	12
0805200-20*	13.93	100	NA	7.1	35.7	35.7	21.5
0805200-MB	20	100	2.5	20	20	20	20
0805200-LCS	20	100	2.5	20	20	20	20
0805200-LCSD	20	100	2.5	20	20	20	20

1. *=sample not enough to take full aliquots, analysis aliquot adjusted proportionally
2. Samples split using graduated cylinder or calibrated pipet

Animal Tissue Digestate Splits

Sample ID	Original Wet Wt (g)	Total Digest. Volume (ml)	Digestate Volume Taken for Analysis (ml)				
			Po-210	Pb-210	Th-ISO	Ra-226	U6020
0805200-21	18.34	100	3	28	28	NA	NA
0805200-22	15.44	100	4	33	NA	NA	NA
0805200-23	44.29	100	2	NA	NA	NA	12
0805200-24	19.13	100	NA	6	27	27	16
0805200-25	8.01	100	NA	25	25	25	25
0805200-26	23.53	100	3	22	22	NA	NA
0805200-27	11.89	100	5	43	NA	NA	NA
0805200-28	26.13	100	2	NA	NA	NA	20
0805200-29*	9.22	100	NA	7.1	35.7	35.7	21.5
0805200-30	20.07	100	3	25	25	NA	NA
0805200-31	15.71	100	4	32	NA	NA	NA
0805200-32	19.9	100	3	NA	NA	NA	26
0805200-33*	13.63	100	NA	7.1	35.7	35.7	21.5
0805200-34	13.88	100	4	37	37	NA	NA
0805200-35	14.96	100	4	34	NA	NA	NA
0805200-36	25.8	100	2	NA	NA	NA	20
0805200-37*	10.44	100	NA	7.1	35.7	35.7	21.5
0805200-MB	20	100	2.5	20	20	20	20
0805200-LCS	20	100	2.5	20	20	20	20
0805200-LCSD	20	100	2.5	20	20	20	20

1. *=sample not enough to take full aliquots, analysis aliquot adjusted proportionally
2. Samples split using graduated cylinder or calibrated pipet

PARAGON ANALYTICS
Radiochemistry Data Package

Section 8

STANDARDS TRACEABILITY DOCUMENTS

8

Prepare a working dilution of 818.3020.31 to a final concentration of approximately 100 dpm/ml.

1) Determine density of 1M HCl: (Lot # 063537) (Bal 12)
Mass of empty 100 ml Class A flask: 62.4699 g
Mass of 100 ml Class A flask + 100 ml 1M HCl: 163.9106 g
Net mass of 1M HCl: 101.4407
÷100 = density = 1.0144 g/ml

2) Transfer std to 1 L Nalgene bottle: (Bal 12)
Mass of bottle (w/o lid): 74.2161 g
Mass of bottle + std: 79.6285 g
Net mass of std. transferred: 5.4124 g

3) Dilute w 1M HCl (Bal 26)
Mass of bottle + std + 1M HCl: 1087.3 g
Mass of bottle (from above): 74.2161 g
Net mass of std: 1013.0839 g

4) Final Activity Calculation:

$$\frac{5.4124\,g \times 18451.8\,dpm/g \times 1.0144\,g/ml}{1013.0839\,g} = 99.998\,dpm/ml$$

5) Std. transferred to marinelli beaker for verification by γ-spec

RG 5/15/07

Stnd ID: 818.3020.76

RG 5/15/07

Description: Ra-226
Expiration: 5/3/2008
Activity: 100.00 dpm/mL

2s Uncertainty: 1.20 dpm/mL
Ref. Date: 9/1/2003
Ref Time: N/A
Prep Date: 4/30/2007 Prep by: KB
Matrix/Comp. 1M HCl
Half Life (y): 1.60E+03

Reverification Log		
Analysis Date	Initials	Expiration Date
4/9/08	MC	4/8/09

RG 5/15/07

tinued on Page

RG 5/15/07
Read and Understood By

Krystal Brown 4/25/07 Renee Allegos 5/15/07
Signed Date Signed Date

U.S. Department of Commerce
National Institute of Standards and Technology
SRM 4967A
Radium-226
<15 kBq in 4% hydrochloric acid
CAUTION
RADIOACTIVE
MATERIAL

Prepare a primary dilution of RSO #818 (NIST 4967A) by diluting the entire stock solution to approx 40 ml w/ 1M HCl

1) Prepared 2L HCl in 1M solution by diluting 166 mL conc HCl, Fisher Lot # 060506, in 2L DI water.

2) Determine density of 1M HCl

Mass of 100 ml volumetric flask	=	56.4422 g (Bal 12)
Mass of flask + acid	=	157.6815 g ↓
Net mass of 1M HCl		101.2393 g
÷100 ml = density of 1M HCl	=	1.0124 g/ml.

3) Transfer contents of ampoule to 40 ml VOA vial.

Mass of VOA vial	=	24.9938 g (Bal 12
Mass of vial + std	=	29.9415 g ↓
Net mass of std transferred	=	4.9477 g

4) Dilute w/ 1M HCl

Mass of vial + std + HCl	=	64.9255 g Bal 12
Mass of vial (from above)		24.9938 g
Net mass of primary std.	=	39.9317 g

5) Final Activity Calculation

$$\frac{(2482\ Bq/g)(4.9477\ g)(60\ Bq/dpm)}{(39.9317\ g)} = 18{,}451.8\ dpm/g$$

Ref date 9/1/03

Continued on Page

Read and Understood By

Signed: [signature] Date: 5/10/06 Signed: [signature] Date: 5/18/06

RSO #818 Rec'd 5/8/06 DJB

National Institute of Standards & Technology

Certificate

Standard Reference Material 4967A
Radium-226 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive radium-226 chloride (and its radioactive decay products), non-radioactive barium chloride and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of instruments and for the monitoring of radiochemical procedures.

Radiological Hazard: The SRM ampoule contains radium-226 with an activity of approximately 13 kBq. Radium-226 decays by alpha-particle emission. The progeny of radium-226 have a total activity of approximately 95 kBq and decay by alpha- and beta-particle emission. None of the alpha or beta particles escape from the SRM ampoule. During the decay process, X-rays and gamma rays with energies from 11 kev to 2.5 MeV are also emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. Gaseous radon-222 will escape from the ampoule when it is opened. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard: The SRM ampoule contains hydrochloric acid (HCl) with a concentration of 1.0 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution

Storage and Handling: The SRM should be stored and used at a temperature between 5 °C and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least September 2013. The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) because of both the radioactivity and the strong acid.

Preparation: This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, M.P. Unterweger, Acting Group Leader. The overall technical direction and physical measurements leading to certification were provided by R. Collé and P. Volkovitsky of the Radioactivity Group. Statistical consultation was provided by S.D. Leigh of the NIST Statistical Engineering Division. The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program.

Lisa R. Karam, Acting Chief
Ionizing Radiation Division

Gaithersburg, Maryland 20899
December 2004

Robert L. Watters, Jr., Chief
Measurement Services Division

*Notes and references are on pages 5 to 7.

Recommended Procedure for Opening the SRM Ampoule

1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.

2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood. In addition to the radioactive material, the solution usually contains strong acid or base and is corrosive.

3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.

4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.

5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.

6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.

7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.

8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.

9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

*Notes and references are on pages 5 to 7.

PROPERTIES OF SRM 4967A

Certified values

Radionuclide	**Radium-226**
Reference time	**1200 EST, 01 September 2003**
Massic activity of the solution [b]*	**2482 $Bq \cdot g^{-1}$**
Relative expanded uncertainty (k=2)	**1.20%** [c] [d]
Solution mass	**(5.086 ± 0.003) g** [e]
Solution density	**(1.017 ± 0.002) $g \cdot mL^{-1}$ at 21 °C** [e]

Uncertified values

Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter Wall thickness Barium content Lead-oxide content Other heavy elements	(16.5 ± 0.5) mm (0.60 ± 0.04) mm Less than 2.5% Less than 0.02% Trace quantities	
Chemical Properties:			
Solution composition	Chemical Formula	Concentration ($mol \cdot L^{-1}$)	Mass Fraction ($g \cdot g^{-1}$)
	H_2O	54	0.96
	HCl	1.0	0.04
	$BaCl_2$	4×10^{-4}	8×10^{-5}
	$^{226}RaCl_2$	3×10^{-7}	9×10^{-8}
Radiological Properties:			
Photon-emitting impurities	None detected [f]		
Half lives used	Radium-226: (1600 ± 7) a [g] [5] Radon-222: (3.8235 ± 0.0003) d [g] [5]		
Calibration method and measuring instrument(s)	Gravimetric dilution of SRM 4963, confirmed by comparison with solution standards, and derivatives thereof, from the NBS/NIST "1947 (1967 recalibrated) series" of radium-226 solution standards. The mass of radium-226 in these solution standards had previously been determined by comparison with the U.S. National Standards for radium-226. Conversion from mass of radium-226 to activity of radium-226 was done using the half life of radium-226 shown above. [h]		

*Notes and references are on pages 5 to 7.

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [c] [d]*

Input Quantity x_i, the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [i]	Relative Sensitivity Factor, $\lvert\partial y/\partial x_i\rvert \cdot (x_i/y)$ [j]	Relative Uncertainty Of Output Quantity, $u_i(y)/y$, (%) [k]
Calibration of the "1947 (1967 recalibrated) series" of radium-226 solution standards in terms of mass of radium-226 [h]	Estimated (B)	0.34	1.0	0.34
Ratio of the mass of radium-226 in SRM 4967A to the mass of radium-226 in the "1947 (1967 recalibrated) series" of radium-226 solution standards	Weighted mean of the ratios obtained using seven different comparisons (B)	0.15	1.0	0.15
Corrections for the decay of radium-226	Standard uncertainty of the radium-226 half-life (A) [m]	0.44	0.016 [n]	0.007
Gravimetric measurements	Estimated (B)	0.10	1.0	0.10
Conversion of radium-226 mass to activity [p]	Standard uncertainty of the radium-226 half-life (A) [q]	0.44	1.0	0.44
Photon-emitting impurities	Limit of detection (B) [r]	100.	0.0001	0.01
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.6
Coverage Factor, k				x 2
Relative Expanded Uncertainty of the Output Quantity, U/y, (%)				1.2

*Notes and references are on pages 5 to 7.

NOTES

[a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.

Distance from Ampoule (cm):	1	10	100
Approximate Dose Rate (μSv/h):	5	0.4	-

[b] **Massic activity** is the preferred name for the quantity activity divided by the total mass of the sample. See reference [1].

[c] The reported value, y, of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \ldots x_n)$, where f is a mathematical function derived from the assumed model of the measurement process. The value, x_i, used for each input quantity i has a **standard uncertainty**, $u(x_i)$, that generates a corresponding uncertainty in y, $u_i(y) \equiv |\partial y/\partial x_i| \cdot u(x_i)$, called a **component of combined standard uncertainty** of y. The **combined standard uncertainty** of y, $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty. The combined standard uncertainty is multiplied by a **coverage factor** of $k = 2$ to obtain U, the **expanded uncertainty** of y.

Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.

For further information on the expression of uncertainties, see references [2] and [3].

[d] The value of each component of combined standard uncertainty, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic response is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).

[e] The stated uncertainty is two times the standard uncertainty.

[f] Estimated limits of detection for photon-emitting impurities, as of the reference time, expressed as massic photon emission rates, are:
6×10^0 $s^{-1} \cdot g^{-1}$ for energies between 22 and 182 keV,
3×10^0 $s^{-1} \cdot g^{-1}$ for energies between 190 and 347 keV,
8×10^{-1} $s^{-1} \cdot g^{-1}$ for energies between 356 and 1455 keV, and
3×10^{-1} $s^{-1} \cdot g^{-1}$ for energies between 1465 and 2750 keV,
provided that the photons are separated in energy by 4 keV or more from photons emitted in the decay of radium-226 and progeny.

[g] The stated uncertainty is the standard uncertainty.

[h] For further details on NBS/NIST radium series calibrations refer to reference [6]. The 1967 recalibrations of the "1947 series" and of the "1957 series" were made using pressurized "4π"γ ionization chamber (PIC) "A".

The master solution for SRM 4967A was directly compared with the "1947 (1967 recalibrated) series" of radium-226 solution standards using PIC "A", and was compared with solutions of the "1992 series" of radium solution standards (SRM 4967) using PIC "A", pulse-ionization-chamber radon analyses (see references [7] and [8]), and germanium photon spectrometry.

The radium-226 in SRM 4967A was chemically purified approximately 55 years ago. The lead-210 and its daughter radionuclides are not in equilibrium.

[i] Relative standard uncertainty of the input quantity x_i.

[j] The relative change in the output quantity y divided by the relative change in the input quantity x_i. If $|\partial y/\partial x_i|\cdot(x_i/y) = 1.0$, then a 1% change in x_i results in a 1% change in y. If $|\partial y/\partial x_i|\cdot(x_i/y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y.

k] Relative component of combined standard uncertainty of output quantity y, rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y \equiv |\partial y/\partial x_i|\cdot u(x_i)/y = |\partial y/\partial x_i|\cdot(x_i/y)\cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i|\cdot(x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.

[m] The relative standard uncertainty of $\lambda\cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.

[n] $|\partial y/\partial x_i|\cdot(x_i/y) = |\lambda\cdot t|$

[p] The U.S. National Standards for radium-226 are certified in terms of mass of radium-226, as were all radium-226 SRMs prior to the "1992 series". Beginning with the "1992 series", radium-226 solution SRMs are now certified in terms of the massic activity of radium-226.

[q] The relative standard uncertainty of the activity of radium-226 per unit mass of radium-226 is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainties of the atomic weight of radium-226 and of Avogadro's number are negligible.

[r] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i =$ 100%. $|\partial y/\partial x_i|\cdot(x_i/y) =$ {(response per Bq of impurity)/(response per Bq of Ra-226)}·{(Bq of impurity)/(Bq of Ra-226)}. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a massic activity equal to the estimated limit of detection.

REFERENCES

[1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.

[2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993 (corrected and reprinted, 1995). Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.

[3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.

[4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.

[5] Evaluated Nuclear Structure Data File (ENSDF), September 2003.

[6] W.B. Mann, L.L. Stockman, W.J. Youden, A. Schwebel, P.A. Mullen and S.B. Garfinkel, Preparation of New Solution Standards of Radium, *Journal of Research of the National Bureau of Standards* **62** (1959) 21-26.

[7] R. Collé, J.M.R. Hutchinson and M.P. Unterweger, The NIST Primary Radon-222 Measurement System, *Journal of Research of the National Institute of Standards and Technology* **95** (1990) 155-165.

[8] J.M.R. Hutchinson, J. Cessna, R. Collé and P. Hodge, An International Radon-In-Air Measurement Intercomparison Using a New Transfer Standard, *Applied Radiation and Isotopes* **43** (1992) 175-189.

PARAGON ANALYTICS
Radiochemistry Data Package

Section 9

ADDITIONAL SUPPORTING DOCUMENTATION

9

^{226}Ra by Rn Emanation Calibration Package for Detectors E, B, C, D, F, and A

JAP 1/29/08 DBC 1/29/08

Voltage Plateau
Data

1/28/08 1/28/08

PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

^{230}Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES

DATE: 1/22/2008 ANALYST: DBC

DETECTOR/SCALAR: 3E

VOLTS	COUNTS
600	0
700	0
800	0
900	11
1000	2321
1100	8114
1200	9257
1300	9402
1400	9581

BACKGROUND (NO SOURCE) COUNTED MULTIPLE TIMES FOR 1 MINUTE AT SPECIFIED OPERATING VOLTAGES.

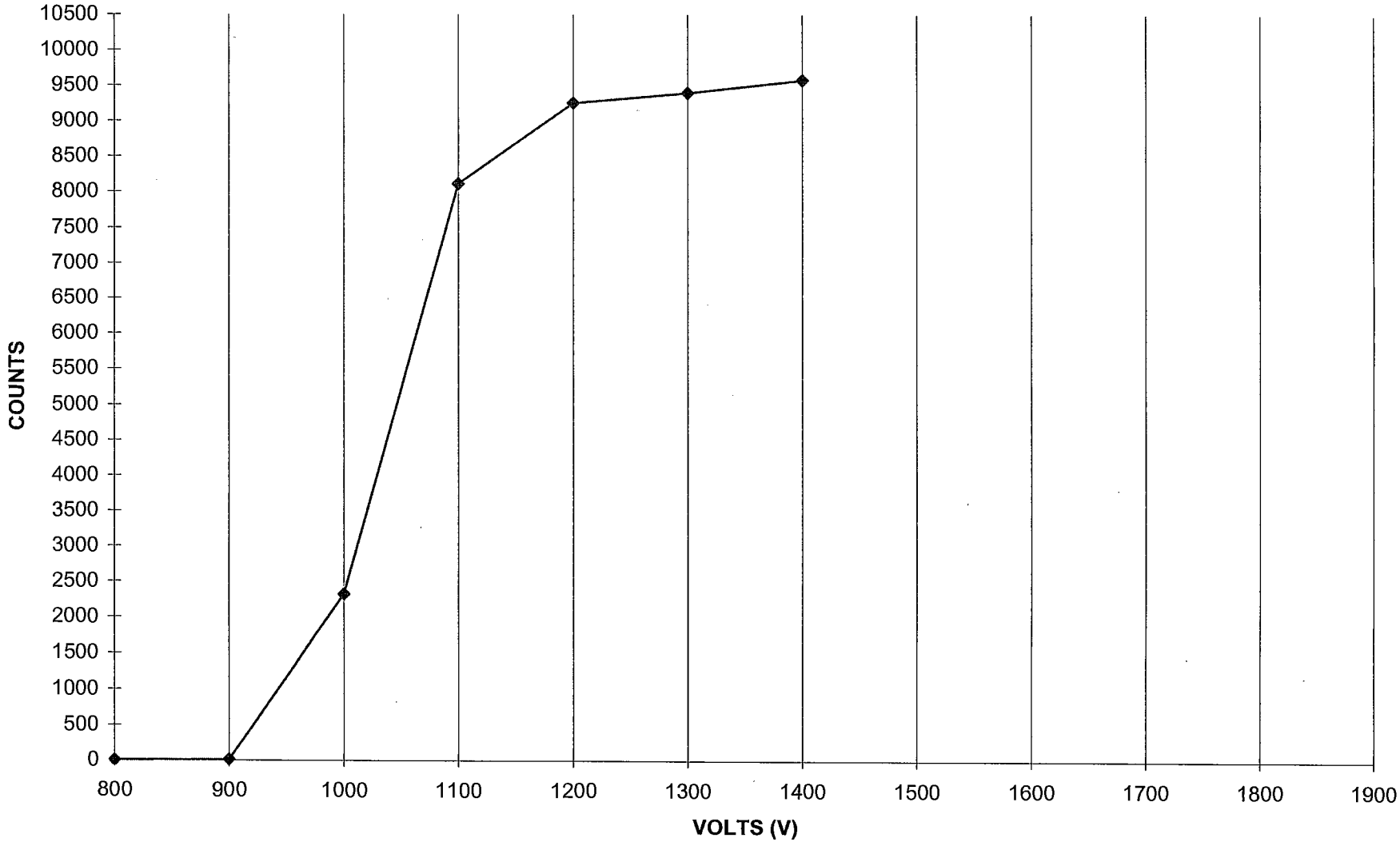
VOLTS	COUNTS (1)	COUNTS (2)	COUNTS (3)	COUNTS (4)	COUNTS (5)
1200	0	0	0	0	0
1300	2	0	0	1	0
1400	3	3	3	2	1

The operating voltage chosen should be the point on the plateau that also gives the lowest possible background counts. Therefore, it is the analyst's opinion that the operating voltage for scalar/detector 3E be set at 1300 V.

REVIEWED BY: DEREK CADUFF

DBC 1/28/08

OPERATING VOLTAGE FOR DETECTOR/SCALAR 3E



PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

^{230}Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES

DATE: 1/22/2008 ANALYST: DBC

DETECTOR/SCALAR: 2B

VOLTS	COUNTS
600	0
700	1010
800	5676
900	8860
1000	9468
1100	9661
1200	9615
1300	9511
1400	9530

BACKGROUND (NO SOURCE) COUNTED MULTIPLE TIMES FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES.

VOLTS	COUNTS (1)	COUNTS (2)	COUNTS (3)	COUNTS (4)	COUNTS (5)
1000	0	0	0	0	0
1100	0	0	0	0	0
1200	0	0	0	0	0
1300	4	7	5	4	3

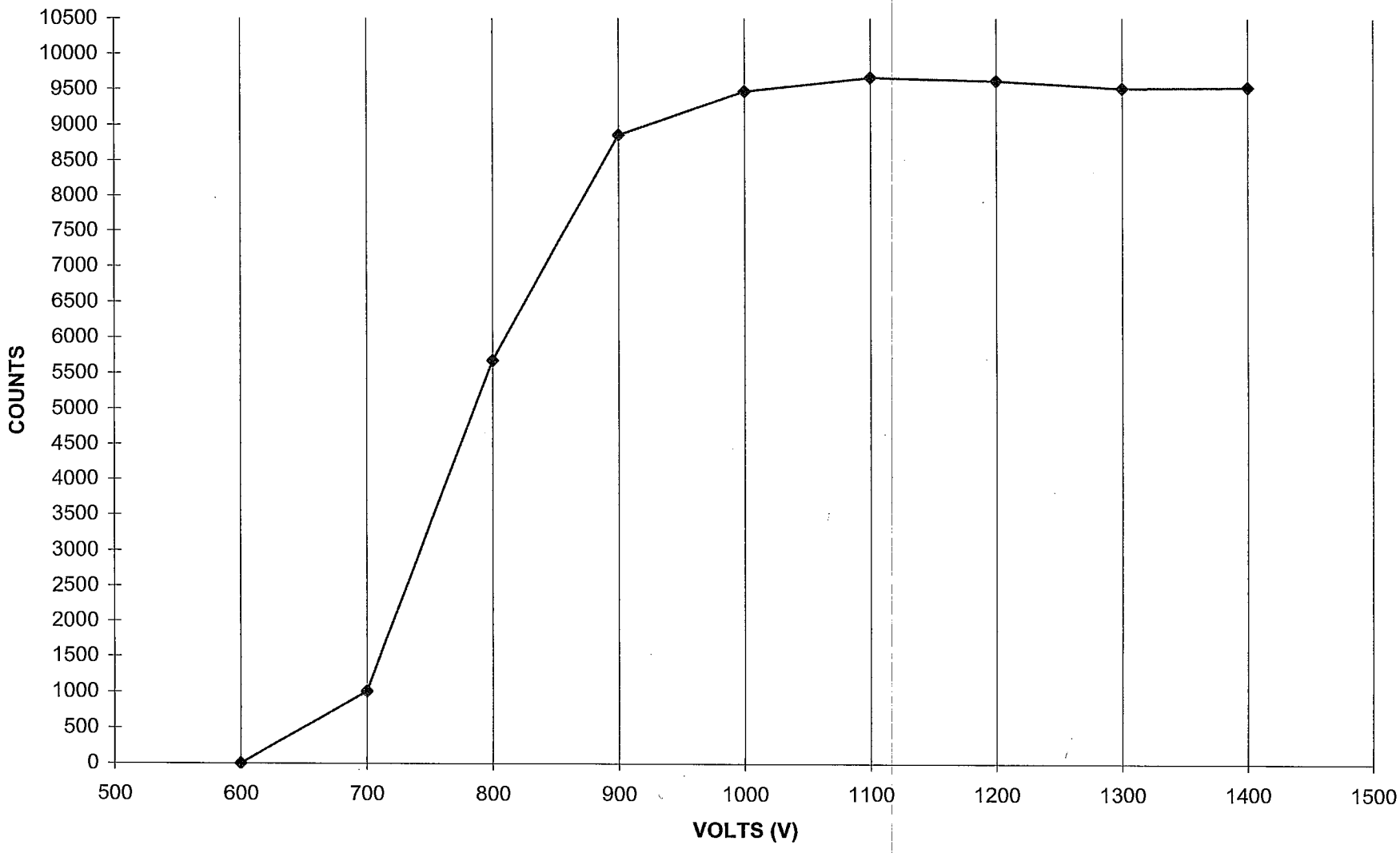
The operating voltage chosen should be the point on the plateau that also gives the lowest possible background counts. Therefore, it is the analyst's opinion that the operating voltage for scalar/detector 2B be set at 1100 V.

REVIEWED BY: DEREK CADUFF

DBC 1/28/08

PLATEAU

OPERATING VOLTAGE FOR DETECTOR/SCALAR 2B



PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

^{230}Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES

DATE:	1/22/2008	ANALYST:	DBC
DETECTOR/SCALAR:		6C	

VOLTS	COUNTS
600	44
700	5504
800	9187
900	9465
1000	9621
1100	9469
1200	9585

BACKGROUND (NO SOURCE) COUNTED MULTIPLE TIMES FOR 1 MINUTE AT SPECIFIED OPERATING VOLTAGES

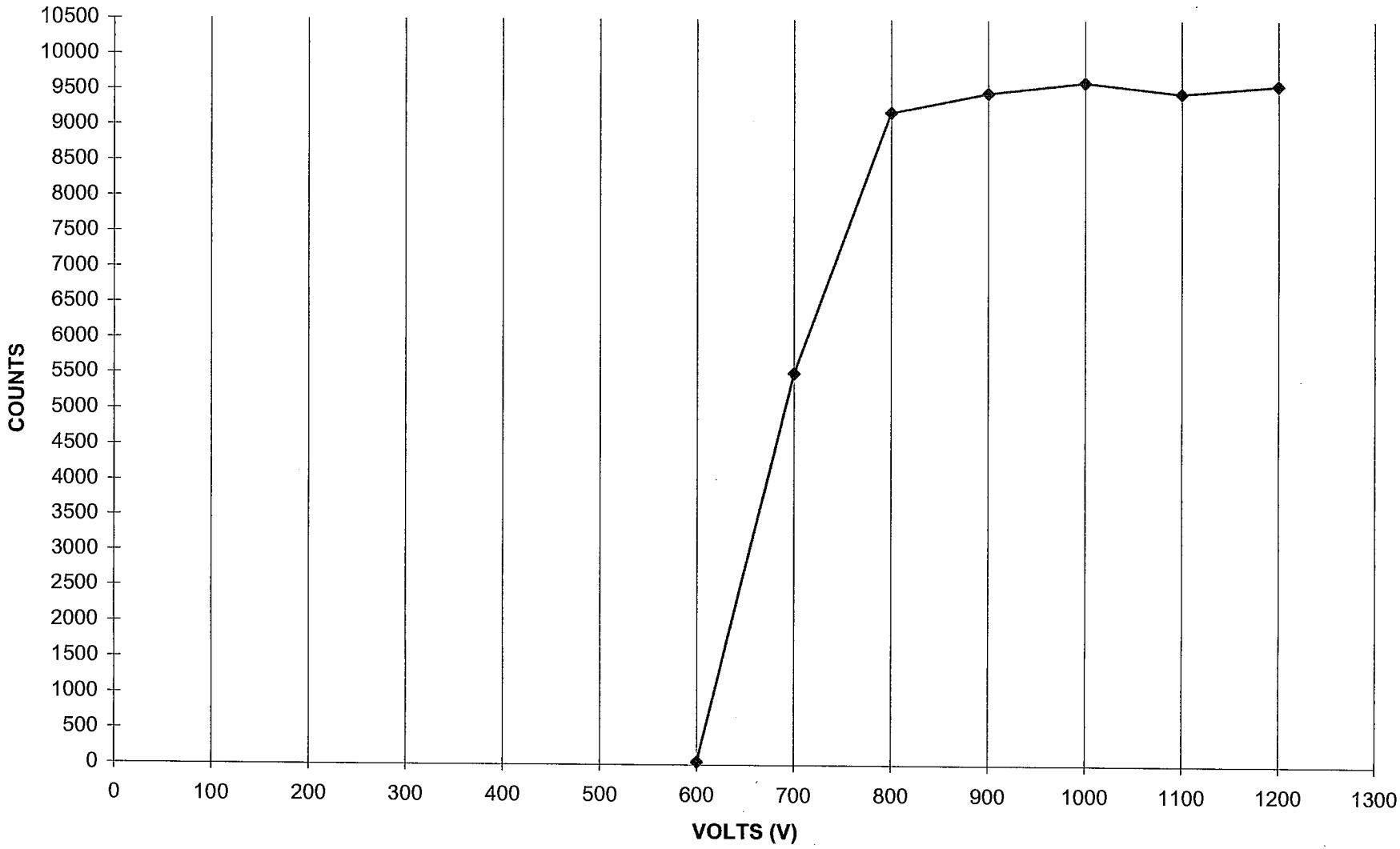
VOLTS	COUNTS (1)	COUNTS (2)	COUNTS (3)	COUNTS (4)	COUNTS (5)
800	0	0	0	0	0
900	0	0	0	0	0
1000	0	0	0	0	0
1100	4	4	0	2	2

The operating voltage chosen should be the point on the plateau that also gives the lowest possible background counts. Therefore, it is the analyst's opinion that the operating voltage for scalar/detector 6C be set at 900 V.

REVIEWED BY: DEREK CADUFF

DRC 1/28/08

OPERATING VOLTAGE FOR DETECTOR/SCALAR



PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

^{230}Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES

DATE: 1/22/2008 ANALYST: DBC

DETECTOR/SCALAR: 5D

VOLTS	COUNTS
600	2234
700	8562
800	9425
900	9449
1000	9437
1100	9576
1200	9590
1300	11104

BACKGROUND (NO SOURCE) COUNTED MULTIPLE TIMES FOR 1 MINUTE AT SPECIFIED OPERATING VOLTAGES

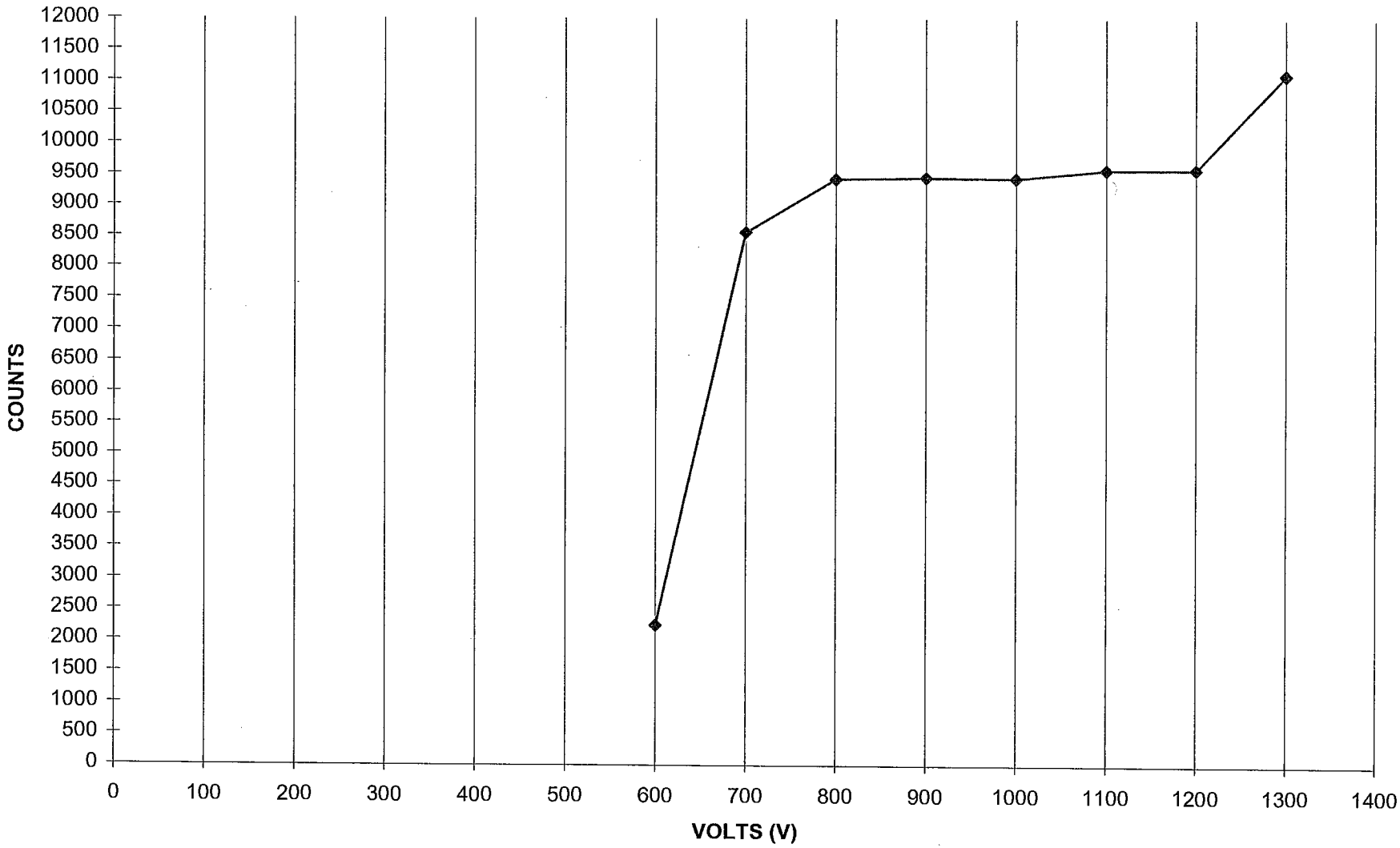
VOLTS	COUNTS (1)	COUNTS (2)	COUNTS (3)	COUNTS (4)	COUNTS (5)
800	0	0	0	0	0
900	0	0	0	0	0
1000	1	3	7	6	2

The operating voltage chosen should be the point on the plateau that also gives the lowest possible background counts. Therefore, it is the analyst's opinion that the operating voltage for scalar/detector 5D be set at 900 V.

REVIEWED BY: DEREK CADUFF

DBC 1/28/08

OPERATING VOLTAGE FOR DETECTOR/SCALAR



PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

^{230}Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES

DATE: 1/22/2008 ANALYST: DBC

DETECTOR/SCALAR: 1F

VOLTS	COUNTS
600	99
700	7072
800	9266
900	9509
1000	9566
1100	9630
1200	9605
1300	13242

BACKGROUND (NO SOURCE) COUNTED MULTIPLE TIMES FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES.

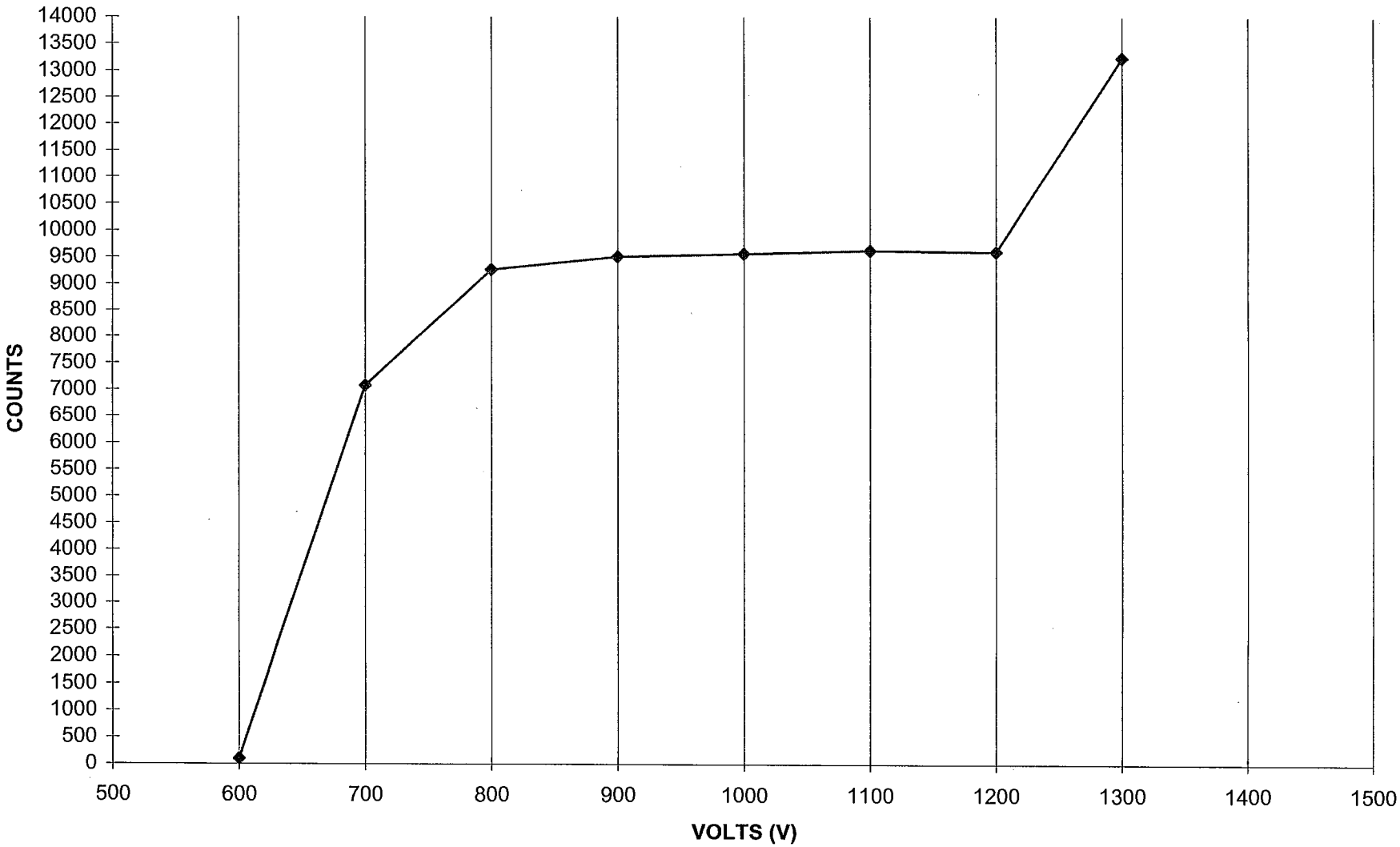
VOLTS	COUNTS (1)	COUNTS (2)	COUNTS (3)	COUNTS (4)	COUNTS (5)
800	0	0	0	0	0
900	0	0	0	0	0
1000	0	0	0	0	1
1100	2	3	4	6	5

The operating voltage chosen should be the point on the plateau that also gives the lowest possible background counts. Therefore, it is the analyst's opinion that the operating voltage for scalar/detector 1F be set at 900 V.

REVIEWED BY: DEREK CADUFF

DBC
1/28/08

OPERATING VOLTAGE FOR DETECTOR/SCALAR 1F



PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

^{230}Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES

DATE: 1/22/2008 ANALYST: DBC

DETECTOR/SCALAR: 7A

VOLTS	COUNTS
600	0
700	240
800	6828
900	8964
1000	9447
1100	9534
1200	9563
1300	9566
1400	9737

BACKGROUND (NO SOURCE) COUNTED MULTIPLE TIMES FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES.

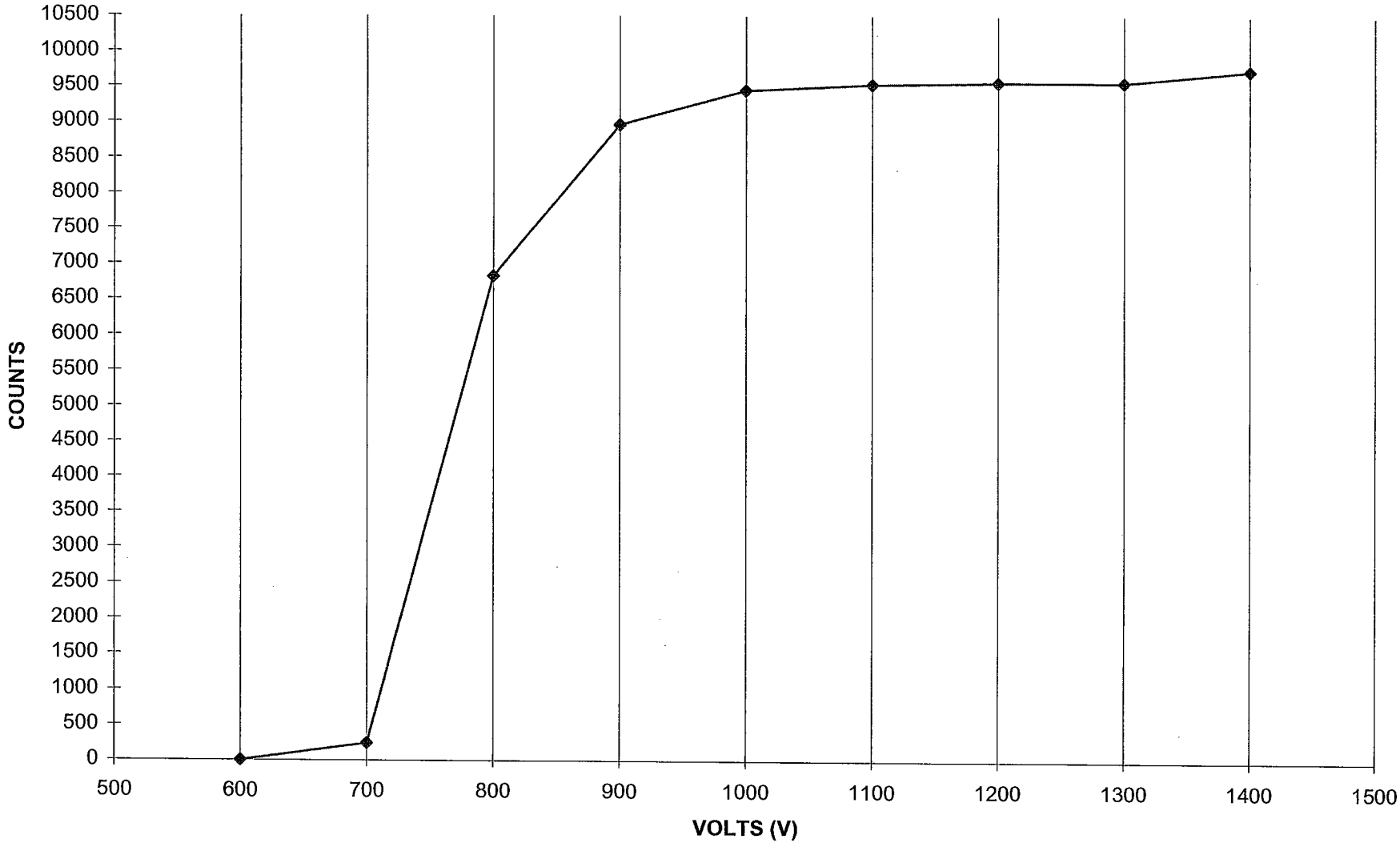
VOLTS	COUNTS (1)	COUNTS (2)	COUNTS (3)	COUNTS (4)	COUNTS (5)
1000	0	0	0	0	0
1100	0	0	0	0	0
1200	0	0	0	0	1
1300	1	1	5	2	1
1400	11				

The operating voltage chosen should be the point on the plateau that also gives the lowest possible background counts. Therefore, it is the analyst's opinion that the operating voltage for scalar/detector 7A be set at 1100 V.

REVIEWED BY: DEREK CADUFF

DRC
1/29/08

OPERATING VOLTAGE FOR DETECTOR/SCALAR 7A



Voltage Plateaus for Counters 3E, 2B, 6C, 5D, 1F, & 7A
(Cth Source for 1 minute @ each voltage)

Volts (kV)	3E	2B	6C	5D	1F	7A
0.6	0	0	44	2234	99	0
0.7	0	1010	5504	8562	7072	240
0.8	0	5676	9187	9425	9266	6828
0.9	11	8860	9465	9449	9509	8964
1.0	2321	9468	9621	9437	DBC 1/22/08 ~~9415~~ 9366	9447
1.1	8114	9661	9469	9576	9630	9534
1.2	9257	9615	9585	9590	DBC 1/22/08 ~~9509~~ 9605	9563
1.3	9402	9511	DBC 1/22/08	11104	13242	9566
1.4	9581	9530		DBC 1/22/08	DBC 1/22/08	9737

Background Counts (no source) at plateau energies.

Volts (kV)	3E	2B	6C	5D	1F	7A
0.8	DBC 1/22/08	DBC 1/22/08	0,0,0,0,0	0,0,0,0,0	0,0,0,0,0	DBC 1/22/08
0.9			0,0,0,0,0	0,0,0,0,0	0,0,0,0,0	
1.0		0,0,0,0,0	0,0,0,0,0	1,3,7,6,2	0,0,0,0,1	0,0,0,0,0
1.1		0,0,0,0,0	4,4,0,2,2	DBC 1/22/08	2,3,4,6,5	0,0,0,0,0
1.2	0,0,0,0,0	0,0,0,0,0	DBC 1/22/08		DBC 1/22/08	0,0,0,0,1
1.3	2,0,0,1,0	4,7,5,4,3				1,1,5,2,1
1.4	3,3,3,2,1	DBC 1/22/08				1 DBC 1/22/08

DBC 1/22/08

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
[signature]	1/22/08	[signature]	1/28/08

Efficiency Data

1/29/08 DBC 1/28/08

Lucas Cell + PMT Calibration Control Summary																								
r:\inst\alphscnt\cell_cal.xls																								
Acceptance criteria: Passing ICV (control limits = 85-115%; warning limits = 90-110%- Requires Technical Manager Approval)																								
Det+Flask ID																								
Date	E1		E2		E3		E4		E6		E7		E8		E9		E10		E12		E13		E14	
1/22/08-1/28/08	0.7978	PASS	1.8485	PASS	1.7566	PASS	1.3782	PASS	DNU	FAIL	DNU	FAIL	1.0563	PASS	DNU	FAIL	1.4829	PASS	1.4357	PASS	DNU	FAIL	1.5452	PASS
DNU = DO NOT USE																								
WRN = OUTSIDE WARNING LIMIT - APPROVED BY TM																								
	DBC 1/28/2008																							
	Reviewed By/Date																							

DBC
1/28/08

Lucas Cell + PMT Calibration Control Summary																								
r:\inst\alphscnt\cell_cal.xls																								
Acceptance criteria: Passing ICV (control limits = 85-115%; warning limits = 90-110%- Requires Technical Manager Approval)																								
Det+Flask ID																								
Date	B1		B2		B3		B4		B6		B7		B8		B9		B10		B12		B13		B14	
1/22/08-1/28/08	1.1596	PASS	2.1437	PASS	2.1494	PASS	1.7236	PASS	DNU	FAIL	DNU	FAIL	1.4216	PASS	DNU	FAIL	1.7115	PASS	1.5562	PASS	DNU	FAIL	1.9359	PASS
DNU = DO NOT USE																								
WRN = OUTSIDE WARNING LIMIT - APPROVED BY TM																								
	DBC 1/28/2008																							
	REVIEWED BY/DATE:																							

PBC 1/28/08

Lucas Cell + PMT Calibration Control Summary																								
r:\Inst\alphscnt\cell_cal.xls																								
Acceptance criteria: Passing ICV (control limits = 85-115%; warning limits = 90-110%- Requires Technical Manager Approval)																								
Det+Flask ID																								
Date	C20		C21		C22		C23		C24		C25		C26		C27		C28		C29		C30		C31	
1/22/08-1/28/08	1.7083	PASS	2.0763	PASS	1.5201	PASS	DNU	FAIL	2.2715	PASS	2.5487	PASS	2.1382	PASS	2.1902	PASS	2.2615	PASS	DNU	FAIL	2.0223	PASS	1.803	PASS
DNU = DO NOT USE																								
WRN = OUTSIDE WARNING LIMIT - APPROVED BY TM																								
	DBC 1/28/2008																							
	Reviewed By/Date																							

DBC
1/28/08

Lucas Cell + PMT Calibration Control Summary																								
r:\ins\alphscn\cell_cal.xls																								
Acceptance criteria: Passing ICV (control limits = 85-115%; warning limits = 90-110%- Requires Technical Manager Approval)																								
Det+Flask ID																								
Date	D20		D21		D22		D23		D24		D25		D26		D27		D28		D29		D30		D31	
1/22/08-1/28/08	1.7360	PASS	2.2537	PASS	1.6369	PASS	DNU	FAIL	2.3404	PASS	2.5764	PASS	2.1990	PASS	2.2736	PASS	2.2390	PASS	DNU	FAIL	2.0905	PASS	1.9333	PASS
DNU = DO NOT USE																								
WRN = OUTSIDE WARNING LIMIT - APPROVED BY TM																								
	DBC1/28/2008																							
	Reviewed By/Date																							

ABC
1/28/08

Lucas Cell + PMT Calibration Control Summary

r:\inst\alphscnt\cell_cal.xls

Acceptance criteria: Passing ICV (control limits = 85-115%; warning limits = 90-110%- Requires Technical Manager Approval)

Det+Flask ID																								
Date	F40		F41		F42		F43		F44		F45		F46		F47		F48		F49		F50		F51	
1/22/08-1/28/08	1.6392	PASS	1.3938	PASS	1.098	PASS	DNU	FAIL	1.5943	PASS	2.0014	PASS	1.5765	PASS	1.6724	PASS	1.7657	PASS	1.2701	PASS	1.6386	PASS	1.4338	PASS

DNU = DO NOT USE

WRN = OUTSIDE WARNING LIMIT - APPROVED BY TM

DBC 1/28/2008

REVIEWED BY/DATE

DBC 1/28/08

Lucas Cell + PMT Calibration Control Summary

r:\inst\alphscnt\cell_cal.xls

Acceptance criteria: Passing ICV (control limits = 85-115%; warning limits = 90-110%- Requires Technical Manager Approval)

Det+Flask ID																								
Date	A40		A41		A42		A43		A44		A45		A46		A47		A48		A49		A50		A51	
1/22/08-1/28/08	1.8606	PASS	1.7646	PASS	1.2912	PASS	DNU	FAIL	1.649	PASS	2.0444	PASS	1.8767	PASS	1.9931	PASS	2.0284	PASS	1.5259	PASS	2.0128	PASS	1.7681	PASS

DNU = DO NOT USE

WRN = OUTSIDE WARNING LIMIT - APPROVED BY TM

DBC 1/28/2008

REVIEWED BY/DATE

DBC 1/28/08

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Calibration results

Analyst:	DBC							
Prep. Date S:	6/28/07		Count Date:	1/22/2008				
Prep. Date C:	6/29/07							
SOP Used:	783R8							
	S	Flask	Counter	Scaler	Ra-226			
W.O.#	ID	No.	No.	No.	Standard (dpm)	Efficiency		
07-18-511	S1	1	E	3	207.7580976	0.7977688		
07-18-511	S2	2	E	3	207.7580976	1.848513		
07-18-511	S3	20	C	6	207.7580976	1.7082969		
07-18-511	S4	21	C	6	207.7580976	2.0763298		
07-18-511	S5	40	F	1	207.7580976	1.639157		
07-18-511	S6	41	F	1	207.7580976	1.3938188		
07-18-511	S7	3	E	3	207.7580976	1.7565539		
07-18-511	S8	4	E	3	207.7580976	1.3782333		
07-18-511	S9	22	C	6	207.7580976	1.5201218		
07-18-511	S10	23	C	6	207.7580976	2.3026726	DNU	
07-18-511	S11	42	F	1	207.7580976	1.0979817		
07-18-511	S15	24	C	6	207.7580976	2.2714748		
07-18-511	S16	25	C	6	207.7580976	2.5486318		
07-18-511	S17	44	F	1	207.7580976	1.5942851		
07-18-511	S18	45	F	1	207.7580976	2.0014241		
07-18-511	S19	8	E	3	207.7580976	1.0563265		
07-18-511	S20	9	E	3	207.7580976	1.0996704	DNU	
07-18-511	S21	26	C	6	207.7580976	2.1382291		
07-18-511	S22	27	C	6	207.7580976	2.1901674		
07-18-511	S23	46	F	1	207.7580976	1.5764762		
07-18-511	S24	47	F	1	207.7580976	1.672366		
07-18-511	S25	10	E	3	207.7580976	1.4828584		
07-18-511	S26	12	E	3	207.7580976	1.4357462		
07-18-511	S27	28	C	6	207.7580976	2.2614498		
07-18-511	S28	29	C	6	207.7580976	1.8777033	DNU	
07-18-511	S29	48	F	1	207.7580976	1.7657043		
07-18-511	S31	13	E	3	207.7580976	1.0322401	DNU	
07-18-511	S32	14	E	3	207.7580976	1.5452462		
07-18-511	S33	30	C	6	207.7580976	2.0222551		
07-18-511	S34	31	C	6	207.7580976	1.8029628		
07-18-511	S35	50	F	1	207.7580976	1.6385888		
07-18-511	S36	51	F	1	207.7580976	1.4338387		
07-18-511	S37	6	E	3	207.7580976	1.1240668	DNU	
07-18-511	S38	7	E	3	207.7580976	0.7060916	DNU	
07-18-511	S39	43	F	1	207.7580976	0.5571336	DNU	
07-18-511	S40	49	F	1	207.7580976	1.2700839		

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Calibration results

Analyst:	DBC							
Prep. Date S:	6/28/07		Count Date:	1/22/2008-1/25/2008				
Prep. Date C:	6/29/07							
SOP Used:	783R8							
	S	Flask	Counter	Scaler	Ra-226			
W.O.#	ID	No.	No.	No.	Standard (dpm)	Efficiency		
07-18-511	S1	1	B	2	207.7580976	1.1595808		
07-18-511	S2	2	B	2	207.7580976	2.1436964		
07-18-511	S3	20	D	5	207.7580976	1.735986		
07-18-511	S4	21	D	5	207.7580976	2.253706		
07-18-511	S5	40	A	7	207.7580976	1.8605855		
07-18-511	S6	41	A	7	207.7580976	1.7646271		
07-18-511	S7	3	B	2	207.7580976	2.149382		
07-18-511	S8	4	B	2	207.7580976	1.7236032		
07-18-511	S9	22	D	5	207.7580976	1.6369304		
07-18-511	S10	23	D	5	207.7580976	2.2530657	DNU	
07-18-511	S11	42	A	7	207.7580976	1.2911787		
07-18-511	S15	24	D	5	207.7580976	2.3404375		
07-18-511	S16	25	D	5	207.7580976	2.576373		
07-18-511	S17	44	A	7	207.7580976	1.6490275		
07-18-511	S18	45	A	7	207.7580976	2.0443771		
07-18-511	S19	8	B	2	207.7580976	1.4215988		
07-18-511	S20	9	B	2	207.7580976	1.4469325	DNU	
07-18-511	S21	26	D	5	207.7580976	2.1989826		
07-18-511	S22	27	D	5	207.7580976	2.2735873		
07-18-511	S23	46	A	7	207.7580976	1.8766792		
07-18-511	S24	47	A	7	207.7580976	1.9931225		
07-18-511	S25	10	B	2	207.7580976	1.7115183		
07-18-511	S26	12	B	2	207.7580976	1.5561908		
07-18-511	S27	28	D	5	207.7580976	2.2389922		
07-18-511	S28	29	D	5	207.7580976	1.9501605	DNU	
07-18-511	S29	48	A	7	207.7580976	2.0283573		
07-18-511	S30	49	A	7	207.7580976	1.5259116		
07-18-511	S31	13	B	2	207.7580976	1.363195	DNU	
07-18-511	S32	14	B	2	207.7580976	1.9359373		
07-18-511	S33	30	D	5	207.7580976	2.0905387		
07-18-511	S34	31	D	5	207.7580976	1.9332865		
07-18-511	S35	50	A	7	207.7580976	2.0128009		
07-18-511	S36	51	A	7	207.7580976	1.7681064		
07-18-511	S37	6	B	2	207.7580976	1.3988754	DNU	
07-18-511	S38	7	B	2	207.7580976	0.9513572	DNU	
07-18-511	S39	43	A	7	207.7580976	0.6863255	DNU	
07-18-511	S40	49	A	7	207.7580976	1.5556346		

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: DBC
Prep. Date S: 10/5/2007
Prep. Date C: 10/5/2007
SOP Used: 783R8

		S	Purge (end)							Deeman. (end)		Count Start		Count		
	S	V	Date	Time	Flask	Counter	Scaler	CBKG	CBKG	Date	Time	Date	Time	Duration	COUNT	REMARKS
W.O.#	ID	(L)	D1	T1	No.	No.	No.	#	(CORR.)	D2	T2	D3	T3	(min.)	#	
07-18-511	S1	1	10/5/2007	16:15	1	E	3	65	65	1/22/2008	11:26	1/22/2008	15:26	65	10475	
07-18-511	S2	1	10/5/2007	16:15	2	E	3	26	26	1/22/2008	11:26	1/22/2008	16:32	30	11091	
07-18-511	S3	1	10/5/2007	16:15	20	C	6	17	17	1/22/2008	11:26	1/22/2008	15:26	30	10328	
07-18-511	S4	1	10/5/2007	16:15	21	C	6	17	17	1/22/2008	11:26	1/22/2008	15:58	30	12499	
07-18-511	S5	1	10/5/2007	16:15	40	F	1	2	2	1/22/2008	11:26	1/22/2008	15:26	35	11541	
07-18-511	S6	1	10/5/2007	16:15	41	F	1	2	2	1/22/2008	11:26	1/22/2008	16:03	40	11160	
07-18-511	S7	1	10/5/2007	16:15	3	E	3	37	37	1/22/2008	12:26	1/22/2008	17:03	30	10590	
07-18-511	S8	1	10/5/2007	16:15	4	E	3	34	34	1/22/2008	12:26	1/22/2008	17:53	40	10998	
07-18-511	S9	1	10/5/2007	16:15	22	C	6	14	14	1/22/2008	12:26	1/22/2008	16:29	35	10711	
07-18-511	S10	1	10/5/2007	16:15	23	C	6	8	8	1/22/2008	12:26	1/22/2008	17:07	30	13835	
07-18-511	S11	1	10/5/2007	16:15	42	F	1	11	11	1/22/2008	12:26	1/22/2008	16:48	50	11012	
07-18-511	S15	1	10/5/2007	16:15	24	C	6	9	9	1/23/2008	10:05	1/23/2008	14:15	30	13702	
07-18-511	S16	1	10/5/2007	16:15	25	C	6	9	9	1/23/2008	10:05	1/23/2008	14:47	30	15311	
07-18-511	S17	1	10/5/2007	16:15	44	F	1	2	2	1/23/2008	10:05	1/23/2008	14:15	35	11211	
07-18-511	S18	1	10/5/2007	16:15	45	F	1	2	2	1/23/2008	10:05	1/23/2008	14:52	30	12011	
07-18-511	S19	1	10/5/2007	16:15	8	E	3	72	72	1/23/2008	11:18	1/23/2008	15:44	60	12758	
07-18-511	S20	1	10/5/2007	16:15	9	E	3	50	50	1/23/2008	11:18	1/23/2008	16:48	50	10974	
07-18-511	S21	1	10/5/2007	16:15	26	C	6	27	27	1/23/2008	11:18	1/23/2008	15:18	30	12933	
07-18-511	S22	1	10/5/2007	16:15	27	C	6	7	7	1/23/2008	11:18	1/23/2008	15:49	30	13175	
07-18-511	S23	1	10/5/2007	16:15	46	F	1	2	2	1/23/2008	11:18	1/23/2008	15:30	35	11083	
07-18-511	S24	1	10/5/2007	16:15	47	F	1	3	3	1/23/2008	11:18	1/23/2008	16:11	30	10030	
07-18-511	S25	1	10/5/2007	16:15	10	E	3	57	57	1/23/2008	12:14	1/23/2008	17:42	45	13322	
07-18-511	S26	1	10/5/2007	16:15	12	E	3	45	45	1/23/2008	12:14	1/23/2008	18:27	45	12816	
07-18-511	S27	1	10/5/2007	16:15	28	C	6	16	16	1/23/2008	12:14	1/23/2008	16:22	30	13652	
07-18-511	S28	1	10/5/2007	16:15	29	C	6	8	8	1/23/2008	12:14	1/23/2008	16:53	30	11286	
07-18-511	S29	1	10/5/2007	16:15	48	F	1	1	1	1/23/2008	12:14	1/23/2008	16:42	30	10621	
07-18-511	S30	1	10/5/2007	16:15	49	F	1	51	51	1/23/2008	12:14	1/23/2008	17:21	45	10890	
07-18-511	S31	1	10/5/2007	16:15	13	E	3	61	61	1/24/2008	10:00	1/24/2008	14:00	50	10432	
07-18-511	S32	1	10/5/2007	16:15	14	E	3	21	21	1/24/2008	10:00	1/24/2008	14:50	40	12371	
07-18-511	S33	1	10/5/2007	16:15	30	C	6	12	12	1/24/2008	10:00	1/24/2008	14:00	30	12218	
07-18-511	S34	1	10/5/2007	16:15	31	C	6	5	5	1/24/2008	10:00	1/24/2008	14:31	30	10845	
07-18-511	S35	1	10/5/2007	16:15	50	F	1	8	8	1/24/2008	10:00	1/24/2008	14:00	35	11543	
07-18-511	S36	1	10/5/2007	16:15	51	F	1	4	4	1/24/2008	10:00	1/24/2008	14:36	35	10052	
07-18-511	S37	1	10/5/2007	16:15	6	E	3	61	61	1/24/2008	10:58	1/24/2008	15:32	45	10185	
07-18-511	S38	1	10/5/2007	16:15	7	E	3	64	64	1/24/2008	10:58	1/24/2008	16:29	45	6378	TRANS. ERROR/DO NOT USE
07-18-511	S39	1	10/5/2007	16:15	43	F	1	8	8	1/24/2008	10:58	1/24/2008	15:14	30	3364	TRANS. ERROR/DO NOT USE
07-18-511	S40	1	10/5/2007	16:15	49	F	1	116	116	1/24/2008	10:58	1/24/2008	15:51	40	10263	

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
783.3020.77	Ra 226	2.0	rs015	208	1/28/2005

Spiked by: DBC on 10/5/2007
Spike Witness: EMF
Reviewed by: DBC

1/29/2008.....11:17 AM

R:\A-RA-SR\REMCALIB\0108ECF

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: DBC
Prep. Date S: 10/5/2007
Prep. Date C: 10/5/2007
SOP Used: 783R8

		S	Purge (end)							Deeman. (end)		Count Start		Count		
	S	V	Date	Time	Flask	Counter	Scaler	CBKG	CBKG	Date	Time	Date	Time	Duration	COUNT	REMARKS
W.O.#	ID	(L)	D1	T1	No.	No.	No.	#	(CORR.)	D2	T2	D3	T3	(min.)	#	
07-18-511	S1	1	10/5/2007	16:15	1	B	2	30	30	1/22/2008	11:26	1/22/2008	16:32	50	11584	
07-18-511	S2	1	10/5/2007	16:15	2	B	2	24	24	1/22/2008	11:26	1/22/2008	15:26	30	12963	
07-18-511	S3	1	10/5/2007	16:15	20	D	5	19	19	1/22/2008	11:26	1/22/2008	15:58	30	10455	
07-18-511	S4	1	10/5/2007	16:15	21	D	5	16	16	1/22/2008	11:26	1/22/2008	15:26	30	13619	
07-18-511	S5	1	10/5/2007	16:15	40	A	7	6	6	1/22/2008	11:26	1/22/2008	16:03	30	11184	
07-18-511	S6	1	10/5/2007	16:15	41	A	7	9	9	1/22/2008	11:26	1/22/2008	15:26	30	10660	
07-18-511	S7	1	10/5/2007	16:15	3	B	2	23	23	1/22/2008	12:26	1/22/2008	17:53	30	12855	
07-18-511	S8	1	10/5/2007	16:15	4	B	2	14	14	1/22/2008	12:26	1/22/2008	17:23	30	10343	
07-18-511	S9	1	10/5/2007	16:15	22	D	5	21	21	1/22/2008	12:26	1/22/2008	17:07	35	11485	
07-18-511	S10	1	10/5/2007	16:15	23	D	5	17	17	1/22/2008	12:26	1/22/2008	16:29	30	13611	
07-18-511	S11	1	10/5/2007	16:15	42	A	7	10	10	1/22/2008	12:26	1/22/2008	17:41	40	10297	
07-18-511	S15	1	10/5/2007	16:15	24	D	5	17	17	1/23/2008	10:05	1/23/2008	14:47	30	14069	
07-18-511	S16	1	10/5/2007	16:15	25	D	5	18	18	1/23/2008	10:05	1/23/2008	14:15	30	15549	
07-18-511	S17	1	10/5/2007	16:15	44	A	7	4	4	1/23/2008	10:05	1/23/2008	14:52	35	11544	
07-18-511	S18	1	10/5/2007	16:15	45	A	7	2	2	1/23/2008	10:05	1/23/2008	14:15	30	12326	
07-18-511	S19	1	10/5/2007	16:15	8	B	2	33	33	1/23/2008	11:18	1/23/2008	16:48	50	14155	
07-18-511	S20	1	10/5/2007	16:15	9	B	2	40	40	1/23/2008	11:18	1/23/2008	15:44	60	17417	
07-18-511	S21	1	10/5/2007	16:15	26	D	5	24	24	1/23/2008	11:18	1/23/2008	15:49	30	13245	
07-18-511	S22	1	10/5/2007	16:15	27	D	5	15	15	1/23/2008	11:18	1/23/2008	15:18	30	13738	
07-18-511	S23	1	10/5/2007	16:15	46	A	7	5	5	1/23/2008	11:18	1/23/2008	16:11	30	11257	
07-18-511	S24	1	10/5/2007	16:15	47	A	7	1	1	1/23/2008	11:18	1/23/2008	15:30	30	12013	
07-18-511	S25	1	10/5/2007	16:15	10	B	2	39	39	1/23/2008	12:14	1/23/2008	18:27	45	15263	
07-18-511	S26	1	10/5/2007	16:15	12	B	2	31	31	1/23/2008	12:14	1/23/2008	17:42	45	13952	
07-18-511	S27	1	10/5/2007	16:15	28	D	5	24	24	1/23/2008	12:14	1/23/2008	16:53	30	13472	
07-18-511	S28	1	10/5/2007	16:15	29	D	5	15	15	1/23/2008	12:14	1/23/2008	16:22	30	11774	
07-18-511	S29	1	10/5/2007	16:15	48	A	7	2	2	1/23/2008	12:14	1/23/2008	17:21	30	12142	
07-18-511	S30	1	10/5/2007	16:15	49	A	7	3	3	1/23/2008	12:14	1/23/2008	16:42	35	10707	
07-18-511	S31	1	10/5/2007	16:15	13	B	2	44	44	1/24/2008	10:00	1/24/2008	14:50	40	10939	
07-18-511	S32	1	10/5/2007	16:15	14	B	2	26	26	1/24/2008	10:00	1/24/2008	14:00	30	11711	
07-18-511	S33	1	10/5/2007	16:15	30	D	5	21	21	1/24/2008	10:00	1/24/2008	14:31	30	12590	
07-18-511	S34	1	10/5/2007	16:15	31	D	5	19	19	1/24/2008	10:00	1/24/2008	14:00	30	11688	
07-18-511	S35	1	10/5/2007	16:15	50	A	7	14	14	1/24/2008	10:00	1/24/2008	14:36	30	12108	
07-18-511	S36	1	10/5/2007	16:15	51	A	7	3	3	1/24/2008	10:00	1/24/2008	14:00	30	10675	
07-18-511	S37	1	10/5/2007	16:15	6	B	2	55	55	1/24/2008	10:58	1/24/2008	16:29	45	12564	
07-18-511	S38	1	10/5/2007	16:15	7	B	2	58	58	1/24/2008	10:58	1/24/2008	15:32	55	10524	TRANS. EROR/DO NOT USE
07-18-511	S39	1	10/5/2007	16:15	43	A	7	9	9	1/24/2008	10:58	1/24/2008	15:51	30	4124	TRANS. EROR/DO NOT USE
07-18-511	S40	1	10/5/2007	16:15	49	A	7	63	63	1/24/2008	10:58	1/24/2008	15:14	35	10992	

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
783.3020.77	Ra 226	2.0	rs015	208	1/28/2005

Spiked by: DBC on 10/5/2007
Spike Witness: EMF
Reviewed by: DBC

R:\A-RA-SR\REMCALIB\0108BDA

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: ~~ALB~~ ABC, 11/08
Prep. Date S: ~~6/28/2007~~ 10/5/07
Prep. Date C: ~~6/29/2007~~ 10/5/07
SOP Used: 783R8

W.O.#	S ID	S V (L)	Purge (end) Date D1	Time T1	Flask No.	Counter No.	Scaler No.	CBKG #	CBKG (CORR.)	Deeman. (end) Date D2	Time T2	Count Start Date D3	Time T3	Count Duration (min.)	COUNT #	REMARKS
07-18-511	S1	1	~~6/28/2007~~ 10/3/07	16:15	1	6	3	65	0	11/2/08	11:36	11/2/08	15:26	65	10475	
07-18-511	S2	1	6/29/2007		2	E	3	26	0				16:32	30	11091	
07-18-511	S3	1	6/29/2007		20	C	6	17	0				15:26	30	10328	
07-18-511	S4	1	6/29/2007		21	C	6	17	0				15:58	30	12499	
07-18-511	S5	1	6/29/2007		40	F	1	2	0				15:26	35	11541	
07-18-511	S6	1	6/29/2007		41	F	1	2	0				16:03	40	11160	
07-18-511	S7	1	6/29/2007		3	E	3	37	0		12:26		17:03	30	10590	
07-18-511	S8	1	6/29/2007		4	E	3	34	0				17:53	40	10998	
07-18-511	S9	1	6/29/2007		22	C	6	14	0				16:29	35	10711	
07-18-511	S10	1	6/29/2007		23	C	6	8	0				17:07	30	13835	
07-18-511	S11	1	6/29/2007		42	F	1	11	0				16:48	50	11012	
07-18-511	S12	1	6/29/2007		43	F	1	4	0				17:41	30	984	transfer error
07-18-511	S13	1	6/29/2007		6 ABC 10/8/08	6	3	32	0	11/2/08	10:05	11/2/08	14:15	30	3379	transfer error
07-18-511	S14	1	6/29/2007		7	E	3	33	0				15:12	30	4975	
07-18-511	S15	1	6/29/2007		24	C	6	9	0				14:15	30	13702	
07-18-511	S16	1	6/29/2007		25	C	6	9	0				14:47	~~15:43~~ 30 ABC 10/4/08	15311	
07-18-511	S17	1	6/29/2007		44	F	1	2	0				14:15	35	11211	
07-18-511	S18	1	6/29/2007		45	F	1	2	0				14:52	30	12011	
07-18-511	S19	1	6/29/2007		8	E	3	72	0		11:18		15:44	60	12758	
07-18-511	S20	1	6/29/2007		9	E	3	50	0				16:48	50 ABC 10/8/08	10974	
07-18-511	S21	1	6/29/2007		26	C	6	27	0				15:18	~~12:30~~ 30	12933	
07-18-511	S22	1	6/29/2007		27	C	6	7	0				15:49	30	13175	
07-18-511	S23	1	6/29/2007		46	F	1	2	0				15:30	35	11083	
07-18-511	S24	1	6/29/2007		47	F	1	3	0				16:11	30	10030	
07-18-511	S25	1	6/29/2007		10	E	3	57	0		12:14		17:42	45	13322	
07-18-511	S26	1	6/29/2007		12	E	3	45	0				18:27	45	12816	
07-18-511	S27	1	6/29/2007		28	C	6	16	0				16:22	30	13652	
07-18-511	S28	1	6/29/2007		29	C	6	8	0				16:53	30	11286	
07-18-511	S29	1	6/29/2007		48	F	1	1	0				16:12	30	10621	
07-18-511	S30	1	6/29/2007		49	F	1	51	0				17:21	45	10890	
07-18-511	S31	1	6/29/2007		13	E	3	61	0	11/24/08	10:00	11/24/08	14:00	50	10432	
07-18-511	S32	1	6/29/2007		14	E	3	21	0				14:50	40	12371	
07-18-511	S33	1	6/29/2007		30	C	6	12	0				14:00	30	12218	
07-18-511	S34	1	6/29/2007		31	C	6	5	0				14:31	30	10845	
07-18-511	S35	1	6/29/2007		50	F	1	8	0				14:00	35	11543	
07-18-511	S36	1	6/29/2007		51	F	1	4	0				14:36	35	10052	
07-18-511	S37	1	6/29/2007		6	E	3	61	0	11/24/08	10:58		15:32	45	10185	
07-18-511	S38	1	6/29/2007		7	E	3	64	0				16:29	45	6378	Trans. error / Do not use
07-18-511	S39	1	6/29/2007		43	F	1	8	0				15:14	30	3364	Trans. error / Do not use
07-18-511	S40	1	6/29/2007		49	F	1	116	0				15:51	40	10263	
07-18-511	S41	1	6/29/2007						0	ABC						
07-18-511	S42	1	6/29/2007						0	11/28/08						

10/5/07

07-18-511	S43	1	6/29/2007						0							
07-18-511	S44	1	6/29/2007						0							
07-18-511	S45	1	6/29/2007						0							
07-18-511	S46	1	6/29/2007						0							
07-18-511	S47	1	6/29/2007						0							
07-18-511	S48	1	6/29/2007						0							
07-18-511	S49	1	6/29/2007						0							
07-18-511	S50	1	6/29/2007						0							
07-18-511	S51	1	6/29/2007						0							
07-18-511	S52	1	6/29/2007						0							
07-18-511	S53	1	6/29/2007						0							
07-18-511	S54	1	6/29/2007						0							
07-18-511	S55	1	6/29/2007						0							
07-18-511	S56	1	6/29/2007						0							
07-18-511	S57	1	6/29/2007						0							
07-18-511	S58	1	6/29/2007						0							
07-18-511	S59	1	6/29/2007						0							
07-18-511	S60	1	6/29/2007						0							
07-18-511	S61	1	6/29/2007						0							
07-18-511	S62	1	6/29/2007						0							
07-18-511	S63	1	6/29/2007						0							
07-18-511	S64	1	6/29/2007						0							
07-18-511	S65	1	6/29/2007						0							
07-18-511	S66	1	6/29/2007						0							
07-18-511	S67	1	6/29/2007						0							
07-18-511	S68	1	6/29/2007						0							
07-18-511	S69	1	6/29/2007						0							
07-18-511	S70	1	6/29/2007						0							
07-18-511	S71	1	6/29/2007						0							
07-18-511	S72	1	6/29/2007						0							

SEE QASS#

DBC 1/28/08

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
783.3020.77	Ra 226	2.0	rs015	208	1/28/2005

S, exp: 6/15/06

Spiked by: DBC on 10/5/2007
Spike Witness: EMF 10/5/07
Reviewed by: DL 1/28/08

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: ~~ALB~~ DBC 1/24/08 DBC
Prep. Date S: ~~6/28/2007~~ 10/5/07
Prep. Date C: ~~6/28/2007~~ 10/5/07
SOP Used: 783R5

W.O.#	S ID	S V (L)	Purge (end) Date D1	Time T1	Flask No.	Counter No.	Scaler No.	CBKG #	CBKG (CORR.)	Deeman. (end) Date D2	Time T2	Count Start Date D3	Time T3	Count Duration (min.)	COUNT #	REMARKS
07-18-511	S1	1	6/29/2007	16:15	1	B	2	30	0	1/22/08	11:26	1/22/08	16:32	50	11584	
07-18-511	S2	1	6/29/2007		2	B	2	24	0				15:26	30	12963	
07-18-511	S3	1	6/29/2007		30	D	5	19	0				15:58	30	10455	
07-18-511	S4	1	6/29/2007		21	D	5	16	0				15:26	30	13619	
07-18-511	S5	1	6/29/2007		40	A	7	6	0				16:03	30	11184	
07-18-511	S6	1	6/29/2007		41	A	7	9	0				15:26	30	10660	
07-18-511	S7	1	6/29/2007		3	B	2	23	0		12:26		17:53	30	12855	
07-18-511	S8	1	6/29/2007		4	B	2	14	0				17:23	30	10343	
07-18-511	S9	1	6/29/2007		22	D	5	21	0				17:07	35	11485	
07-18-511	S10	1	6/29/2007		23	D	5	17	0				16:29	30	13611	
07-18-511	S11	1	6/29/2007		42	A	7	10	0				17:41	40	10997	
07-18-511	S12	1	6/29/2007		43	A	7	8	0				16:48	30	1203	Transfer error
07-18-511	S13	1	6/29/2007		6	B	2	20	0	1/23/08	10:05	1/23/08	15:12	30	4263	
07-18-511	S14	1	6/29/2007		7	B	2	21	0				14:15	30	5913	
07-18-511	S15	1	6/29/2007		24	D	5	17	0				14:47	30	14069	
07-18-511	S16	1	6/29/2007		25	D	5	18	0				14:15	30	15549	
07-18-511	S17	1	6/29/2007		44	A	7	4	0				14:52	35	11544	
07-18-511	S18	1	6/29/2007		45	A	7	2	0				14:15	30	12326	
07-18-511	S19	1	6/29/2007		8	B	2	33	0		11:18		16:58	50	14155	
07-18-511	S20	1	6/29/2007		9	B	2	40	0				15:44	60	17417	
07-18-511	S21	1	6/29/2007		26	D	5	29	0				15:49	30	13245	
07-18-511	S22	1	6/29/2007		27	D	5	15	0				15:18	30	13738	
07-18-511	S23	1	6/29/2007		46	A	7	5	0				16:11	30	11257	
07-18-511	S24	1	6/29/2007		47	A	7	1	0				15:30	30	12013	
07-18-511	S25	1	6/29/2007		10	B	2	39	0		12:14		18:27	45	15263	
07-18-511	S26	1	6/29/2007		12	B	2	31	0				17:42	45	13952	
07-18-511	S27	1	6/29/2007		28	D	5	24	0				16:53	30	13472	
07-18-511	S28	1	6/29/2007		29	D	5	15	0				16:22	30	11774	
07-18-511	S29	1	6/29/2007		48	A	7	2	0				17:21	30	12142	
07-18-511	S30	1	6/29/2007		49	A	7	3	0				16:42	35	10707	
07-18-511	S31	1	6/29/2007		13	B	2	44	0	1/24/08	10:00	1/24/08	14:50	40	10939	
07-18-511	S32	1	6/29/2007		14	B	2	26	0				14:00	30	11711	
07-18-511	S33	1	6/29/2007		30	D	5	21	0				14:31	30	12590	
07-18-511	S34	1	6/29/2007		31	D	5	19	0				14:00	30	11688	
07-18-511	S35	1	6/29/2007		50	A	7	14	0				14:36	30	12108	
07-18-511	S36	1	6/29/2007		51	A	7	3	0				14:00	30	10675	
07-18-511	S37	1	6/29/2007		6	B	2	55	0		10:58		16:29	45	12564	
07-18-511	S38	1	6/29/2007		7	B	2	58	0				15:32	55	10524	Trans. error / do not use
07-18-511	S39	1	6/29/2007		43	A	7	9	0				15:31	40 30	4124	Trans. error / do not use
07-18-511	S40	1	6/29/2007		49	A	7	63	0				15:14	35	10992	
07-18-511	S41	1	6/29/2007						0	DBC						
07-18-511	S42	1	6/29/2007						0		1/28/08					

10/5/07

07-18-511	S43	1	6/29/2007						0							
07-18-511	S44	1	6/29/2007						0							
07-18-511	S45	1	6/29/2007						0							
07-18-511	S46	1	6/29/2007						0							
07-18-511	S47	1	6/29/2007						0							
07-18-511	S48	1	6/29/2007						0							
07-18-511	S49	1	6/29/2007						0							
07-18-511	S50	1	6/29/2007						0							
07-18-511	S51	1	6/29/2007						0							
07-18-511	S52	1	6/29/2007						0							
07-18-511	S53	1	6/29/2007						0							
07-18-511	S54	1	6/29/2007						0							
07-18-511	S55	1	6/29/2007						0							
07-18-511	S56	1	6/29/2007						0							
07-18-511	S57	1	6/29/2007						0							
07-18-511	S58	1	6/29/2007						0							
07-18-511	S59	1	6/29/2007						0							
07-18-511	S60	1	6/29/2007						0							
07-18-511	S61	1	6/29/2007						0							
07-18-511	S62	1	6/29/2007						0							
07-18-511	S63	1	6/29/2007						0							
07-18-511	S64	1	6/29/2007						0							
07-18-511	S65	1	6/29/2007						0							
07-18-511	S66	1	6/29/2007						0							
07-18-511	S67	1	6/29/2007						0							
07-18-511	S68	1	6/29/2007						0							
07-18-511	S69	1	6/29/2007						0							
07-18-511	S70	1	6/29/2007						0							
07-18-511	S71	1	6/29/2007						0							
07-18-511	S72	1	6/29/2007						0							

SEE QASS#

DBC 12/8/08

Std./Ba Carrier ID	Std./ Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
783.3020.77	Ra 226	2.0	rs015	208	1/28/2005

S, exp: 6/15/08

Spiked by: DBC on 10/5/2007
Spike Witness: EMF 10/5/07
Reviewed by: 12/8/08

Logbook No./Page 325098

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0722513 -ICV13	N/A	3E	4	N/A	1/18/08	8:59	22	15	DBC	1/18/08	13:54	1957	15	DBC
-ICV14		2B	3			↓	16		DBC		↓	3071		DBC
-ICV16		3E	6			9:17	14		DBC		14:13	1821		DBC
-ICV17		2B	7			↓	10		DBC		↓ DBC 1/18/08	2101		DBC
-ICV17		3E	7			9:34	28		DBC		14:28	1477		DBC
-ICV16		2B	6			↓	7		DBC		↓	2419		DBC
-ICV18		3E	8			9:50	16		DBC		14:46	1913		DBC
-ICV19		2B	9			↓	9		DBC		↓	2901		DBC
-ICV19		3E	9			10:06	22		DBC		15:03	1910		DBC
-ICV18		2B	8			↓	15		DBC		↓	2797		DBC
-ICV20		3E	10			10:22	10		DBC		15:29	2078		DBC
-ICV21		2B	12			↓	16		DBC		↓	2869		DBC
-ICV21		3E	12			10:45	12		DBC		15:46	2373		DBC
-ICV20		2B	10			↓	11		DBC		16:35	2716		DBC
-ICV22		3E	13			11:01	13		DBC		16:03	2047		DBC
-ICV23		2B	14			↓	12		DBC		↓	3248		DBC
-ICV23		3E	14			11:17	11		DBC		16:19	2340		DBC
-ICV22	↓	2B	13	↓	↓	↓	16	↓	DBC	↓	↓	2833	↓	DBC
check Source	N/A	3E	Th	N/A						1/18/08	16:24	9501		DBC
		2B									16:52	9478		DBC
		GC									16:24	9561		DBC
		GP	↓	↓						↓	16:25	9401	↓	DBC
check Source	N/A	3E	Th	N/A						1/22/08	8:00	9402		DBC

Comments:

Reviewed by/date: DBC 1/28/08

Form 795r3.xls (11/14/05)

Logbook No./Page 325099

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
Check Source	N/A	2B	Th	N/A						112/08	8:01	9661	1	DBC
		6C									8:02	9621		DBC
		5D									8:03	9449		DBC
		1F									8:04	9509		DBC
		7A									8:05	9563		DBC
0718511-51	N/A	3E	1	N/A	112/08	9:47	~~3065~~	~~3065~~	DBC	112/08	15:26	10475	~~3065~~	DBC
-52		2B	2				24	30 DBC 112/08	DBC			12963	30 DBC 112/08	DBC
-52		3E	2			10:19	26		DBC		16:32	11691		DBC
-51		2B	1			DBC 112/08	~~1663~~ DBC	50	DBC			11584	50 DBC 112/08	DBC
-53		6C	20			9:47	17	30	DBC		15:26	10328	30	DBC
-54		5D	21				16		DBC			13619		DBC
-54		6C	21			10:19	17		DBC		15:58	12499		DBC
-53		5D	20				19		DBC			10455		DBC
-55		1F	40			9:47	2	35	DBC		15:26	11541	35 DBC 112/08	DBC
-56		7A	41				9	DBC 112/08 30	DBC			10660	30	DBC
-56		1F	41			10:19	2	40	DBC		16:03	11160	DBC 112/08 40	DBC
-55		7A	40				6	30	DBC			11184	90	DBC
-57		3E	3			10:50	37		DBC		17:03	10590		DBC
-58		2B	4				14		DBC		17:23	10343		DBC
-58		3E	4			11:25	~~9634~~	40	DBC		17:53	10998	40 DBC 112/08	DBC
-57		2B	3				23	30	DBC			10855	30	DBC
-59		6C	22			10:50	~~12~~ 14	35	DBC		14:29	10711	35 DBC 112/08	DBC
-510		5D	23				17	30	DBC			13611	30	DBC

Comments:

Reviewed by/date: DBC 112/08

Form 795r3.xls (11/14/05)

Logbook No./Page **359601**

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0718511-510	N/A	6C	23	N/A	11/22/08	11:25	8	30	DBC	11/22/08	17:07	13835	30	DBC
-59		5D	22			↓	DBC 11/22/08 ~~18~~ 21	35	DBC		↓	11485	35	DBC
-511		1F	42			10:50	11/22/08 711	50	DBC 11/22/08 DBC		16:48	11012	50	DBC
-512		7A	43			↓	8	30	DBC		↓	1223	30	DBC
-512		1F	43			11:25	4	↓	DBC		17:41	984	↓	DBC
-511	↓	7A	42	↓	↓	↓	DBC 11/22/08 10	40	DBC 11/22/08 DBC	↓	↓	6297	40	DBC
Check Source	N/A	3E	Th	N/A	→	→	→	→	→	11/22/08	18:25	9593	1	DBC
		2B			→	→	→	→	→		18:34	9636		DBC
		6C			→	→	→	→	→		17:52	9590		DBC
		5D			→	→	→	→	→		17:53	9564		DBC
		1F			→	→	→	→	→		18:12	9341		DBC
	↓	7A	↓	↓	→	→	→	→	→	↓	18:22	9675	↓	DBC
Check Source	N/A	3E	Th	N/A	→	→	→	→	→	11/23/08	8:14	9383		DBC
		2B			→	→	→	→	→		8:15	9584		DBC
		6C			→	→	→	→	→		8:16	9569		DBC
		5D			→	→	→	→	→		8:17	9677		DBC
		1F			→	→	→	→	→		8:18	9371		DBC
	↓	7A	↓	↓	→	→	→	→	→	↓	8:19	9343	↓	DBC
0718511-513	N/A	3E	6	N/A	11/23/08	8:22	32	30	DBC	11/23/08	14:15	3379	30	DBC
-514		2B	7			↓	21		DBC		↓	5913		DBC
-514		3E	7			8:53	33		DBC		15:12	4975		DBC
-513		2B	6			↓	DBC 11/23/08 ~~18~~ 20	↓	DBC		DBC 11/23/08 14 ↓	4263	↓	DBC
-515	↓	6C	24	↓	↓	8:22	~~8~~ 9	30	DBC	↓	14:15	13702	30	DBC

Comments:

Form 795r3.xls (11/14/05)

Reviewed by/date: DBC 11/23/08

Logbook No./Page 359602

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0718511-516	N/A	5P	25	N/A	112308	8:22	18 ~~8~~ DBC 112308	30	DBC	112308	14:15	15549	30	DBC
-516		6C	25			8:53	9		DBC		14:47	15311		DBC
-515		5D	24				17		DBC			14069		DBC
-517		1F	44			8:22	2	35	DBC		14:15	11211	35	DBC
-518		7A	45				2	30	DBC			12326	30	DBC
-518		1F	45			8:53	2		DBC		14:52	12011		DBC
-517		7A	44				4	35	DBC			11544	35	DBC
-519		3E	8			9:25	72	60	DBC		15:44	12758	60	DBC
-520		2B	9				40		DBC			17417		DBC
-520		3E	9			9:57	50	50	DBC		16:48	10974	50	DBC
-519		2B	8				33		DBC			14155		DBC
-521		6C	26			9:25	27	30	DBC		15:18	12933	30	DBC
-522		5D	27				15		DBC			13788	30	DBC
-522		6C	27			9:57	7		DBC		15:49	13175		DBC
-521		5D	26				24		DBC			13245		DBC
-523		1F	46			9:25	2	35	DBC		16:36	11083	35	DBC
-524		7A	47				1	30	DBC			12613	30	DBC
-524		1F	47			9:57	3		DBC		16:11	10030		DBC
-523		7A	46				5		DBC			11257		DBC
-525		3E	10			10:28	57	45	DBC		17:42	13322	45	DBC
-526		2B	12				31		DBC			13952		DBC
-526		3E	12			11:00	45		DBC		18:27	12816		DBC
-525		2B	10				39		DBC			15263		DBC

Comments:

Reviewed by/date: DBC 112308

Logbook No./Page **359603**

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0718511-527	N/A	6C	28	N/A	1/23/08	10:28	16	30	DBC	1/23/08	16:22	13652	30	DBC
-528		5D	29				13		DBC			11774		DBC
-528		6C	29			11:00	8		DBC		16:53	11086		DBC
-527		5D	28				24		DBC			13472		DBC
-529		1F	48			10:28	1		DBC		16:42	10621		DBC
-530		7A	49				3	35	DBC			10707	35	DBC
-536		1F	49			11:00	~~3951~~		DBC		17:21	10890	45	DBC
-529		7A	48				2	36	DBC			12142	30	DBC
Check Source	N/A	3G	Th	N/A						1/23/08	19:13	9469	1	DBC
		2B									19:14	9399		DBC
		6C									17:24	9618		DBC
		5D									17:25	9424		DBC
		1F									18:23	9422		DBC
		7A									17:52	9472		DBC
Check Source	N/A	3G	Th	N/A						1/24/08	8:13	9365	1	DBC
		2B									8:14	9674		DBC
		6C									8:15	9578		DBC
		5D									8:16	9470		DBC
		1F									8:17	9361		DBC
		7A									8:18	9436		DBC
0718511-531	N/A	3G	13	N/A	1/24/08	8:22	61	50	DBC	1/24/08	14:00	10432	50	DBC
-532		2B	14				26	30	DBC			11711	30	DBC
-532		3E	14			8:54	27	40	DBC		14:50	12371	40	DBC

Comments:

Form 795r3.xls (11/14/05)

Reviewed by/date: DBC 1/24/08

Logbook No./Page 359604

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0718511-531	N/A	2B	13	N/A	1/24/08	8:39	44	40	DBC	1/24/08	14:58	10939	40	DBC
-533		6C	36			8:22	12	30	DBC		14:00	12218	30	DBC
-534		5D	31			↓	19		DBC		↓	11688	30	DBC
-534		6C	31			8:54	5		DBC		14:31	10845		DBC
-533		5D	30			↓	21	↓	DBC		↓	12590	↓	DBC
-535		1F	50			8:22	8	35	DBC		14:00	11543	35	DBC
-536		7A	51			↓	3	30	DBC		↓	10675	30	DBC
-536		1F	51			8:54	4	35	DBC		14:36	10052	35	DBC
-535		7A	50			↓	14	30	DBC		↓	12108	30	DBC
-537		3E	6			9:25	4	30	DBC		15:32	10185	45	DBC
-538		2B	7			↓	58	55	DBC		↓	10504	55	DBC
-538		3E	7			10:00	64	45	DBC		16:29	6378	45	DBC
-537		2B	6			↓	55	↓	DBC		↓	12564	↓	DBC
-539		1F	43			9:25	8	30	DBC		15:14	9364	30	DBC
-540		7A	49			↓	63	35	DBC		↓	10992	35	DBC
-540		1F	49			10:00	116	40	DBC		15:51	10263	40	DBC
-539		7A	43			↓	9	30	DBC		↓	4124	30	DBC
Check Source	N/A	3E	Th	N/A						1/24/08	17:15	9480	1	DBC
		2B									17:16	9357		DBC
		6C									15:08	9440		DBC
		5D									15:09	9451		DBC
		1F									16:33	9454		DBC
		7A									16:23	9573		DBC

Comments:

Reviewed by/date: DBC 1/24/07

Form 795r3.xls (11/14/05)

Prepare a working level dilution of 783.2613.72 to a final concentration of ~100 dpm/mL using 0.1M HCl

① Determine the density of 0.1M HCl — Bal 12

Mass of empty 100mL class A flask: 62.4696g lot # 061842
Mass of flask + 100mL 0.1M HCl: 162.3412g
Net mass of 0.1M HCl: 99.8716g
$\rho = 0.9987$ g/mL

② Transfer std to 1L Nalgene — 12

Mass of bottle w/o lid: 74.1318g
Mass of bottle + std: 77.9055g
Net mass of std transferred: 3.8232g

③ Dilute w/ 0.1M HCl — 26

Mass of bottle + std + 0.1M HCl: 1097.0g
Mass of bottle (from above): 74.1318g
Net mass of standard: 1022.8682g

④ Final Activity Calculation

$$\frac{(277\,68.35\ \text{dpm/mL})(3.8232\text{g})(0.9987\text{g/mL})}{(0.9982\text{g/mL})(1022.8682\text{g})} = 103.84\ \text{dpm/mL}$$

* Note the density of 783.2613.72 is 0.9982 g/mL

Stnd ID: 783.3020.77 DCB 10/5/07

Description: Ra-226
Expiration: 6/15/08
Activity: 103.84 dpm/ml
2sig. Uncert: 3.43 dpm/ml
Ref. Date: 1/28/05
Ref Time: n/a
Prep Date: 3/9/07 Prep by: ALB
Matrix/Comp. 0.1 M HCl
Half Life (y): 1.60E+03 DCB 10/5/07

DCB 10/5/07

DCB 10/5/07

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
ALB	3/9/07	DCB	10/5/07

72
PROJECT 783.2613.72 - Ra-226

Notebook No. 2613

Continued From Page

PREPARE A PRIMARY DILUTION OF RSO# 783 BY DILUTING TO ~40 mL WITH 0.1 M HCl.

1. DETERMINE DENSITY OF 0.1 M HCl

MASS OF CLASS A VOLUMETRIC FLASK (100 mL):	68.6008 g	Bal 12
MASS OF FLASK + 100 mL 0.1 M HCl:	168.4208 g	↓
NET MASS OF 0.1 M HCl:	99.82 g	

LOT# 44042

$\rho = 0.9982$ g/mL

2. TRANSFER CONTENTS OF AMPULE - RSO# 783 TO A 40 mL VOA VIAL

MASS OF EMPTY 40 mL VOA VIAL w/o LID:	21.4763 g	Bal 12
MASS OF OPEN AMPULE + 50 mL BEAKER:	37.8692 g	↓
MASS OF EMPTY AMPULE + 50 mL BEAKER:	32.9096 g	
NET MASS OF STD. TRANSFERRED:	4.9596 g	

3. FINAL DILUTION WITH 0.1 M HCl

MASS OF EMPTY 40 mL VOA VIAL w/o LID (FROM ABOVE):	21.4763 g	Bal 12
MASS OF VIAL + STD + 0.1 M HCl:	61.4738 g	↓
NET MASS OF STD + 0.1 M HCl:	39.9975 g	

4. FINAL ACTIVITY CALCULATION

$$\frac{(1.877\times10^{4}\ \text{dps})(60\ \text{dpm/dps})(4.9596\ \text{g})(0.9982\ \text{g/mL})}{(5.01992\ \text{g})(39.9975\ \text{g})} = 27{,}768.3514\ \text{dpm/mL}$$

ANALYTICS
1380 Seaboard Ind Blvd * Atlanta, GA 30318 * USA * 404-352-8677
Ra-226
SRS 70034-307 Qty 5.07E-1 µCi QA UM
Date 01/28/05 12:00 EST Exp. XXXXXX
PO # 71239, Item 1
5.01992 grams 0.1M HCl solution
CAUTION RADIOACTIVE MATERIAL

Continued on Page

Read and Understood By

Signed 2/15/05 Date

Signed 3/14/05 Date

ANALYTICS

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

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

RSO# 783
Rec'd 2/2/05
JB

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

70034-307

Ra-226 5 mL Liquid in Flame Sealed Vial

This standard radionuclide source was prepared gravimetrically from a calibrated master solution. The master solution was calibrated using a germanium gamma spectrometer system.

Radionuclide purity and calibration were checked with a germanium gamma spectrometer system. The nuclear decay rate and assay date for this source are given below.

Analytics maintains traceability to the National Institute of Standards and Technology through participation in a Measurements Assurance Program as described in USNRC Reg. Guide 4.15, Revision 1, February 1979.

ISOTOPE:	Ra-226
ACTIVITY (dps):	1.877 E4
HALF-LIFE:	1.600 E3 years
CALIBRATION DATE:	January 28, 2005 12:00 EST
RELATIVE EXPANDED UNCERTAINTY (k=2):	3.3%

Impurities: γ-impurities (other than decay products) <0.1%

5.01992 grams 0.1M HCl solution with 50 µg/g Ba carrier.

P O NUMBER 71239, Item 1

SOURCE PREPARED BY: M. Dimitrova
M. Dimitrova, Radiochemist

Q A APPROVED: 2-1-05

Ra-226 Standard Verification: For Use In Ra-Sr Lab

Std: 783.3020.77
Date 6/15/2007

Known Act:	103.84	dpm/mL	46774.8	pCi/L
Volume:	1000	mL		

	Det	Act. (pCi/L)	Act. (pCi/mL)	Ave Act	2 Std Dev	% Recovery	Ave Rec w/in 5% (PAI)	2 Std Dev w/in 10% Ave (ICPT)
Count 1	2	44200	44.2			94.5%	96.6%	0.094
Count 2	6	43200	43.2			92.4%	Pass	Pass
Count 3	4	48100	48.1	45166.7	4227.9	102.8%		

r:\inst\gamma\783.3020.77-Ra226

OK
JCB
10/5/07

070887D02.SPC Analyzed by JM

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0718001-1 RA-226 VER 783.3020.77

Sampling Start:	01/28/2005 10:00:00	Counting Start:	06/13/2007 09:02:14
Sampling Stop:	01/28/2005 10:00:00	Decay Time.	2.08E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	7200 Sec
Sample Size	1.00E+000 L	Real Time	7417 Sec
Collection Efficiency	1.0000	Spc. File	.070887D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -0.67 + 0.500*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 06/13/2007
FWHM(keV) = 0.69 + 0.005*En + 9.43E-04*En^2 + 0.00E+00*En^3 05/07/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.58	94.42	631	150	116	2980	0.65	a	
2	53.22	107.68	347	193	156	4468	0.93	a	
3	74.76	150.72	5286	242	159	5096	0.80	a	HiResid Wide Pk
4	75.21	151.62	309	354	290	10941	1.83	b	HiResid
5	77.04	155.27	10220	273	151	4593	0.80	c	HiResid
6	81.10	163.39	99	124	100	2483	0.42	d	NET< CL HiResid
7	83.79	168.75	485	152	120	3173	0.68	e	HiResid
8	87.14	175.45	4247	230	155	4465	1.03	f	HiResid
9	89.80	180.78	1826	222	168	4833	1.08	g	HiResid
10	94.61	190.38	520	264	214	6326	1.59	h	HiResid
11	186.16	373.30	11993	275	137	3786	0.88	a	
12	196.17	393.29	153	138	112	2781	0.62	a	
13	221.18	443.27	95	141	115	2666	0.79	a	NET< CL
14	241.98	484.83	11240	260	123	2807	0.97	a	
15	258.86	518.56	694	149	115	2441	0.93	a	
16	274.55	549.91	561	171	136	2909	1.31	a	
17	295.22	591.20	25096	340	102	1939	1.04	a	
18	314.52	629.77	59	73	59	847	0.53	a	NET< CL
19	349.34	699.34	488	224	181	3626	2.22	a	Wide Pk
20	351.87	704.39	41400	426	103	1813	1.10	b	
21	386.82	774.23	300	120	95	1535	1.16	a	
22	388.89	778.37	387	134	105	1755	1.37	b	

070887D02.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
23	405.67	811.89	139	148	120	2127	1.52 a	
24	428.53	857.57	64	72	58	833	0.60 a	
25	439.80	880.07	58	77	62	872	0.86 a	NET< CL
26	454.83	910.11	233	93	73	1038	1.17 a	
27	461.70	923.83	193	110	88	1334	1.44 b	
28	474.64	949.69	37	60	48	569	0.62 a	NET< CL
29	480.47	961.34	305	102	78	1138	1.27 b	
30	487.05	974.50	231	83	64	854	1.04 c	
31	510.73	1021.80	466	148	117	1748	2.38 a	Wide Pk
32	533.64	1067.57	143	79	62	761	1.11 a	
33	536.88	1074.05	112	86	69	870	1.35 b	
34	543.36	1087.01	104	94	76	995	1.48 a	
35	580.23	1160.66	216	79	60	716	1.12 a	
36	609.33	1218.80	31676	366	70	853	1.41 a	
37	665.59	1331.22	939	94	59	606	1.43 a	
38	683.30	1366.60	55	54	43	392	1.02 a	
39	703.22	1406.40	304	93	71	789	1.75 a	
40	719.89	1439.72	201	77	59	610	1.40 a	
41	742.13	1484.14	100	71	56	608	1.44 a	
42	768.49	1536.82	2715	128	61	679	1.58 a	
43	786.03	1571.87	626	84	56	608	1.47 a	
44	806.37	1612.50	696	84	54	566	1.52 a	
45	821.25	1642.23	96	48	36	322	0.86 a	
46	826.36	1652.45	63	58	46	451	1.08 b	
47	839.18	1678.06	337	81	59	650	1.69 a	
48	934.24	1867.99	1511	101	53	556	1.53 a	
49	964.33	1928.10	174	67	51	504	1.50 a	
50	1051.82	2102.93	79	63	50	458	1.68 a	
51	1070.09	2139.42	110	45	33	271	1.05 a	
52	1104.70	2208.59	51	52	41	370	1.39 a	
53	1120.36	2239.87	6409	172	51	486	1.98 a	
54	1133.46	2266.04	135	66	51	484	1.96 a	
55	1155.45	2309.98	673	81	51	490	1.88 a	
56	1182.55	2364.13	82	63	50	463	1.97 a	
57	1207.82	2414.61	185	57	41	342	1.70 a	
58	1238.27	2475.45	2480	114	45	379	2.01 a	
59	1253.60	2506.08	116	69	54	495	2.36 a	
60	1281.08	2560.99	493	69	43	365	1.78 a	
61	1303.64	2606.06	68	43	33	243	1.37 a	
62	1377.69	2754.01	1556	96	45	382	2.01 a	
63	1385.32	2769.27	231	57	40	318	1.56 b	
64	1401.68	2801.95	531	80	54	455	2.57 a	
65	1408.17	2814.93	853	81	46	369	2.15 b	
66	1509.29	3016.97	751	85	53	470	2.51 a	
67	1538.70	3075.74	118	58	44	359	1.95 a	
68	1543.81	3085.94	150	62	47	389	2.18 b	
69	1583.20	3164.65	180	61	45	361	2.05 a	
70	1594.86	3187.94	36	47	37	278	1.71 b	NET< CL
71	1661.65	3321.38	329	57	36	226	2.25 a	

070887D02.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
72	1684.20	3366.45	47	29	21	99	1.27	a
73	1692.83	3383.68	62	40	30	161	2.16	b
74	1729.65	3457.26	979	74	32	167	2.59	a
75	1764.58	3527.04	5035	146	30	139	2.57	a
76	1838.22	3674.18	88	37	26	119	2.36	a
77	1847.40	3692.52	630	61	28	128	2.44	b
78	1872.88	3743.44	70	39	29	126	2.93	a
79	1936.25	3870.05	39	43	34	168	3.08	a

070887D02.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET020608.BKG (WEEKLY BKG 070608-2)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.58	631	150	116	618	151	117	
3	74.76	5286	242	159	5267	242	160	
5	77.04	10220	273	151	10198	274	152	
8	87.14	4247	230	155	4244	230	156	
10	94.61	520	264	214	469	265	215	
11	186.16	11993	275	137	11958	276	138	
17	295.22	25096	340	102	25086	341	103	
20	351.87	41400	426	103	41381	426	104	
31	510.73	466	148	117	274	151	121	
36	609.33	31676	366	70	31660	366	71	
49	964.33	174	67	51	168	68	52	
53	1120.36	6409	172	51	6406	172	52	

070887D02.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0718001-1 RA-226 VER 783.3020.77

Sampling Start:	01/28/2005 10:00:00	Counting Start:	06/13/2007 09:02:14
Sampling Stop:	01/28/2005 10:00:00	Decay Time.	2.08e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	7200 Sec
Sample Size	1.00e+000 L	Real Time	7417 Sec
Collection Efficiency	1.0000	Spectrum File	.070887D02.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 2 (Detector 2)

Efficiency File: (D02)(Sh01).EFF (Geo 1 Eff Cal)

Eff=10^[-2.48E+01 +2.17E+01*L +-5.07E+00*L^2 +0.00E+00*L^3] 05/07/2007

Eff.=10^[-2.65E+00 +2.22E+00*L +-1.03E+00*L^2 +1.15E-01*L^3] Above 180.00 keV

Library File: . RA-226(186 KEV).LIB (Ra-226 std ver. (186 keV))

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.21		4.42E+04 +- 1.02E+03	1.03E+03	5.11E+02	1.40E+07

MEASURED TOTAL: 4.42E+04 +- 1.02E+03 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.58	94.42	618	151	117	2980	0.65	1070DEsc
2	53.22	107.68	347	193	156	4468	0.93	Unknown
3	74.76	150.72	5267	242	160	5096	0.80	Unknown
4	75.21	151.62	309	354	290	10941	1.83	Unknown
5	77.04	155.27	10198	274	152	4593	0.80	Unknown
6	81.10	163.39	99	124	100	2483	0.42	Deleted
7	83.79	168.75	485	152	120	3173	0.68	Unknown
8	87.14	175.45	4244	230	156	4465	1.03	Unknown
9	89.80	180.78	1826	222	168	4833	1.08	Unknown
10	94.61	190.38	469	265	215	6326	1.59	Unknown
12	196.17	393.29	153	138	112	2781	0.62	Unknown
13	221.18	443.27	95	141	115	2666	0.79	Deleted
14	241.98	484.83	11240	260	123	2807	0.97	Unknown
15	258.86	518.56	694	149	115	2441	0.93	1281DEsc

070887D02.SPC Analyzed by

UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
16	274.55	549.91	561	171	136	2909	1.31	Unknown
17	295.22	591.20	25086	341	103	1939	1.04	Unknown
18	314.52	629.77	59	73	59	847	0.53	Deleted
19	349.34	699.34	488	224	181	3626	2.22	Unknown
20	351.87	704.39	41381	426	104	1813	1.10	Unknown
21	386.82	774.23	300	120	95	1535	1.16	1408DEsc
22	388.89	778.37	387	134	105	1755	1.37	Unknown
23	405.67	811.89	139	148	120	2127	1.52	Unknown
24	428.53	857.57	64	72	58	833	0.60	Unknown
25	439.80	880.07	58	77	62	872	0.86	Deleted
26	454.83	910.11	233	93	73	1038	1.17	Unknown
27	461.70	923.83	193	110	88	1334	1.44	Unknown
28	474.64	949.69	37	60	48	569	0.62	Deleted
29	480.47	961.34	305	102	78	1138	1.27	Unknown
30	487.05	974.50	231	83	64	854	1.04	1509DEsc
31	510.73	1021.80	274	151	121	1748	2.38	Unknown
32	533.64	1067.57	143	79	62	761	1.11	Unknown
33	536.88	1074.05	112	86	69	870	1.35	Unknown
34	543.36	1087.01	104	94	76	995	1.48	Unknown
35	580.23	1160.66	216	79	60	716	1.12	Unknown
36	609.33	1218.80	31660	366	71	853	1.41	1120SEsc
37	665.59	1331.22	939	94	59	606	1.43	Unknown
38	683.30	1366.60	55	54	43	392	1.02	Unknown
39	703.22	1406.40	304	93	71	789	1.75	Unknown
40	719.89	1439.72	201	77	59	610	1.40	Unknown
41	742.13	1484.14	100	71	56	608	1.44	1765DEsc
42	768.49	1536.82	2715	128	61	679	1.58	1281SEsc
43	786.03	1571.87	626	84	56	608	1.47	Unknown
44	806.37	1612.50	696	84	54	566	1.52	Unknown
45	821.25	1642.23	96	48	36	322	0.86	Unknown
46	826.36	1652.45	63	58	46	451	1.08	1847DEsc
47	839.18	1678.06	337	81	59	650	1.69	Unknown
48	934.24	1867.99	1511	101	53	556	1.53	Unknown
49	964.33	1928.10	168	68	52	504	1.50	Unknown
50	1051.82	2102.93	79	63	50	458	1.68	Unknown
51	1070.09	2139.42	110	45	33	271	1.05	Unknown
52	1104.70	2208.59	51	52	41	370	1.39	Unknown
53	1120.36	2239.87	6406	172	52	486	1.98	Unknown
54	1133.46	2266.04	135	66	51	484	1.96	Unknown
55	1155.45	2309.98	673	81	52	490	1.88	Unknown
56	1182.55	2364.13	82	63	50	463	1.97	Unknown
57	1207.82	2414.61	185	57	41	342	1.70	Unknown
58	1238.27	2475.45	2480	114	45	379	2.01	Unknown
59	1253.60	2506.08	116	69	54	495	2.36	1765SEsc
60	1281.08	2560.99	493	69	44	365	1.78	Unknown
61	1303.64	2606.06	68	43	33	243	1.37	Unknown
62	1377.69	2754.01	1556	96	45	382	2.01	Unknown
63	1385.32	2769.27	231	57	40	318	1.56	Unknown
64	1401.68	2801.95	531	80	54	455	2.57	Unknown

070887D02.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
65	1408.17	2814.93	853	81	46	369	2.15	Unknown
66	1509.29	3016.97	751	85	53	470	2.51	Unknown
67	1538.70	3075.74	118	58	44	359	1.95	Unknown
68	1543.81	3085.94	150	62	47	389	2.18	Unknown
69	1583.20	3164.65	180	61	45	361	2.05	Unknown
70	1594.86	3187.94	36	47	37	278	1.71	Deleted
71	1661.65	3321.38	329	57	36	226	2.25	Unknown
72	1684.20	3366.45	47	29	21	99	1.27	Unknown
73	1692.83	3383.68	62	40	30	161	2.16	Unknown
74	1729.65	3457.26	979	74	32	167	2.59	Unknown
75	1764.58	3527.04	5035	146	30	139	2.57	Unknown
76	1838.22	3674.18	88	37	26	119	2.36	Unknown
77	1847.40	3692.52	630	61	28	128	2.44	Unknown
78	1872.88	3743.44	70	39	29	126	2.93	Unknown
79	1936.25	3870.05	39	43	34	168	3.08	Unknown

c:\SEEKER\BIN\070887d02.res Analysis Results Saved.

070872D06.SPC Analyzed by JM

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0718001-2 RA-226 VER 783.3020.77

Sampling Start:	01/28/2005 10:00:00	Counting Start:	06/13/2007 16:28:18
Sampling Stop:	01/28/2005 10:00:00	Decay Time.	2.08E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	10800 Sec
Sample Size	1.00E+000 L	Real Time	10872 Sec
Collection Efficiency	1.0000	Spc. File	.070872D06.SPC

Detector #: 6 (Detector 6)

Energy(keV)= -0.65 + 0.501*Ch +-2.21E-10*Ch^2 + 0.00E+00*Ch^3 06/13/2007
FWHM(keV) = 1.19 + -0.002*En + 7.29E-04*En^2 + 0.00E+00*En^3 07/24/2006
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.43	94.04	407	193	155	5451	0.76 a	
2	52.96	107.09	243	191	155	5451	0.83 b	
3	74.77	150.65	6384	270	179	6765	0.98 a	HiResid
4	76.34	153.78	353	169	135	4510	0.66 b	HiResid
5	77.06	155.21	11240	286	157	5638	0.86 c	HiResid
6	83.81	168.70	488	170	135	4510	0.62 d	HiResid
7	87.12	175.32	5050	260	179	6765	1.05 e	HiResid
8	89.79	180.64	1895	234	179	6765	0.93 f	HiResid
9	186.20	373.21	15852	329	174	6372	0.97 a	
10	195.84	392.45	261	205	167	5882	0.93 a	
11	242.02	484.69	15279	297	136	3893	1.02 a	
12	258.89	518.39	912	184	143	4034	1.10 a	
13	274.74	550.05	619	175	138	3739	1.11 a	
14	295.22	590.96	33822	400	130	3321	1.07 a	
15	314.47	629.39	222	149	120	2826	1.12 a	
16	333.36	667.14	145	275	225	6260	2.59 a	NET< CL Wide Pk
17	349.47	699.31	837	302	244	6496	3.05 a	Wide Pk
18	351.92	704.20	56013	492	110	2393	1.12 b	
19	386.67	773.60	456	146	115	2439	1.34 a	
20	388.92	778.10	547	135	104	2134	1.13 b	
21	405.63	811.47	185	133	107	2267	1.06 a	
22	454.81	909.71	422	123	95	1685	1.38 a	
23	461.91	923.88	189	87	68	1053	0.90 b	

070872D06.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
24	469.86	939.75	113	84	67	1026	0.75 a	
25	480.59	961.18	404	107	81	1301	1.10 a	
26	487.12	974.23	506	118	90	1487	1.24 b	
27	510.67	1021.27	686	172	135	2587	2.59 a	Wide Pk
28	533.46	1066.78	240	98	77	1212	1.26 a	
29	543.41	1086.65	75	78	62	896	1.04 a	
30	580.07	1159.89	369	95	71	1038	1.38 a	
31	609.28	1218.22	40591	412	71	1028	1.36 a	
32	639.82	1279.22	70	90	73	989	1.65 a	NET< CL
33	665.44	1330.39	1190	101	61	766	1.31 a	
34	683.44	1366.34	77	68	54	640	1.22 a	
35	703.10	1405.62	286	85	64	854	1.27 a	
36	719.79	1438.94	274	75	55	657	1.18 a	
37	742.11	1483.52	149	91	72	963	1.63 a	
38	752.96	1505.20	65	61	48	532	0.91 a	
39	768.40	1536.04	3655	144	64	796	1.45 a	
40	785.95	1571.08	920	106	71	894	1.76 a	
41	806.22	1611.58	837	92	59	720	1.35 a	
42	821.16	1641.43	137	70	54	641	1.09 a	
43	825.91	1650.90	97	100	81	1099	1.93 b	
44	839.08	1677.21	439	89	64	801	1.49 a	
45	904.34	1807.56	64	82	66	857	1.44 a	NET< CL
46	934.14	1867.08	1997	116	61	733	1.52 a	
47	964.06	1926.84	180	72	55	614	1.38 a	
48	1052.09	2102.66	132	68	53	587	1.51 a	
49	1070.01	2138.44	108	70	55	603	1.59 a	
50	1104.72	2207.77	76	63	49	515	1.49 a	
51	1120.28	2238.85	8179	192	53	565	1.71 a	
52	1134.19	2266.64	106	58	45	443	1.34 a	
53	1155.29	2308.78	917	94	59	637	1.93 a	
54	1181.29	2360.71	31	126	103	1279	4.02 a	NET< CL Wide Pk
55	1207.69	2413.44	244	74	55	562	1.90 a	
56	1238.14	2474.26	3001	124	48	458	1.71 a	
57	1253.71	2505.35	233	97	76	798	3.25 a	Wide Pk
58	1281.13	2560.13	721	82	51	497	1.81 a	
59	1303.40	2604.59	42	52	42	365	1.40 a	
60	1377.68	2752.95	1998	107	49	437	1.90 a	
61	1385.34	2768.27	372	68	46	401	1.73 b	
62	1401.55	2800.63	553	72	45	410	1.63 a	
63	1408.00	2813.52	1044	87	48	451	1.80 b	
64	1460.63	2918.64	63	62	49	462	1.76 a	
65	1509.21	3015.66	936	91	55	567	1.97 a	
66	1538.56	3074.29	145	73	56	540	2.36 a	
67	1543.31	3083.78	155	55	41	347	1.51 b	
68	1583.19	3163.43	239	56	38	296	1.63 a	
69	1594.59	3186.19	74	50	38	296	1.60 b	
70	1599.36	3195.73	63	49	38	296	1.66 c	
71	1661.20	3319.24	419	60	36	231	2.12 a	

070872D06.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
72	1683.86	3364.50	85	48	36	222	2.31	a
73	1693.20	3383.15	97	55	42	269	2.83	b
74	1729.53	3455.72	1364	82	29	147	2.27	a
75	1764.41	3525.38	6242	162	28	141	2.20	a
76	1838.21	3672.77	147	41	27	133	2.11	a
77	1847.31	3690.96	874	68	27	133	2.09	b
78	1873.01	3742.29	88	35	24	113	1.73	a
79	1896.34	3788.89	29	29	22	110	1.25	a

070872D06.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET060608.BKG (WEEKLY BKG 070608-6)

Bkg.File Detector #: 6

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
9	186.20	15852	329	174	15825	329	175	
14	295.22	33822	400	130	33808	401	131	
18	351.92	56013	492	110	56000	492	111	
27	510.67	686	172	135	444	177	141	
31	609.28	40591	412	71	40577	413	74	
64	1460.63	63	62	49	1	64	52	NET<CL
75	1764.41	6242	162	28	6236	162	29	

070872D06.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0718001-2 RA-226 VER 783.3020.77

Sampling Start:	01/28/2005 10:00:00	Counting Start:	06/13/2007 16:28:18
Sampling Stop:	01/28/2005 10:00:00	Decay Time.	2.08e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	10800 Sec
Sample Size	1.00e+000 L	Real Time	10872 Sec
Collection Efficiency	1.0000	Spectrum File	.070872D06.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 6 (Detector 6)

Efficiency File: (D06)(Sh01).eff (Geo 1 Eff Cal)

*Eff=10^[-2.87E+01 +2.52E+01*L +-5.85E+00*L^2 +0.00E+00*L^3] 09/11/2006

Eff.=10^[-1.40E+00 +1.00E+00*L +-6.55E-01*L^2 +7.72E-02*L^3] Above 180.00 keV

Library File: . RA-226(186 KEV).LIB (Ra-226 std ver. (186 keV))

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.21		4.32E+04 +- 9.00E+02	9.63E+02	4.78E+02	1.40E+07

MEASURED TOTAL: 4.32E+04 +- 9.00E+02 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.43	94.04	407	193	155	5451	0.76	1070DEsc
2	52.96	107.09	243	191	155	5451	0.83	Unknown
3	74.77	150.65	6384	270	179	6765	0.98	Unknown
4	76.34	153.78	353	169	135	4510	0.66	Unknown
5	77.06	155.21	11240	286	157	5638	0.86	Unknown
6	83.81	168.70	488	170	135	4510	0.62	Unknown
7	87.12	175.32	5050	260	179	6765	1.05	Unknown
8	89.79	180.64	1895	234	179	6765	0.93	Unknown
10	195.84	392.45	261	205	167	5882	0.93	Unknown
11	242.02	484.69	15279	297	136	3893	1.02	Unknown
12	258.89	518.39	912	184	143	4034	1.10	1281DEsc
13	274.74	550.05	619	175	138	3739	1.11	Unknown
14	295.22	590.96	33808	401	131	3321	1.07	Unknown
15	314.47	629.39	222	149	120	2826	1.12	Unknown

070872D06.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
16	333.36	667.14	145	275	225	6260	2.59	Deleted
17	349.47	699.31	837	302	244	6496	3.05	Unknown
18	351.92	704.20	56000	492	111	2393	1.12	Unknown
19	386.67	773.60	456	146	115	2439	1.34	1408DEsc
20	388.92	778.10	547	135	104	2134	1.13	Unknown
21	405.63	811.47	185	133	107	2267	1.06	Unknown
22	454.81	909.71	422	123	96	1685	1.38	Unknown
23	461.91	923.88	189	87	68	1053	0.90	Unknown
24	469.86	939.75	113	84	67	1026	0.75	Unknown
25	480.59	961.18	404	107	81	1301	1.10	Unknown
26	487.12	974.23	506	118	90	1487	1.24	1509DEsc
27	510.67	1021.27	444	177	141	2587	2.59	Unknown
28	533.46	1066.78	240	98	77	1212	1.26	Unknown
29	543.41	1086.65	75	78	62	896	1.04	Unknown
30	580.07	1159.89	369	95	71	1038	1.38	Unknown
31	609.28	1218.22	40577	413	74	1028	1.36	1120SEsc
32	639.82	1279.22	70	90	73	989	1.65	Deleted
33	665.44	1330.39	1190	101	61	766	1.31	Unknown
34	683.44	1366.34	77	68	54	640	1.22	Unknown
35	703.10	1405.62	286	85	64	854	1.27	Unknown
36	719.79	1438.94	274	75	55	657	1.18	Unknown
37	742.11	1483.52	149	91	72	963	1.63	1764DEsc
38	752.96	1505.20	65	61	48	532	0.91	Unknown
39	768.40	1536.04	3655	144	64	796	1.45	1281SEsc
40	785.95	1571.08	920	106	71	894	1.76	Unknown
41	806.22	1611.58	837	92	59	720	1.35	Unknown
42	821.16	1641.43	137	70	54	641	1.09	Unknown
43	825.91	1650.90	97	100	81	1099	1.93	1847DEsc
44	839.08	1677.21	439	89	64	801	1.49	Unknown
45	904.34	1807.56	64	82	66	857	1.44	Deleted
46	934.14	1867.08	1997	116	61	733	1.52	Unknown
47	964.06	1926.84	180	72	55	614	1.38	Unknown
48	1052.09	2102.66	132	68	53	587	1.51	Unknown
49	1070.01	2138.44	108	70	55	603	1.59	Unknown
50	1104.72	2207.77	76	63	49	515	1.49	Unknown
51	1120.28	2238.85	8179	192	53	565	1.71	Unknown
52	1134.19	2266.64	106	58	45	443	1.34	Unknown
53	1155.29	2308.78	917	94	59	637	1.93	Unknown
54	1181.29	2360.71	31	126	103	1279	4.02	Deleted
55	1207.69	2413.44	244	74	55	562	1.90	Unknown
56	1238.14	2474.26	3001	124	48	458	1.71	Unknown
57	1253.71	2505.35	233	97	76	798	3.25	1764SEsc
58	1281.13	2560.13	721	82	51	497	1.81	Unknown
59	1303.40	2604.59	42	52	42	365	1.40	Unknown
60	1377.68	2752.95	1998	107	49	437	1.90	Unknown
61	1385.34	2768.27	372	68	46	401	1.73	Unknown
62	1401.55	2800.63	553	72	45	410	1.63	Unknown
63	1408.00	2813.52	1044	87	48	451	1.80	Unknown
64	1460.63	2918.64	1	64	52	462	1.76	Deleted

070872D06.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
65	1509.21	3015.66	936	91	55	567	1.97	Unknown
66	1538.56	3074.29	145	73	56	540	2.36	Unknown
67	1543.31	3083.78	155	55	41	347	1.51	Unknown
68	1583.19	3163.43	239	56	38	296	1.63	Unknown
69	1594.59	3186.19	74	50	38	296	1.60	Unknown
70	1599.36	3195.73	63	49	38	296	1.66	Unknown
71	1661.20	3319.24	419	60	36	231	2.12	Unknown
72	1683.86	3364.50	85	48	36	222	2.31	Unknown
73	1693.20	3383.15	97	55	42	269	2.83	Unknown
74	1729.53	3455.72	1364	82	29	147	2.27	Unknown
75	1764.41	3525.38	6236	162	29	141	2.20	Unknown
76	1838.21	3672.77	147	41	27	133	2.11	Unknown
77	1847.31	3690.96	874	68	27	133	2.09	Unknown
78	1873.01	3742.29	88	35	24	113	1.73	Unknown
79	1896.34	3788.89	29	29	22	110	1.25	Unknown

c:\SEEKER\BIN\070872d06.res Analysis Results Saved.

070763D04.SPC Analyzed by MR

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0718001-3 RA-226 VER 783.3020.77

Sampling Start:	01/28/2005 10:00:00	Counting Start:	06/15/2007 13:14:28
Sampling Stop:	01/28/2005 10:00:00	Decay Time.	2.08E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	7200 Sec
Sample Size	1.00E+000 L	Real Time	7258 Sec
Collection Efficiency	1.0000	Spc. File	.070763D04.SPC

Detector #: 4 (Detector 4)

Energy(keV)= -0.88 + 0.500*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 06/15/2007
FWHM(keV) = 0.61 + 0.012*En + 6.19E-04*En^2 + 0.00E+00*En^3 01/11/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	46.53	94.73	479	129	100	2464	0.54	a	
2	53.22	108.08	338	175	141	3996	0.81	a	
3	74.88	151.36	6135	257	168	5691	0.82	a	HiResid
4	77.06	155.72	10586	284	161	5200	0.74	b	HiResid
5	79.35	160.30	264	134	107	2838	0.56	c	HiResid
6	81.20	164.00	15	99	81	1837	0.38	d	NET< CL HiResid
7	83.89	169.38	348	131	104	2641	0.53	e	HiResid
8	87.17	175.92	4410	219	143	4117	0.86	f	HiResid
9	89.88	181.35	1783	187	137	3781	0.86	g	HiResid
10	92.48	186.53	79	139	114	2868	0.64	h	NET< CL HiResid
11	94.96	191.49	128	138	112	2776	0.62	i	HiResid
12	111.23	224.00	32	90	73	1493	0.40	a	NET< CL
13	186.28	373.94	10638	262	133	3545	0.86	a	
14	242.08	485.44	10498	252	120	2664	0.92	a	
15	259.05	519.34	623	127	96	1858	0.81	a	
16	274.13	549.47	293	162	130	2685	1.37	a	
17	275.09	551.40	336	86	64	1007	0.50	b	
18	295.31	591.80	22992	327	101	1878	0.96	a	
19	314.57	630.28	60	86	69	1069	0.64	a	NET< CL
20	333.25	667.59	54	127	104	1832	1.22	a	NET< CL
21	351.96	704.99	37691	404	93	1597	1.02	a	HiResid
22	386.96	774.92	171	93	74	1097	0.82	a	

070763D04.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
23	389.04	779.08	305	108	84	1316	1.00	b	
24	406.16	813.28	57	91	74	1107	0.80	a	NET< CL
25	454.96	910.78	193	113	90	1209	1.45	a	
26	461.76	924.37	129	74	58	678	0.87	a	
27	469.72	940.28	97	72	57	652	0.75	a	
28	474.11	949.05	53	80	65	782	0.99	b	NET< CL
29	480.47	961.75	248	85	65	833	1.15	a	
30	487.22	975.25	266	85	64	818	1.17	a	
31	494.27	989.33	36	52	42	433	0.59	a	NET< CL
32	509.65	1020.05	195	99	78	1010	1.65	a	Wide Pk
33	511.48	1023.72	322	116	91	1212	1.90	b	
34	533.81	1068.33	104	62	48	519	0.84	a	
35	573.13	1146.90	79	95	77	974	1.56	a	
36	580.32	1161.26	224	68	50	539	1.05	a	
37	584.43	1169.47	64	77	62	718	1.27	b	
38	609.41	1219.39	27360	340	66	805	1.30	a	HiResid Wide Pk
39	616.85	1234.24	130	95	76	771	2.34	b	HiResid
40	665.60	1331.65	744	84	53	515	1.36	a	
41	703.17	1406.71	223	71	53	524	1.27	a	
42	720.19	1440.72	143	68	53	511	1.29	a	
43	741.55	1483.41	58	41	32	248	0.70	a	
44	742.95	1486.21	54	65	52	496	1.31	b	
45	752.52	1505.33	57	69	55	529	1.39	a	
46	768.58	1537.42	2396	120	57	573	1.49	a	
47	786.12	1572.45	622	84	55	505	1.63	a	
48	806.40	1612.98	487	77	52	496	1.25	a	
49	821.25	1642.65	104	64	50	468	1.27	a	
50	826.40	1652.93	65	52	41	351	0.95	b	
51	839.07	1678.25	276	74	54	513	1.47	a	
52	934.24	1868.41	1255	97	54	539	1.57	a	
53	964.19	1928.25	87	49	38	328	0.93	a	
54	1052.20	2104.11	83	40	29	210	0.88	a	
55	1070.06	2139.78	65	47	36	286	1.18	a	
56	1084.09	2167.81	57	67	54	462	2.17	a	
57	1120.45	2240.46	5315	158	50	432	1.76	a	
58	1133.82	2267.18	45	42	33	250	1.06	a	
59	1155.54	2310.58	636	77	48	388	1.96	a	
60	1182.01	2363.47	75	47	36	264	1.23	a	
61	1208.13	2415.66	131	59	44	347	1.73	a	
62	1238.33	2476.01	1950	103	44	338	1.79	a	
63	1253.62	2506.55	87	55	42	317	1.84	a	
64	1281.29	2561.83	469	66	41	319	1.72	a	
65	1304.25	2607.71	61	50	39	301	1.81	a	
66	1377.85	2754.77	1289	88	42	322	2.01	a	
67	1385.41	2769.87	216	59	42	322	1.90	b	
68	1401.79	2802.61	436	67	44	336	2.15	a	
69	1408.23	2815.47	669	72	41	310	2.03	b	
70	1479.85	2958.57	56	63	50	415	2.43	a	

070763D04.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
71	1509.29	3017.39	546	72	45	367	2.00	a
72	1538.98	3076.70	105	47	34	251	1.53	a
73	1543.72	3086.19	94	61	48	391	2.24	b
74	1583.34	3165.35	164	49	34	226	1.84	a
75	1661.70	3321.92	264	45	26	127	1.81	a
76	1684.16	3366.78	40	31	23	106	1.85	a
77	1693.50	3385.45	61	35	25	115	2.07	a
78	1729.77	3457.92	859	67	26	121	2.18	a
79	1764.70	3527.71	3984	130	24	104	2.20	a HiResid
80	1838.62	3675.41	82	33	22	88	2.05	a
81	1847.52	3693.20	554	55	24	95	2.30	b
82	1873.44	3744.98	40	31	24	103	2.05	a
83	1896.03	3790.12	39	21	14	43	1.22	a
84	1936.73	3871.44	58	43	33	138	3.70	a Wide Pk

070763D04.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET040608.BKG (WEEKLY BKG 070608-4)

Bkg.File Detector #: 4

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.53	479	129	100	472	130	101	
2	53.22	338	175	141	332	176	141	
3	74.88	6135	257	168	6112	258	168	
4	77.06	10586	284	161	10565	284	161	
7	83.89	348	131	104	336	134	106	
8	87.17	4410	219	143	4400	219	144	
10	92.48	79	139	114	15	141	116	NET<CL
13	186.28	10638	262	133	10587	262	134	
16	274.13	293	162	130	290	162	130	
18	295.31	22992	327	101	22975	327	102	
21	351.96	37691	404	93	37681	405	94	
32	509.65	195	99	78	42	103	84	NET<CL
37	584.43	64	77	62	45	78	64	NET<CL
38	609.41	27360	340	66	27344	341	67	
53	964.19	87	49	38	82	50	38	

070763D04.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0718001-3 RA-226 VER 783.3020.77

Sampling Start:	01/28/2005 10:00:00	Counting Start:	06/15/2007 13:14:28
Sampling Stop:	01/28/2005 10:00:00	Decay Time.	2.08e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	7200 Sec
Sample Size	1.00e+000 L	Real Time	7258 Sec
Collection Efficiency	1.0000	Spectrum File	.070763D04.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 4 (Detector 4)

Efficiency File: (D04)(Sh01).EFF (Geo 1 Eff Cal)

Eff.=1/[9.03E-03*En^-3.44E+00 + 1.73E+02*En^8.64E-01] 01/12/2007

Library File: . RA-226(186 KEV).LIB (Ra-226 std ver. (186 keV))

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.21		4.81E+04 +- 1.19E+03	1.23E+03	6.08E+02	1.40E+07

MEASURED TOTAL: 4.81E+04 +- 1.19E+03 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.53	94.73	472	130	101	2464	0.54	Unknown
2	53.22	108.08	332	176	141	3996	0.81	Unknown
3	74.88	151.36	6112	258	168	5691	0.82	Unknown
4	77.06	155.72	10565	284	161	5200	0.74	Unknown
5	79.35	160.30	264	134	107	2838	0.56	Unknown
6	81.20	164.00	15	99	81	1837	0.38	Deleted
7	83.89	169.38	336	134	106	2641	0.53	Unknown
8	87.17	175.92	4400	219	144	4117	0.86	Unknown
9	89.88	181.35	1783	187	137	3781	0.86	Unknown
10	92.48	186.53	15	141	116	2868	0.64	Deleted
11	94.96	191.49	128	138	112	2776	0.62	Unknown
12	111.23	224.00	32	90	73	1493	0.40	Deleted
14	242.08	485.44	10498	252	120	2664	0.92	Unknown
15	259.05	519.34	623	127	96	1858	0.81	1281DEsc
16	274.13	549.47	290	162	130	2685	1.37	Unknown

070763D04.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
17	275.09	551.40	336	86	64	1007	0.50	Unknown
18	295.31	591.80	22975	327	102	1878	0.96	Unknown
19	314.57	630.28	60	86	69	1069	0.64	Deleted
20	333.25	667.59	54	127	104	1832	1.22	Deleted
21	351.96	704.99	37681	405	94	1597	1.02	Unknown
22	386.96	774.92	171	93	74	1097	0.82	1408DEsc
23	389.04	779.08	305	108	84	1316	1.00	Unknown
24	406.16	813.28	57	91	74	1107	0.80	Deleted
25	454.96	910.78	193	113	90	1209	1.45	Unknown
26	461.76	924.37	129	74	58	678	0.87	Unknown
27	469.72	940.28	97	72	57	652	0.75	Unknown
28	474.11	949.05	53	80	65	782	0.99	Deleted
29	480.47	961.75	248	85	65	833	1.15	Unknown
30	487.22	975.25	266	85	64	818	1.17	1509DEsc
31	494.27	989.33	36	52	42	433	0.59	Deleted
32	509.65	1020.05	42	103	84	1010	1.65	Deleted
33	511.48	1023.72	322	116	91	1212	1.90	Unknown
34	533.81	1068.33	104	62	48	519	0.84	Unknown
35	573.13	1146.90	79	95	77	974	1.56	Unknown
36	580.32	1161.26	224	68	51	539	1.05	Unknown
37	584.43	1169.47	45	78	64	718	1.27	Deleted
38	609.41	1219.39	27344	341	67	805	1.30	1120SEsc
39	616.85	1234.24	130	95	76	771	2.34	Unknown
40	665.60	1331.65	744	84	53	515	1.36	Unknown
41	703.17	1406.71	223	71	53	524	1.27	Unknown
42	720.19	1440.72	143	68	53	511	1.29	Unknown
43	741.55	1483.41	58	41	32	248	0.70	1765DEsc
44	742.95	1486.21	54	65	52	496	1.31	1765DEsc
45	752.52	1505.33	57	69	55	529	1.39	Unknown
46	768.58	1537.42	2396	120	57	573	1.49	1281SEsc
47	786.12	1572.45	622	84	55	505	1.63	Unknown
48	806.40	1612.98	487	77	52	496	1.25	Unknown
49	821.25	1642.65	104	65	50	468	1.27	Unknown
50	826.40	1652.93	65	52	41	351	0.95	1848DEsc
51	839.07	1678.25	276	74	54	513	1.47	Unknown
52	934.24	1868.41	1255	97	54	539	1.57	Unknown
53	964.19	1928.25	82	50	38	328	0.93	Unknown
54	1052.20	2104.11	83	40	29	210	0.88	Unknown
55	1070.06	2139.78	65	47	36	286	1.18	Unknown
56	1084.09	2167.81	57	67	54	462	2.17	Unknown
57	1120.45	2240.46	5315	158	50	432	1.76	Unknown
58	1133.82	2267.18	45	42	33	250	1.06	Unknown
59	1155.54	2310.58	636	77	48	388	1.96	Unknown
60	1182.01	2363.47	75	47	36	264	1.23	Unknown
61	1208.13	2415.66	131	59	44	347	1.73	Unknown
62	1238.33	2476.01	1950	103	44	338	1.79	Unknown
63	1253.62	2506.55	87	55	42	317	1.84	1765SEsc
64	1281.29	2561.83	469	66	41	319	1.72	Unknown
65	1304.25	2607.71	61	50	39	301	1.81	Unknown

070763D04.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
66	1377.85	2754.77	1289	88	42	322	2.01	Unknown
67	1385.41	2769.87	216	59	42	322	1.90	Unknown
68	1401.79	2802.61	436	67	44	336	2.15	Unknown
69	1408.23	2815.47	669	72	41	310	2.03	Unknown
70	1479.85	2958.57	56	63	50	415	2.43	Unknown
71	1509.29	3017.39	546	72	45	367	2.00	Unknown
72	1538.98	3076.70	105	47	34	251	1.53	Unknown
73	1543.72	3086.19	94	61	48	391	2.24	Unknown
74	1583.34	3165.35	164	49	34	226	1.84	Unknown
75	1661.70	3321.92	264	45	26	127	1.81	Unknown
76	1684.16	3366.78	40	31	23	106	1.85	Unknown
77	1693.50	3385.45	61	35	25	115	2.07	Unknown
78	1729.77	3457.92	859	67	26	121	2.18	Unknown
79	1764.70	3527.71	3984	130	24	104	2.20	Unknown
80	1838.62	3675.41	82	33	22	88	2.05	Unknown
81	1847.52	3693.20	554	55	24	95	2.30	Unknown
82	1873.44	3744.98	40	31	24	103	2.05	Unknown
83	1896.04	3790.12	39	21	14	43	1.22	Unknown
84	1936.73	3871.44	58	43	33	138	3.70	Unknown

c:\SEEKER\BIN\070763d04.res Analysis Results Saved.

Gamma Spectrometer Run Log

Date: 6/13/07 Reviewed By/Date: JPL 6/14/07

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID/Comments	Saved?
TC070613-2 MB	JPL	1	NA	1	16:17	JPL	070880 D01.SPC	JPL
TC070613-2 LCS	JPL	↓	↓	↓	16:19	JPL	070881 D01.SPC	JPL
0706051-57	JPL	2	6	500	16:29	JPL	070890 D02.SPC	JPL
↓ -65	JPL	3	↓	↓	↓	↓	070771 D03.SPC	JPL
650706 12-2 MB	JPL	4	↓	↓	↓	↓	070755 D04.SPC	JPL
JPL 6/15/07 071800081-2	JPL	6	1	180	16:29	JPL	070872 D06.SPC	JPL

JPL 6/14/07

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry.

[3] Count duration.

KEY:
- * sample was counted on a puck
- ↑ sample was counted with air flow arrow pointing up
- ↓ sample was counted with air flow arrow pointing down

356746 B

Form 754r12b.doc (3/7/2007)

Gamma Spectrometer Run Log

Date: 6/13/07 Reviewed By/Date: JPK 6/13/07

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID/Comments	Saved?
6S070613-1 LCS	JPK	1	13	30	9:02	JPK	070855 D01.SPC	JPK
0706050-5D	JPK	4	↓	↓	↓	↓	070747 D04.SPC	JPK
↓ -10	JPK	6	↓	↓	↓	↓	070866 D06.SPC	JPK
6S070613-2 LCS	JPK	3	6	30	↓	↓	070766 D03.SPC	JPK
0718001-1	JPK	2	1	120	↓	↓	070857 D02.SPC	JPK
0713011-4 (144)	JPK	4	26	60	9:53	JPK	070749 D04.SPC	JPK
0713011-6 (435)	JPK	6	↓	↓	↓	↓	070867 D06.SPC	JPK
0706070-1	JPK	1	9↑	60	11:04	JPK	070856 D01.SPC	JPK
-2	JPK	3	↓	↓	↓	↓	070767 D03.SPC	JPK
0706071-1	JPK	4	↓	↓	↓	↓	070750 D04.SPC	JPK
↓ -2	JPK	6	↓	↓	↓	↓	070868 D06.SPC	JPK
0706071-3	JPK	2	9↑	60	11:35	JPK	070858 D02.SPC	JPK
0706070-2D	JPK	1	9↑	60	12:15	JPK	070857 D01.SPC	JPK
0706071-2D	JPK	3	↓	↓	↓	↓	070768 D03.SPC	JPK
↓ -4	JPK	4	↓	↓	↓	↓	070751 D04.SPC	JPK
↓ -5	JPK	6	↓	↓	↓	↓	070869 D06.SPC	JPK
6S070613-3 MB	JPK	2	9↑	60	12:46	JPK	070889 D02.SPC	JPK
6S070613-3 LCS	JPK	1	9↑	30	13:28	JPK	070858 D01.SPC	JPK
0706069-1	JPK	3	7*	60	↓	↓	070769 D03.SPC	JPK
↓ -2	JPK	4	↓	↓	↓	↓	070752 D04.SPC	JPK
6S070613-2 MB	JPK	6	↓	↓	↓	↓	070870 D06.SPC	JPK
0713001-8 (529)	JPK	1	13	30	14:29	JPK	070785 D08.SPC	JPK
0706069-2D	JPK	3	7*	60	14:35	JPK	070770 D03.SPC	JPK
6S070613-2 LCS	JPK	4	↓	30	↓	↓	070753 D04.SPC	JPK

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry.

[3] Count duration.

KEY:
- * sample was counted on a puck
- ↑ sample was counted with air flow arrow pointing up
- ↓ sample was counted with air flow arrow pointing down

356744 B

Form 754r12b.doc (3/7/2007)

Gamma Spectrometer Run Log

Date: 6/15/07

Reviewed By/Date: JPG 6/18/07

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID/Comments	Saved?
0706088-1	JPG	2	7*	60	10:49	JPG	070887D02.SPC	JPG
-9	JPG	3	↓	↓	↓	↓	070780D03.SPC	JPG
-17	JPG	4	↓	↓	↓	↓	070760D04.SPC	JPG
-26	JPG	6	↓	↓	↓	↓	070879D06.SPC	JPG
0706088-9D	JPG	2	7*	60	12:09	JPG	070898D02.SPC	JPG
-27	JPG	3	↓	↓	↓	↓	070781D03.SPC	JPG
-28	JPG	4	↓	↓	↓	↓	070761D04.SPC	JPG
-29	JPG	6	↓	↓	↓	↓	070880D06.SPC	JPG
6S070615-1 MB	JPG	2	7*	60	13:14	JPG	070892D02.SPC	JPG
6S070615-1 LCS	JPG	3	↓	30	↓	↓	070782D03.SPC	JPG
0718001-3	JPG	4	1	120	↓	↓	070763D04.SPC	JPG
070615-1	JSO	1	WBK6	1000	15:32	JPG	070887D01.SPC	JSO
-2	JSO	2	↓	↓	↓	↓	070900D02.SPC	JSO
-3	JSO	3	↓	↓	↓	↓	070783D03.SPC	JSO
-4	JSO	4	↓	↓	↓	↓	070765D04.SPC	JSO
-6	JSO	6	↓	↓	↓	↓	070881D06.SPC	JSO
-8	JSO	8	↓	↓	↓	↓	070745D08.SPC	JSO
-9	JSO	9	↓	↓	↓	↓	070899D09.SPC	JSO
				JPG 6/15/07				

[1] Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

[2] Calibration geometry.

[3] Count duration.

KEY:
- * sample was counted on a puck
- ↑ sample was counted with air flow arrow pointing up
- ↓ sample was counted with air flow arrow pointing down

356748B

Form 754r12b.doc (3/7/2007)

226Ra Standard Verification

Paragon Analytics

315030 A

WORKSHEET FOR IN-HOUSE OR RUSH SAMPLES / Ra/Sr Lab

Matrix N/A Prep Analyst ACB Prep Date 6/12/07 Analyte 226Ra Analytical Batch _____

Pretreatment? (Y / N) Batch _____ Count Date / Time _____ Superseded _____

Paragon WO No.	Sample Wt. (g/L)	Sample Aliq. (g/L)	Aliquot Basis (Dry / AR)	Spike Information	Remarks	Det. No.	Filename	POS Ckd By
0718001 - 1	N/A	1L	AR	S1		2	070887b02.SPC	
- 2						6	070872b06.SPC	
- 3						4	070763b04.SPC	

Balance No. _____ Spiked By _____ Date _____ Spike Witness _____ Date _____ QASS? (Y / N) No. _____

	Isotope	No	Act / mL	Vol	P	Total Act (dpm)	Decay Corrected		Relinquished by / Date	Received by / Date
Spike 1	226Ra	783.3020.77	103.84 dpm/mL	1L		103840 dpm		1		
Spike 2										
Spike 3								2		
Spike 4										

Electronic Benchsheet No. (if / when generated) _____ Reviewed by / Date _____

315030 B

WORKSHEET FOR IN-HOUSE OR RUSH SAMPLES / Ra/Sr Lab

Initials ALB Date 6/12/07 Method (SOP / Rev) _____ Matrix _____

COMMENTS

226Ra Standard Verification

① 1 L of 783.3020.77 added to Geo 1 marinelli for γ analysis

Reviewed by / Date _____

ANALYTICS
An Isotope Products Laboratories Company

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

CERTIFICATE OF CALIBRATION

Standard Radionuclide Source

73487-307 RSO# 824 Rec'd 8/29/06 GJB

1.0 Solid in 138G GA-MA Beaker

This standard radionuclide source was prepared using aliquots measured gravimetrically from master radionuclide solution sources. The Am-241 was calibrated by 4 pi alpha liquid scintillation counting. All other radionuclides were calibrated using a germanium gamma spectrometer system. Calibration and purity were checked using a germanium gamma spectrometer system. At the time of calibration no interfering gamma-ray emitting impurities were detected. The gamma-ray emission rates for the most intense gamma-ray lines are given. Analytics maintains traceability to the National Institute of Standards and Technology through a Measurements Assurance Program as described in USNRC Regulatory Guide 4.15, Rev. 1, February, 1979.

US Patent 4,430,258; UK Patent GB2,149,194B; CA Patent 1,196,776.
Density of solid matrix 1.15 g/cc.

Calibration date: July 1, 2006 12:00 EST

ISOTOPE	GAMMA-RAY ENERGY	HALF-LIFE		GAMMA-RAYS PER SECOND	TOTAL UNCERTAINTY %
Am-241	59.5	432	y	1323	3.0
Cd-109	88	462.6	d	1872	3.3
Co-57	122	271.79	d	984.9	3.0
Ce-139	166	137.6	d	1391	2.8
Hg-203	279	46.61	d	3088	2.7
Sn-113	392	115.1	d	1971	2.6
Cs-137	662	30.07	y	1256	3.0
Y-88	898	106.6	d	4857	2.6
Co-60	1173	5.2714	y	2377	2.7
Co-60	1332	5.2714	y	2374	2.6
Y-88	1836	106.6	d	5084	2.6

P O NUMBER 71239, Rel. 7/31/06, Item 1

SOURCE PREPARED BY: M Taskaeva
M. Taskaeva, Radiochemist

Q A APPROVED: 8-24-06

This standard will expire one year after the calibration date.

070691D02.SPC Analyzed by

****

SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

****

Geo 1 / Water

Sample ID: 0713002-2 GEO1 EFF CAL (824)

Sampling Start:	07/01/2006 10:00:00	Counting Start:	05/07/2007 12:25:18
Sampling Stop:	07/01/2006 10:00:00	Decay Time.	7.44E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	3600 Sec
Sample Size	1.00E+000 L	Real Time	3747 Sec
Collection Efficiency	1.0000	Spc. File	.070691D02.SPC

Detector #: 2 (Detector 2)

Energy(keV)= -0.50 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/07/2007
FWHM(keV) = 0.69 + 0.005*En + 9.43E-04*En^2 + 0.00E+00*En^3 05/07/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.58	120.02	28367	424	212	9076	0.80 a	
2	88.05	176.90	82181	638	229	10600	0.82 a	
3	122.15	245.01	44237	473	178	6394	0.85 a	
4	136.58	273.85	5676	250	164	5413	0.81 a	
5	165.93	332.48	29820	394	155	4864	0.88 a	
6	179.01	358.62	115	126	102	2574	0.46 a	
7	255.36	511.13	975	223	176	5280	1.22 a	
8	279.32	559.00	2350	203	147	3999	1.00 a	
9	391.88	783.86	18150	318	139	3294	1.17 a	
10	511.70	1023.23	364	175	140	3422	1.48 a	
11	536.98	1073.73	60	91	74	1333	0.65 a	NET< CL
12	661.94	1323.37	47490	462	126	2768	1.42 a	
13	814.45	1628.04	214	128	103	2171	1.37 a	
14	898.42	1795.79	19249	319	129	3075	1.70 a	
15	1173.66	2345.65	51039	466	92	1572	1.94 a	HiResid
16	1325.49	2648.96	448	111	84	982	3.32 a	HiResid
17	1332.89	2663.75	46166	436	60	638	2.12 b	HiResid
18	1836.48	3669.77	11168	215	32	165	2.54 a	HiResid

070691D02.SPC Analyzed by

****

SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

Paragon Analytics, Div. of DataChem Lab

GammaScan

****

Background File:. . . . . DET020505.BKG (WEEKLY BKG 070505-2)

Bkg.File Detector #: 2

==========

BACKGROUND SUBTRACT RESULTS

==========

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	88.05	82181	638	229	82177	638	229	
8	279.32	2350	203	147	2346	204	147	
10	511.70	364	175	140	264	175	142	
11	536.98	60	91	74	58	91	74	NET<CL
14	898.42	19249	319	129	19247	319	129	

070691D02.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 0713002-2 GEO1 EFF CAL (824)
Stds. Match Tolerance: 2.00 keV

Detector Number: 02 Calibration Date. . . 05/07/2007 12:25:18
Geometry File (D02)(Sh01).EFF ID. Geo 1 Eff Cal
Amount of Std. in Calib. Source: 1.000000 gm

Crossover: 180.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-2.48e+01 + 2.17e+01*En +-5.07e+00*En^2 + 0.00e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-2.65e+00 + 2.22e+00*En +-1.03e+00*En^2 + 1.15e-01*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	5.96e-03	1.03	6.03e-03	0.02	6.03e-03
2	88.04	1.94e-02	-3.77	1.87e-02	-2.50	1.82e-02
3	122.06	2.75e-02	4.08	2.87e-02	-1.93	2.81e-02
4	165.85	2.84e-02	-1.52	2.80e-02	1.60	2.84e-02
5	279.00	2.12e-02	0.29	2.13e-02	-3.39	2.06e-02
6	391.68	1.66e-02	-0.69	1.64e-02	-3.58	1.59e-02
7	661.64	1.07e-02	0.32	1.07e-02	-2.42	1.05e-02
8	898.02	8.26e-03	0.79	8.33e-03	-1.12	8.23e-03
9	1173.21	6.67e-03	-0.20	6.66e-03	0.07	6.66e-03
10	1332.48	6.04e-03	-0.91	5.99e-03	0.58	6.02e-03
11	1836.01	4.58e-03	0.39	4.60e-03	1.48	4.67e-03

Calibration Results Saved.

OK
MC 5/18/07

Geometry 1 Calibration Verification: Gamma Mixed Nuclide Source; Geometry 1

Detector 2

NEW SOURCE : 718 REF DATE : 7/1/2003 Count Date: 5/7/2007

FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB			EXPECTED ACTIVITY						
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Mass of Standard			DPS	pCi/L	Activity	Recovery	Pass/Fail	# of Half Lives Expired
Am-241	59.9	432.0000	1304	0.3590	1	L	Am-241	3632.3	98170.6	96100	98%	Pass	0.01
Cd-109	88	1.2666	1862	0.0361			Cd-109	51578.9	1394025.6	1390000	100%	Pass	3.04
Co-57	122	0.7441	1032	0.8560			Co-57	1205.6	32584.0	31500	97%	Pass	5.17
Ce-139	166	0.3768	1419	0.8035			Ce-139	1766.0	47730.4	NR	>5 h-lives	>5 h-lives	10.22
Hg-203	279	0.1276	3194	0.8146			Hg-203	3920.9	105971.4	NR	>5 h-lives	>5 h-lives	30.17
Sn-113	392	0.3151	1960	0.6490			Sn-113	3020.0	81622.5	NR	>5 h-lives	>5 h-lives	12.22
Cs-137	662	30.0000	1260	0.8521			Cs-137	1478.7	39964.9	40100	100%	Pass	0.13
Y-88	898	0.2919	5060	0.9340			Y-88	5417.6	146420.5	NR	>5 h-lives	>5 h-lives	13.19
Co-60	1173	5.2714	2402	0.9997			Co-60	2402.7	64938.4	65600	101%	Pass	0.73
Co-60	1332	5.2714	2427	0.9998			Co-60	2427.5	65607.7	65900	100%	Pass	0.73
Y-88	1836	0.2919	5287	0.9938			Y-88	5320.0	143783.3	NR	>5 h-lives	>5 h-lives	13.19

NR = NOT REPORTED

R:\INST\GAMMA\CALIBRATION\EFF\GEO1\DET2STD824.XLS

OK
MC
5/18/07

070692D02.SPC Analyzed by JLG

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0713002-2 GEO1 CAL VER (718)

Sampling Start:	07/01/2003 10:00:00	Counting Start:	05/07/2007 13:35:07
Sampling Stop:	07/01/2003 10:00:00	Decay Time.	3.37E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	3600 Sec
Sample Size	1.00E+000 L	Real Time	3667 Sec
Collection Efficiency	1.0000	Spc. File	.070692D02.SPC

Detector #: 2 (Detector 2)

Energy(keV) = -0.50 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/07/2007
FWHM(keV) = 0.69 + 0.005*En + 9.43E-04*En^2 + 0.00E+00*En^3 05/07/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	57.88	116.63	2039	416	334	13003	2.14	a	Wide Pk
2	59.58	120.03	27585	371	136	3727	0.79	b	
3	88.02	176.85	15305	292	128	3298	0.76	a	HiResid
4	116.82	234.38	100	98	79	1526	0.43	a	
5	122.18	245.07	2824	176	115	2684	0.84	a	
6	136.62	273.93	458	144	113	2584	0.87	a	
7	181.64	363.87	165	153	124	2854	1.03	a	
8	429.67	859.36	64	89	72	1271	0.60	a	NET< CL
9	509.71	1019.26	79	76	60	901	0.64	a	
10	661.96	1323.41	44759	437	91	1433	1.44	a	
11	712.28	1423.94	26	88	72	1014	1.14	a	NET< CL
12	1173.69	2345.71	35049	384	70	902	1.97	a	
13	1332.92	2663.80	31677	358	35	215	2.10	a	HiResid

070692D02.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET020505.BKG (WEEKLY BKG 070505-2)

Bkg.File Detector #: 2

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	88.02	15305	292	128	15301	292	128	
9	509.71	79	76	60	-21	77	64	NET<CL

070692D02.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0713002-2 GEO1 CAL VER (718)

Sampling Start:	07/01/2003 10:00:00	Counting Start:	05/07/2007 13:35:07
Sampling Stop:	07/01/2003 10:00:00	Decay Time.	3.37e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	3600 Sec
Sample Size	1.00e+000 L	Real Time	3667 Sec
Collection Efficiency	1.0000	Spectrum File	.070692D02.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 2 (Detector 2)

Efficiency File: (D02)(Sh01).EFF (Geo 1 Eff Cal)

Eff=10^[-2.48E+01 +2.17E+01*L +-5.07E+00*L^2 +0.00E+00*L^3] 05/07/2007

Eff.=10^[-2.65E+00 +2.22E+00*L +-1.03E+00*L^2 +1.15E-01*L^3] Above 180.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		9.61E+04 +- 1.29E+03	9.57E+02	4.74E+02	3.79E+06
Cd-109	88.02		1.39E+06 +- 2.66E+04	2.35E+04	1.16E+04	1.11E+04
Co-57	122.07		3.15E+04 +- 1.96E+03	2.61E+03	1.29E+03	6.50E+03
Cs-137	661.62		4.01E+04 +- 3.92E+02	1.65E+02	8.13E+01	2.64E+05
Co-60	Average:x		6.58E+04 +- 5.18E+02	. . . .	. . . .	4.62E+04
	1173.21		6.56E+04 +- 7.19E+02	2.67E+02	1.31E+02	4.62E+04
	1332.48		6.59E+04 +- 7.46E+02	1.50E+02	7.24E+01	4.62E+04
Ce-139	165.85		MDA	1.00E+05	4.95E+04	3.30E+03
Hg-203	279.18		MDA	1.24E+11	6.13E+10	1.12E+03
Sn-113	391.68		MDA	7.69E+05	3.80E+05	2.76E+03
Y-88	898.02		MDA	1.86E+06	9.16E+05	2.56E+03

MEASURED TOTAL: 1.62E+06 +- 3.07E+04 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	57.88	116.63	2039	416	334	13003	2.14	Unknown
4	116.82	234.38	100	98	79	1526	0.43	Unknown
6	136.62	273.93	458	144	113	2584	0.87	Unknown
7	181.64	363.87	165	153	124	2854	1.03	Unknown

070692D02.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
8	429.67	859.36	64	89	72	1271	0.60	Deleted
9	509.71	1019.26	-21	77	64	901	0.64	Deleted
11	712.28	1423.94	26	88	72	1014	1.14	Deleted

c:\SEEKER\BIN\070692d02.res Analysis Results Saved.

070017D04.SPC Analyzed by JP

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0713002-4 Geo 1 Eff Cal (824)

Sampling Start:	07/01/2006 12:00:00	Counting Start:	01/12/2007 10:25:53
Sampling Stop:	07/01/2006 12:00:00	Decay Time.	4.68E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	1800 Sec
Sample Size	1.00E+000 L	Real Time	1954 Sec
Collection Efficiency	1.0000	Spc. File	.070017D04.SPC

Detector #: 4 (Detector 4)

Energy(keV) = -1.08 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 01/12/2007
FWHM(keV) = 0.61 + 0.012*En + 6.19E-04*En^2 + 0.00E+00*En^3 01/11/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.52	121.04	14533	305	153	5210	0.72 a	HiResid
2	72.98	147.91	278	191	155	5331	0.72 a	
3	87.96	177.83	42859	458	161	5738	0.67 a	HiResid
4	122.10	246.01	26512	370	144	4187	0.81 a	
5	136.50	274.79	3360	195	129	3370	0.77 a	HiResid
6	165.86	333.41	22619	336	124	3078	0.81 a	HiResid
7	198.29	398.18	151	155	126	2944	0.91 a	
8	255.28	511.99	549	133	103	2118	0.79 a	
9	265.32	532.05	45	121	99	1962	0.87 a	NET< CL
10	279.20	559.77	5370	196	107	2109	1.00 a	
11	310.84	622.95	69	121	99	1809	0.98 a	NET< CL
12	391.73	784.52	14317	270	102	1787	1.07 a	
13	465.45	931.73	49	81	66	956	0.58 a	NET< CL
14	511.27	1023.25	271	156	125	2325	1.99 a	Wide Pk
15	624.50	1249.38	39	65	53	683	0.65 a	NET< CL
16	661.70	1323.67	18410	294	92	1571	1.33 a	
17	814.07	1627.99	356	122	95	1415	1.77 a	
18	898.08	1795.77	15272	268	86	1429	1.55 a	
19	1173.28	2345.38	19760	296	77	1038	1.73 a	HiResid
20	1326.16	2650.71	465	138	108	1116	5.61 a	HiResid Wide Pk
21	1332.46	2663.28	18286	276	43	361	1.87 b	HiResid
22	1835.91	3668.75	8825	190	25	115	2.18 a	HiResid

070017D04.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET040111.BKG (071111-4 Weekly Bkg)

Bkg.File Detector #: 4

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
2	72.98	278	191	155	276	191	155	
3	87.96	42859	458	161	42856	458	161	
7	198.29	151	155	126	147	155	126	
14	511.27	271	156	125	233	156	126	

070017D04.SPC Analyzed by

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SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

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Sample ID: 0713002-4 Geo 1 Eff Cal (824)
Stds. Match Tolerance: 2.00 keV

Detector Number: 04 Calibration Date. . . 01/12/2007 10:25:53
Geometry File (D04)(Sh01).EFF ID. Geo 1 Eff Cal
Amount of Std. in Calib. Source: 1.000000 gm

Eff = 1 / [9.03e-03*En^-3.44e+00 + 1.73e+02*En^ 8.64e-01]
(Where En = Energy in MeV)) (Exponential)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	6.11e-03	1.12	6.18e-03	17.32	7.47e-03
2	88.04	1.70e-02	-1.13	1.68e-02	18.55	2.07e-02
3	122.06	2.46e-02	0.38	2.47e-02	13.42	2.85e-02
4	165.85	2.41e-02	1.26	2.44e-02	9.86	2.71e-02
5	279.00	1.76e-02	-2.05	1.72e-02	10.29	1.92e-02
6	391.68	1.31e-02	-0.76	1.30e-02	12.14	1.47e-02
7	661.64	8.24e-03	0.19	8.26e-03	15.34	9.76e-03
8	898.02	6.20e-03	2.20	6.34e-03	17.20	7.66e-03
9	1173.21	4.95e-03	1.62	5.04e-03	18.79	6.20e-03
10	1332.48	4.59e-03	-1.76	4.51e-03	19.54	5.61e-03
11	1836.01	3.43e-03	-0.20	3.42e-03	21.41	4.35e-03

Calibration Results Saved.

RG 1/12/07

Geometry 01 Calibration Verification: Gamma Mixed Nuclide Source													
Std. #	718	Detector	4										
				REF DATE :	**7/1/2003**				count date		1/12/2007		
FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB			EXPECTED ACTIVITY						
					Mass of								# of half-lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Standard			DPS	pCi/L	Activity	Recovery	Pass/Fail	expired
Am-241	59.9	432.0000	1304	0.3590	1	L	Am-241	3632.3	98170.6	102000	104%	Pass	0.01
Cd-109	88	1.2666	1862	0.0361			Cd-109	51578.9	1394025.6	1510000	108%	Pass	2.79
Co-57	122	0.7441	1032	0.8551			Co-57	1206.9	32618.3	31500	97%	Pass	4.75
Ce-139	166	0.3768	1419	0.8035			Ce-139	1766.0	47730.4	>5 h-lives	>5 h-lives	>5 h-lives	9.38
Hg-203	279	0.1276	3194	0.7730			Hg-203	4132.0	111674.4	>5 h-lives	>5 h-lives	>5 h-lives	27.71
Sn-113	392	0.3151	1960	0.6490			Sn-113	3020.0	81622.5	>5 h-lives	>5 h-lives	>5 h-lives	11.22
Cs-137	662	30.0000	1260	0.8512			Cs-137	1480.3	40007.1	40900	102%	Pass	0.12
Y-88	898	0.2919	5060	0.9340			Y-88	5417.6	146420.5	>5 h-lives	>5 h-lives	>5 h-lives	12.11
Co-60	1173	5.2714	2402	1.0000			Co-60	2402.0	64918.9	65500	101%	Pass	0.67
Co-60	1332	5.2714	2427	1.0000			Co-60	2427.0	65594.6	65200	99%	Pass	0.67
Y-88	1836	0.2919	5287	0.9938			Y-88	5320.0	143783.3	>5 h-lives	>5 h-lives	>5 h-lives	12.11
											R:\inst\gamma\st718.xls		

070018D04.SPC Analyzed by JP

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0713002-4A Geo 1 Cal Ver (718)

Sampling Start:	07/01/2003 12:00:00	Counting Start:	01/12/2007 11:03:22
Sampling Stop:	07/01/2003 12:00:00	Decay Time.	3.10E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	1800 Sec
Sample Size	1.00E+000 L	Real Time	1822 Sec
Collection Efficiency	1.0000	Spc. File	070018D04.SPC

Detector #: 4 (Detector 4)

Energy(keV) = -1.08 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 01/12/2007
FWHM(keV) = 0.61 + 0.012*En + 6.19E-04*En^2 + 0.00E+00*En^3 01/11/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	49.94	101.90	252	162	130	3420	0.85 a	
2	59.51	121.01	15038	281	112	2551	0.74 a	HiResid
3	87.95	177.81	8875	209	74	1228	0.71 a	HiResid
4	98.84	199.55	84	120	97	1614	1.13 a	NET< CL
5	122.11	246.05	1633	115	67	992	0.73 a	
6	136.51	274.80	279	123	97	1603	1.09 a	
7	165.76	333.22	78	90	73	1063	0.83 a	
8	170.49	342.66	70	64	51	638	0.45 b	
9	175.12	351.90	54	77	62	851	0.66 c	NET< CL
10	185.65	372.94	62	105	86	1360	0.90 a	NET< CL
11	235.25	472.00	20	64	52	678	0.47 a	NET< CL
12	322.12	645.50	29	54	43	461	0.54 a	NET< CL
13	490.86	982.50	40	53	42	435	0.60 a	NET< CL
14	581.35	1163.21	44	50	40	358	0.85 a	
15	661.67	1323.63	17666	275	58	625	1.31 a	HiResid
16	995.47	1990.26	94	83	66	769	1.75 a	
17	1173.25	2345.33	13795	242	47	384	1.75 a	HiResid
18	1332.42	2663.22	12303	224	24	113	1.85 a	HiResid

070018D04.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET040111.BKG (071111-4 Weekly Bkg)

Bkg.File Detector #: 4

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	87.95	8875	209	74	8872	209	75	
10	185.65	62	105	86	50	106	86	NET<CL

070018D04.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0713002-4A Geo 1 Cal Ver (718)

Sampling Start:	07/01/2003 12:00:00	Counting Start:	01/12/2007 11:03:22
Sampling Stop:	07/01/2003 12:00:00	Decay Time.	3.10e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	1800 Sec
Sample Size	1.00e+000 L	Real Time	1822 Sec
Collection Efficiency	1.0000	Spectrum File	.070018D04.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 4 (Detector 4)

Efficiency File: (D04)(Sh01).EFF (Geo 1 Eff Cal)

Eff.=1/[9.03E-03*En^-3.44E+00 + 1.73E+02*En^8.64E-01] 01/12/2007

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		1.02E+05 +- 1.91E+03	1.55E+03	7.64E+02	3.79E+06
Cd-109	88.02		1.51E+06 +- 3.55E+04	2.58E+04	1.27E+04	1.11E+04
Co-57	122.07		3.15E+04 +- 2.21E+03	2.64E+03	1.29E+03	6.50E+03
Cs-137	661.62		4.09E+04 +- 6.37E+02	2.75E+02	1.35E+02	2.64E+05
Co-60	Average:x		6.53E+04 +- 8.24E+02	. . . .	. . . .	4.62E+04
	1173.21		6.55E+04 +- 1.15E+03	4.56E+02	2.22E+02	4.62E+04
	1332.48		6.52E+04 +- 1.19E+03	2.71E+02	1.28E+02	4.62E+04
Ce-139	165.85		MDA	5.27E+04r	2.57E+04	3.30E+03
Hg-203	279.18		MDA	3.61E+10	1.77E+10	1.12E+03
Sn-113	391.68		MDA	6.45E+05	3.17E+05	2.76E+03
Y-88	898.02		MDA	1.45E+06	7.11E+05	2.56E+03

MEASURED TOTAL: 1.75E+06 +- 4.11E+04 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	49.94	101.90	252	162	130	3420	0.85	Unknown
4	98.84	199.55	84	120	97	1614	1.13	Deleted
6	136.51	274.80	279	123	97	1603	1.09	Unknown
7	165.76	333.22	78	90	73	1063	0.83	Unknown
8	170.49	342.66	70	64	51	638	0.45	Unknown

070018D04.SPC Analyzed by

UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
9	175.12	351.90	54	77	62	851	0.66	Deleted
10	185.65	372.94	50	106	86	1360	0.90	Deleted
11	235.25	472.00	20	64	52	678	0.47	Deleted
12	322.12	645.50	29	54	43	461	0.54	Deleted
13	490.86	982.50	40	53	42	435	0.60	Deleted
14	581.35	1163.21	44	50	40	358	0.85	Unknown
16	995.47	1990.26	94	83	66	769	1.75	Unknown

062299D06.SPC Analyzed by CW

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0613004-6 GEO 1 EFF CAL (824)

Sampling Start:	07/01/2006 12:00:00	Counting Start:	09/11/2006 10:06:11
Sampling Stop:	07/01/2006 12:00:00	Decay Time.	1.73E+003 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	3600 Sec
Sample Size	1.00E+000 L	Real Time	3816 Sec
Collection Efficiency	1.0000	Spc. File	.062299D06.SPC

Detector #: 6 (Detector 6)

Energy(keV) = -0.69 + 0.501*Ch +-1.21E-08*Ch^2 + 0.00E+00*Ch^3 09/11/2006
FWHM(keV) = 1.19 + -0.002*En + 7.29E-04*En^2 + 0.00E+00*En^3 07/24/2006
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	59.52	120.20	17321	432	282	16764	0.97 a	
2	68.57	138.27	869	573	469	34236	1.81 a	
3	70.84	142.82	2134	456	367	24899	1.33 b	
4	72.87	146.86	2689	335	262	15562	0.90 c	
5	82.43	165.95	3002	571	461	33017	1.82 a	Wide Pk
6	85.57	172.22	9260	1014	819	66033	3.56 b	
7	88.01	177.10	89635	696	292	18009	1.00 c	
8	122.08	245.12	67543	624	284	17005	1.04 a	
9	136.50	273.92	9248	419	306	18487	1.07 a	
10	165.87	332.56	85526	661	253	13482	1.04 a	HiResid Wide Pk
11	169.73	340.25	7	895	736	51681	3.84 b	NET< CL HiResid
12	255.20	510.90	3206	298	227	10112	1.21 a	
13	279.25	558.93	70487	588	208	8536	1.18 a	
14	291.15	582.70	135	161	131	4242	0.68 a	
15	391.79	783.63	64255	552	181	6023	1.27 a	HiResid
16	486.62	972.99	90	162	132	3675	0.94 a	NET< CL
17	511.23	1022.12	1613	274	216	7476	2.15 a	
18	661.70	1322.56	40791	452	167	5398	1.50 a	
19	814.06	1626.80	1148	160	120	2938	1.38 a	
20	898.14	1794.69	74717	574	144	3827	1.67 a	HiResid
21	1173.29	2344.11	46124	448	106	2151	1.85 a	
22	1325.16	2647.37	1580	178	131	2472	3.03 a	

062299D06.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
23	1332.56	2662.15	41933	425	92	1561	1.98	b
24	1835.95	3667.36	43750	422	46	363	2.29	a HiResid

062299D06.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Version 1.8.2

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET060908.BKG (060908-6 WEEKLY BKGD)

Bkg.File Detector #: 6

==========

BACKGROUND SUBTRACT RESULTS

==========

PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
17	511.23	1613	274	216	1535	275	216	

062299D06.SPC Analyzed by

****

SEEKER C A L I B R A T I O N R E S U L T S Version 2.0.4

****

Sample ID: 0613004-6 GEO 1 EFF CAL (824)
Stds. Match Tolerance: 2.00 keV

Detector Number: 06 Calibration Date. . . 09/11/2006 10:06:11
Geometry File (D06)(Sh01).EFF ID. Geo 1 Eff Cal
Amount of Std. in Calib. Source: 1.000000 gm

Crossover: 180.00 keV

Below Crossover Efficiency Fit:
Eff = 10 ^ [-2.87e+01 + 2.52e+01*En +-5.85e+00*En^2 + 0.00e+00*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)
Above Knee Efficiency Fit:
Eff = 10 ^ [-1.40e+00 + 1.00e+00*En +-6.55e-01*En^2 + 7.72e-02*En^3]
(Where En = LOG(Energy in keV)) (Polynomial)

Pk. #	Energy (kev)	Measured Efficiency	% Difference	Calculated Efficiency	% Difference	Prev.Calc. Efficiency
1	59.50	3.64e-03	1.22	3.68e-03	-0.85	3.65e-03
2	88.04	1.48e-02	-4.48	1.42e-02	1.50	1.44e-02
3	122.06	2.29e-02	4.81	2.40e-02	2.25	2.46e-02
4	165.85	2.45e-02	-1.80	2.41e-02	1.96	2.46e-02
5	279.00	1.85e-02	0.02	1.85e-02	1.23	1.87e-02
6	391.68	1.40e-02	0.07	1.40e-02	1.78	1.42e-02
7	661.64	9.06e-03	-0.92	8.98e-03	1.35	9.10e-03
8	898.02	6.82e-03	1.55	6.93e-03	1.11	7.01e-03
9	1173.21	5.53e-03	0.06	5.53e-03	1.33	5.61e-03
10	1332.48	5.04e-03	-1.14	4.98e-03	1.66	5.06e-03
11	1836.01	3.82e-03	0.34	3.83e-03	3.40	3.97e-03

Calibration Results Saved.

OK
9/11/06

Page 004

Geometry 01 Calibration Verification: Gamma Mixed Nuclide Source													
Std. #	798	Detector	6										
NEW SOURCE :	**798**			**REF DATE :**	**7/1/2005**				count date		9/11/2006		
FROM CALIBRATION CERTIFICATE				FROM ANALYTICS.LIB			EXPECTED ACTIVITY						
					Mass of								# of half-lives
Isotope	KeV	Half Life(y)	Gammas/Sec.	Gamma Fraction:	Standard			DPS	pCi/g	Activity	Recovery	Pass/Fail	expired
Am-241	59.9	432.0000	1353	0.3590	1	L	Am-241	3768.8	101859.5	97000	95%	Pass	0.00
Cd-109	88	1.2666	1912	0.0361			Cd-109	52964.0	1431459.2	1490000	104%	Pass	0.94
Co-57	122	0.7441	1048	0.8551			Co-57	1225.6	33124.0	32000	97%	Pass	1.61
Ce-139	166	0.3768	1426	0.8035			Ce-139	1774.7	47965.8	48500	101%	Pass	3.17
Hg-203	279	0.1276	3260	0.7730			Hg-203	4217.3	113982.0	NA	>5 h-lives	>5 h-lives	9.38
Sn-113	392	0.3151	2038	0.6490			Sn-113	3140.2	84870.7	88200	104%	Pass	3.80
Cs-137	662	30.0000	1268	0.8512			Cs-137	1489.7	40261.1	41000	102%	Pass	0.04
Y-88	898	0.2919	5008	0.9340			Y-88	5361.9	144915.8	146000	101%	Pass	4.10
Co-60	1173	5.2714	2475	1.0000			Co-60	2475.0	66891.9	68600	103%	Pass	0.23
Co-60	1332	5.2714	2499	1.0000			Co-60	2499.0	67540.5	68100	101%	Pass	0.23
Y-88	1836	0.2919	5224	0.9938			Y-88	5256.6	142070.0	144000	101%	Pass	4.10
											R:\Inst\gamma\ST798.xls		

062302D06.SPC Analyzed by CW

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0613004-6A GEO 1 CAL VER (798)

Sampling Start:	07/01/2005 12:00:00	Counting Start:	09/11/2006 11:24:12
Sampling Stop:	07/01/2005 12:00:00	Decay Time.	1.05E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	5400 Sec
Sample Size	1.00E+000 L	Real Time	5543 Sec
Collection Efficiency	1.0000	Spc. File	.062302D06.SPC

Detector #: 6 (Detector 6)

Energy(keV)= -0.69 + 0.501*Ch +-1.21E-08*Ch^2 + 0.00E+00*Ch^3 09/11/2006
FWHM(keV) = 1.19 + -0.002*En + 7.29E-04*En^2 + 0.00E+00*En^3 07/24/2006
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000.

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)		FLAG
1	59.48	120.14	25644	420	224	10565	0.93	a	HiResid
2	86.98	175.03	3233	643	521	33393	2.65	a	Wide Pk
3	88.01	177.10	79514	632	236	11715	1.03	b	
4	122.07	245.11	43091	497	224	9901	1.08	a	
5	136.45	273.81	5438	271	187	7422	1.00	a	
6	165.85	332.52	20801	379	202	8020	1.08	a	
7	255.21	510.93	358	180	145	4784	0.82	a	
8	279.26	558.95	327	168	135	4143	0.77	a	
9	391.77	783.60	11517	287	157	4568	1.31	a	
10	432.05	864.01	65	158	129	3513	1.00	a	NET< CL
11	510.34	1020.35	452	205	165	4781	1.82	a	
12	512.17	1024.00	224	133	106	2608	1.05	b	
13	611.66	1222.65	131	130	105	2407	1.22	a	
14	661.68	1322.53	60926	518	128	3184	1.50	a	
15	813.20	1625.08	362	282	230	6496	3.23	a	Wide Pk
16	815.26	1629.18	-99	97	81	1624	0.86	b	NET< CL
17	836.24	1671.08	248	176	143	3578	1.88	a	
18	898.13	1794.65	11035	274	145	3901	1.63	a	
19	1173.29	2344.11	64793	522	94	1687	1.87	a	HiResid
20	1324.43	2645.91	169	88	69	780	2.54	a	
21	1332.56	2662.14	57861	487	64	749	1.96	a	
22	1460.94	2918.51	46	52	41	325	1.76	a	
23	1835.94	3667.35	6407	163	25	111	2.29	a	

062302D06.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET060908.BKG (060908-6 WEEKLY BKGD)

Bkg.File Detector #: 6

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
11	510.34	452	205	165	336	206	167	
22	1460.94	46	52	41	21	52	42	NET<CL

062302D06.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0613004-6A GEO 1 CAL VER (798)

Sampling Start:	07/01/2005 12:00:00	Counting Start:	09/11/2006 11:24:12
Sampling Stop:	07/01/2005 12:00:00	Decay Time.	1.05e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	5400 Sec
Sample Size	1.00e+000 L	Real Time	5543 Sec
Collection Efficiency	1.0000	Spectrum File	.062302D06.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 6 (Detector 6)

Efficiency File: (D06)(Sh01).EFF (Geo 1 Eff Cal)

Eff=10^[-2.87E+01 +2.52E+01*L +-5.85E+00*L^2 +0.00E+00*L^3] 09/11/2006

Eff.=10^[-1.40E+00 +1.00E+00*L +-6.55E-01*L^2 +7.72E-02*L^3] Above 180.00 keV

Library File: . . . .ANALYTICAL.LIB (Analytical)

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Am-241	59.54		9.70E+04 +- 1.59E+03	1.70E+03	8.46E+02	3.79E+06
Cd-109	88.02		1.49E+06 +- 1.19E+04	8.90E+03	4.43E+03	1.11E+04
Co-57	122.07		3.20E+04 +- 3.69E+02	3.35E+02	1.67E+02	6.50E+03
Ce-139	165.85		4.85E+04 +- 8.83E+02	9.47E+02	4.70E+02	3.30E+03
Sn-113	391.68		8.82E+04 +- 2.20E+03	2.43E+03	1.20E+03	2.76E+03
Cs-137	661.62		4.10E+04 +- 3.48E+02	1.74E+02	8.60E+01	2.64E+05
Y-88	Average:x		1.45E+05 +- 2.58E+03	. . . .	. . . .	2.56E+03
	898.02		1.46E+05 +- 3.64E+03	3.89E+03	1.92E+03	2.56E+03
	1836.01		1.44E+05 +- 3.67E+03	1.21E+03	5.74E+02	2.56E+03
Co-60	Average:x		6.84E+04 +- 3.98E+02	. . . .	. . . .	4.62E+04
	1173.21		6.86E+04 +- 5.52E+02	2.01E+02	9.90E+01	4.62E+04
	1332.48		6.81E+04 +- 5.73E+02	1.53E+02	7.49E+01	4.62E+04
Hg-203	279.18		MDA	5.19E+04r	2.57E+04	1.12E+03

MEASURED TOTAL: 2.01E+06 +- 2.03E+04 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
2	86.98	175.03	3233	643	521	33393	2.65	Unknown
5	136.45	273.81	5439	271	187	7422	1.00	Unknown

062302D06.SPC Analyzed by

UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
7	255.21	510.93	358	180	145	4784	0.82	Unknown
8	279.26	558.95	328	168	135	4143	0.77	Unknown
10	432.05	864.01	65	158	129	3513	1.00	Deleted
11	510.34	1020.35	336	206	167	4781	1.82	Unknown
12	512.17	1024.00	224	133	106	2608	1.05	Unknown
13	611.66	1222.65	131	130	105	2407	1.22	Unknown
15	813.20	1625.08	362	282	230	6496	3.23	1836DEsc
16	815.26	1629.18	-99	97	81	1624	0.86	Deleted
17	836.24	1671.08	248	176	143	3578	1.88	Unknown
20	1324.43	2645.91	169	88	69	780	2.54	1836SEsc
22	1460.94	2918.51	21	52	42	325	1.76	Deleted

c:\SEEKER\BIN\062302d06.res Analysis Results Saved.

Paragon Analytics

Gamma Spectrometer Calibration Log

Date: 6/13/07 Reviewed By/Date: JPS 6/14/07

Det. No.	Out Of Service	Background Started	Background OK	Source Check Started	Source Check OK	Source Check Failed Parameter(s)	Repeat Source Check OK	Repeat Source Check Failed Parameter(s)	Repeat Source Check Corrective Action Taken **	Repeat Source Check Removed from Service
1.				JPS	/	1332 Cent	JPS		Gain Adj.	
2.				JPS	JPS					
3.				JPS	/	1332 Eff	JPS			
4.				JPS	JPS					
5.	JPS			/	/					
6.				JPS	JPS					
7.	JPS			/	/					
8.		JPS	JPS	JPS	JPS		JPS •			
9.				JPS	JPS					
10.	JPS			/	/					

Corrective Action:

• New amp installed. Interium Control limits set.
JPS 6/13/07

356744 A

Form 754r12a.doc (3/7/2007)

356743

Paragon Analytics

Gamma Spectrometer Calibration Log

Date: 6/14/07 Reviewed By/Date: JK 6/15/07

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				JK	JK					
2.				JK	JK					
3.				JK	/	1332 Eff	JK			
4.				JK	JK					
5.	JK			/	/					
6.				JK	JK					
7.	JK			/	/					
8.				JK	JK					
9.		JK	JK	JK	/ ●		JK Δ			
10.	JK			/	/					

** Corrective Action:

● Amp displaying gain stabilizing issues. Amp replaced.
JK 6/14/07

Δ New amp installed. Interim control limits set.
JK 6/14/07

356747 A

Form 754r12a.doc (3/7/2007)

356746

Paragon Analytics

Gamma Spectrometer Calibration Log

Date: 6/15/07 Reviewed By/Date: JLK 6/18/07

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.		JK	LEO	JK	JK					
2.		JK	LEO	JK	JK					
3.		JK	LEO	JK	JK					
4.		JK	LEO	JK	JK					
5.	JK	/	/	/	/					
6.		JK	LEO	JK	JK					
7.	JK	/	/	/	/					
8.		JK	* LEO	JK	JK					
9.		JK	LEO	JK	JK					
10.	JK	/	/	/	/					

** Corrective Action:

* Peak fit error @ 75 + 87, 139 keV.
Detector cleaned and background rerun.
JLK 6/18/07

356748 A

Form 754r12a.doc (3/7/2007)

Paragon Analytics

Gamma Spectrometer Calibration Log

Date: 6/10/07 Reviewed By/Date: JAL 6/15/07

Det. No.	Out Of Service	Background		Source Check			Repeat Source Check			
		Started	OK	Started	OK	Failed Parameter(s)	OK	Failed Parameter(s)	Corrective Action Taken **	Removed from Service
1.				JJO	JJO					
2.				JJO	JJO					
3.				JJO	JJO					
4.				JJO	JJO					
5.	JJO									
6.				JJO	JJO					
7.	JJO									
8.				JJO	JJO					
9.				JJO		1332 KeV centroid		1332 KeV centroid		JJO
10.	JJO									

** Corrective Action:

356749 A

Form 754r12a.doc (3/7/2007)

356749

Radiochemistry Solution Report

Solution Id:	783.3020.77	Name:	Ra-226	Type:	IS
		Lot:		Vendor Name:	

Final Vol:	1024.2	Dept:	RD	Prep By	ALB	on	3/ 9/07	Reviewed By	dcb	on	10/ 5/07
Units:	g	Location:	RADSTD	Opened By		on		Verified By		on	
Matrix:	LIQUID	ExpireDate:	6/15/08	Received By		on		Deactivated By		on	

Comment:

Component Name	Component ID	Volume Added	Units
Ra-226	783.2613.72	3.8232	g

CompName	Calibrated Primary Act/Conc	Calibration Date	Reference Date	1/2 Life (Yrs)	Final Act/Conc	Summed Conc	Units
Rn-222	101056.9	1/28/05	10/5/07	1600 (Prnt)	46.721524757156		pCi/g
Ra-226	101056.9	1/28/05	10/5/07	1600	46.721524757156		pCi/g

Associated Parent IDs

783	783.2613.72

Abbreviations: NC = Not Calculated for reagents when the volume added is not entered.
NE = Not Entered

(Prnt) = Secular equilibrium; parent half life used to calculate concentration.

ICV's

JHS 1/29/08

DBC 1/28/08

ICV Radiometric Recovery Summary for 3E, 6C, and 1F

W.O.#	S ID	Flask No.	Efficiency	Denom	Ra-226 Activity (pCi/l)	Ra-226 Cnt. Unc.	Ra-226 2 sig. TPU	Ra-226 MDC	Sample ID	Radiometric Recovery (%)	
07-22-513	ICV24	1	0.7978	0.003242	45.36	2.66	4.39	1.06	07-22-513 ICV24	100.88%	
07-22-513	ICV25	2	1.8485	0.007495	43.02	1.69	3.71	0.51	07-22-513 ICV25	95.67%	
07-22-513	ICV26	20	1.7083	0.006941	49.32	1.88	4.23	0.57	07-22-513 ICV26	109.68%	
07-22-513	ICV27	21	2.0763	0.008418	38.88	1.51	3.35	0.44	07-22-513 ICV27	86.47%	W
07-22-513	ICV28	40	1.6392	0.00666	42.38	1.78	3.71	0.56	07-22-513 ICV28	94.25%	
07-22-513	ICV29	41	1.3938	0.005651	47.50	2.04	4.18	0.57	07-22-513 ICV29	105.63%	
07-22-513	ICV30	3	1.7566	0.007138	43.67	1.74	3.78	0.49	07-22-513 ICV30	97.12%	
07-22-513	ICV31	4	1.3782	0.005588	42.29	1.95	3.79	0.72	07-22-513 ICV31	94.05%	
07-22-513	ICV32	22	1.5201	0.006177	47.94	1.98	4.18	0.75	07-22-513 ICV32	106.61%	
07-22-513	ICV33	23	2.3027	0.009336	36.58	1.41	3.14	0.52	07-22-513 ICV33	81.36%	F
07-22-513	ICV34	42	1.0980	0.004462	42.15	2.18	3.90	0.80	07-22-513 ICV34	93.75%	
07-22-513	ICV35	44	1.5943	0.006464	43.78	1.84	3.83	0.60	07-22-513 ICV35	97.37%	
07-22-513	ICV36	6	1.1241	0.004565	29.65	1.81	2.91	0.66	07-22-513 ICV36	65.93%	F
07-22-513	ICV37	8	1.0563	0.004281	55.26	2.55	4.95	0.97	07-22-513 ICV37	122.90%	F
07-22-513	ICV38	24	2.2715	0.009225	44.65	1.56	3.77	0.54	07-22-513 ICV38	99.31%	
07-22-513	ICV39	25	2.5487	0.010328	39.31	1.40	3.33	0.63	07-22-513 ICV39	87.42%	W
07-22-513	ICV40	45	2.0014	0.008128	36.24	1.50	3.16	0.55	07-22-513 ICV40	80.61%	F
07-22-513	ICV41	46	1.5765	0.006389	45.70	1.90	3.99	0.72	07-22-513 ICV41	101.63%	
07-22-513	ICV42	9	1.0997	0.004468	52.86	2.42	4.72	0.65	07-22-513 ICV42	117.57%	F
07-22-513	ICV43	10	1.4829	0.006012	44.52	1.92	3.92	0.63	07-22-513 ICV43	99.02%	
07-22-513	ICV44	26	2.1382	0.008687	46.07	1.63	3.89	0.53	07-22-513 ICV44	102.46%	
07-22-513	ICV45	27	2.1902	0.008879	45.32	1.60	3.83	0.55	07-22-513 ICV45	100.78%	
07-22-513	ICV46	47	1.6724	0.006794	47.73	1.87	4.12	0.62	07-22-513 ICV46	106.15%	
07-22-513	ICV47	48	1.7657	0.007158	43.44	1.73	3.76	0.45	07-22-513 ICV47	96.61%	
07-22-513	ICV48	12	1.4357	0.005834	47.54	2.02	4.17	0.72	07-22-513 ICV48	105.72%	
07-22-513	ICV49	13	1.0322	0.004186	12.03	1.26	1.56	0.81	07-22-513 ICV49	26.76%	F
07-22-513	ICV50	28	2.2615	0.00919	46.80	1.60	3.94	0.59	07-22-513 ICV50	104.07%	
07-22-513	ICV51	29	1.8777	0.007614	20.67	1.20	1.99	0.64	07-22-513 ICV51	45.97%	F
07-22-513	ICV52	49	1.2701	0.005161	46.88	2.12	4.18	0.56	07-22-513 ICV52	104.26%	
07-22-513	ICV53	50	1.6386	0.006644	39.77	1.72	3.51	0.49	07-22-513 ICV53	88.45%	
07-22-513	ICV54	14	1.5452	0.006278	43.80	1.87	3.85	0.61	07-22-513 ICV54	97.41%	
07-22-513	ICV55	30	2.0223	0.008216	41.63	1.59	3.57	0.55	07-22-513 ICV55	92.59%	
07-22-513	ICV56	31	1.8030	0.00731	50.53	1.86	4.30	0.60	07-22-513 ICV56	112.37%	W
07-22-513	ICV57	51	1.4338	0.005825	50.05	2.08	4.37	0.73	07-22-513 ICV57	111.32%	W
07-22-513	ICV59	8	1.0563	0.004283	47.97	2.37	4.38	0.86	07-22-513 ICV59	106.69%	
07-22-513	ICV62	44	1.5943	0.006479	41.64	1.77	3.66	0.38	07-22-513 ICV62	92.61%	
07-22-513	ICV63	45	2.0014	0.008115	41.63	1.59	3.57	0.38	07-22-513 ICV63	92.57%	

ICV Radiometric Recovery Summary for 2B, 5D, and 7A

W.O.#	S ID	Flask No.	Efficiency	Denom	Ra-226 Activity (pCi/l)	Ra-226 Cnt. Unc.	Ra-226 2 sig. TPU	Ra-226 MDC	Sample ID	Radiometric Recovery (%)	
07-22-513	ICV24	1	1.1596	0.004702	43.73	2.15	3.99	0.62	07-22-513 ICV24	97.25%	
07-22-513	ICV25	2	2.1437	0.00871	42.44	1.55	3.61	0.42	07-22-513 ICV25	94.38%	
07-22-513	ICV26	20	1.7360	0.007038	48.56	1.87	4.17	0.70	07-22-513 ICV26	108.00%	
07-22-513	ICV27	21	2.2537	0.009157	38.56	1.45	3.30	0.48	07-22-513 ICV27	85.77%	W
07-22-513	ICV28	40	1.8606	0.007325	45.10	1.75	3.88	0.54	07-22-513 ICV28	100.30%	
07-22-513	ICV29	41	1.7646	0.00717	48.55	1.84	4.16	0.62	07-22-513 ICV29	107.98%	
07-22-513	ICV30	3	2.1494	0.008715	43.92	1.58	3.72	0.42	07-22-513 ICV30	97.67%	
07-22-513	ICV31	4	1.7236	0.007004	40.80	1.70	3.56	0.46	07-22-513 ICV31	90.74%	
07-22-513	ICV32	22	1.6369	0.006637	45.68	1.86	3.97	0.69	07-22-513 ICV32	101.59%	
07-22-513	ICV33	23	2.2531	0.009156	38.36	1.45	3.29	0.53	07-22-513 ICV33	85.32%	W
07-22-513	ICV34	42	1.2912	0.005235	41.31	1.98	3.74	0.57	07-22-513 ICV34	91.88%	
07-22-513	ICV35	44	1.6490	0.006701	51.95	1.97	4.45	0.67	07-22-513 ICV35	115.53%	F
07-22-513	ICV36	6	1.3989	0.005669	33.64	1.72	3.11	0.59	07-22-513 ICV36	74.83%	F
07-22-513	ICV37	8	1.4216	0.005773	59.14	2.27	5.08	0.77	07-22-513 ICV37	131.52%	F
07-22-513	ICV38	24	2.3404	0.009484	44.65	1.55	3.76	0.62	07-22-513 ICV38	99.31%	
07-22-513	ICV39	25	2.5764	0.010463	44.74	1.48	3.74	0.60	07-22-513 ICV39	99.49%	
07-22-513	ICV40	45	2.0444	0.008285	44.49	1.66	3.80	0.68	07-22-513 ICV40	98.95%	
07-22-513	ICV41	46	1.8767	0.007621	47.21	1.76	4.03	0.60	07-22-513 ICV41	104.99%	
07-22-513	ICV42	9	1.4469	0.005866	62.03	2.27	5.28	0.46	07-22-513 ICV42	137.95%	F
07-22-513	ICV43	10	1.7115	0.006953	44.81	1.79	3.88	0.53	07-22-513 ICV43	99.66%	
07-22-513	ICV44	26	2.1990	0.008915	46.43	1.61	3.91	0.51	07-22-513 ICV44	103.27%	
07-22-513	ICV45	27	2.2736	0.009237	46.83	1.61	3.94	0.63	07-22-513 ICV45	104.15%	
07-22-513	ICV46	47	1.9931	0.00808	45.65	1.67	3.88	0.48	07-22-513 ICV46	101.53%	
07-22-513	ICV47	48	2.0284	0.008241	44.36	1.63	3.78	0.37	07-22-513 ICV47	98.67%	
07-22-513	ICV48	12	1.5562	0.00631	46.58	1.91	4.06	0.52	07-22-513 ICV48	103.60%	
07-22-513	ICV49	13	1.3632	0.00554	12.48	1.10	1.46	0.63	07-22-513 ICV49	27.75%	F
07-22-513	ICV50	28	2.2390	0.009079	46.76	1.62	3.94	0.65	07-22-513 ICV50	103.99%	
07-22-513	ICV51	29	1.9502	0.007925	22.97	1.24	2.15	0.64	07-22-513 ICV51	51.09%	F
07-22-513	ICV52	49	1.5259	0.006187	49.87	1.99	4.32	0.52	07-22-513 ICV52	110.91%	
07-22-513	ICV53	50	2.0128	0.008179	41.45	1.58	3.55	0.38	07-22-513 ICV53	92.18%	
07-22-513	ICV54	14	1.9359	0.007849	44.96	1.69	3.84	0.52	07-22-513 ICV54	99.99%	
07-22-513	ICV55	30	2.0905	0.008476	40.42	1.54	3.47	0.51	07-22-513 ICV55	89.88%	W
07-22-513	ICV56	31	1.9333	0.007854	50.84	1.81	4.30	0.66	07-22-513 ICV56	113.07%	W
07-22-513	ICV57	51	1.7681	0.007169	40.73	1.69	3.55	0.58	07-22-513 ICV57	90.57%	
07-22-513	ICV59	8	1.4216	0.005777	48.97	2.04	4.28	0.52	07-22-513 ICV59	108.90%	
07-22-513	ICV62	44	1.6490	0.006686	50.78	1.93	4.35	0.41	07-22-513 ICV62	112.94%	W
07-22-513	ICV63	45	2.0444	0.008308	44.82	1.63	3.81	0.41	07-22-513 ICV63	99.69%	

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: DBC
Prep. Date S: 10/19/2007
Prep. Date C: 10/22/2007
SOP Used: 783R8

		S	Purge (end)						Deeman. (end)		Count Start		Count		
	S	V	Date	Time	Flask	Counter	Scaler	CBKG	Date	Time	Date	Time	Duration	COUNT	REMARKS
W.O.#	ID	(L)	D1	T1	No.	No.	No.	#	D2	T2	D3	T3	(min.)	#	
07-22-513	ICV24	1	10/22/2007	17:00	1	E	3	28	1/25/2008	8:11	1/25/2008	12:12	15	1196	
07-22-513	ICV25	1	10/22/2007	17:00	2	E	3	36	1/25/2008	8:11	1/25/2008	12:29	15	2597	
07-22-513	ICV26	1	10/22/2007	17:00	20	C	6	38	1/25/2008	8:11	1/25/2008	12:12	15	2757	
07-22-513	ICV27	1	10/22/2007	17:00	21	C	6	33	1/25/2008	8:11	1/25/2008	12:29	15	2633	
07-22-513	ICV28	1	10/22/2007	17:00	40	F	1	33	1/25/2008	8:11	1/25/2008	12:12	15	2275	
07-22-513	ICV29	1	10/22/2007	17:00	41	F	1	24	1/25/2008	8:11	1/25/2008	12:29	15	2156	
07-22-513	ICV30	1	10/22/2007	17:00	3	E	3	29	1/25/2008	8:52	1/25/2008	12:52	15	2505	
07-22-513	ICV31	1	10/22/2007	17:00	4	E	3	39	1/25/2008	8:52	1/25/2008	13:10	15	1916	
07-22-513	ICV32	1	10/22/2007	17:00	22	C	6	53	1/25/2008	8:52	1/25/2008	12:52	15	2405	
07-22-513	ICV33	1	10/22/2007	17:00	23	C	6	60	1/25/2008	8:52	1/25/2008	13:10	15	2773	
07-22-513	ICV34	1	10/22/2007	17:00	42	F	1	30	1/25/2008	8:52	1/25/2008	12:52	15	1524	
07-22-513	ICV35	1	10/22/2007	17:00	44	F	1	37	1/25/2008	8:52	1/25/2008	13:10	15	2285	
07-22-513	ICV36	1	10/22/2007	17:00	6	E	3	21	1/25/2008	9:22	1/25/2008	13:27	15	1096	
07-22-513	ICV37	1	10/22/2007	17:00	8	E	3	42	1/25/2008	9:22	1/25/2008	13:44	15	1921	
07-22-513	ICV38	1	10/22/2007	17:00	24	C	6	63	1/25/2008	9:22	1/25/2008	13:27	15	3335	
07-22-513	ICV39	1	10/22/2007	17:00	25	C	6	110	1/25/2008	9:22	1/25/2008	13:44	15	3335	
07-22-513	ICV40	1	10/22/2007	17:00	45	F	1	49	1/25/2008	9:22	1/25/2008	13:27	15	2389	
07-22-513	ICV41	1	10/22/2007	17:00	46	F	1	53	1/25/2008	9:22	1/25/2008	13:44	15	2372	
07-22-513	ICV42	1	10/22/2007	17:00	9	E	3	19	1/25/2008	10:07	1/25/2008	14:09	15	1895	
07-22-513	ICV43	1	10/22/2007	17:00	10	E	3	35	1/25/2008	10:07	1/25/2008	14:26	15	2161	
07-22-513	ICV44	1	10/22/2007	17:00	26	C	6	53	1/25/2008	10:07	1/25/2008	14:09	15	3232	
07-22-513	ICV45	1	10/22/2007	17:00	27	C	6	61	1/25/2008	10:07	1/25/2008	14:26	15	3257	
07-22-513	ICV46	1	10/22/2007	17:00	47	F	1	44	1/25/2008	10:07	1/25/2008	14:09	15	2620	
07-22-513	ICV47	1	10/22/2007	17:00	48	F	1	24	1/25/2008	10:07	1/25/2008	14:26	15	2494	
07-22-513	ICV48	1	10/22/2007	17:00	12	E	3	44	1/25/2008	11:02	1/25/2008	15:02	15	2247	
07-22-513	ICV49	1	10/22/2007	17:00	13	E	3	27	1/25/2008	11:02	1/25/2008	15:19	15	427	
07-22-513	ICV50	1	10/22/2007	17:00	28	C	6	76	1/25/2008	11:02	1/25/2008	15:02	15	3492	
07-22-513	ICV51	1	10/22/2007	17:00	29	C	6	60	1/25/2008	11:02	1/25/2008	15:19	15	1310	
07-22-513	ICV52	1	10/22/2007	17:00	49	F	1	19	1/25/2008	11:02	1/25/2008	15:02	15	1941	
07-22-513	ICV53	1	10/22/2007	17:00	50	F	1	25	1/25/2008	11:02	1/25/2008	15:19	15	2124	
07-22-513	ICV54	1	10/22/2007	17:00	14	E	3	36	1/25/2008	11:33	1/25/2008	15:35	15	2220	
07-22-513	ICV55	1	10/22/2007	17:00	30	C	6	50	1/25/2008	11:33	1/25/2008	15:35	15	2767	
07-22-513	ICV56	1	10/22/2007	17:00	31	C	6	47	1/25/2008	11:33	1/25/2008	15:51	15	2981	
07-22-513	ICV57	1	10/22/2007	17:00	61	F	1	45	1/25/2008	11:33	1/25/2008	15:35	15	2361	
07-22-513	ICV59	1	10/22/2007	17:00	8	E	3	33	1/28/2008	9:31	1/28/2008	13:49	15	1665	
07-22-513	ICV62	1	10/22/2007	17:00	44	F	1	13	1/28/2008	9:31	1/28/2008	13:31	15	2156	
07-22-513	ICV63	1	10/22/2007	17:00	45	F	1	22	1/28/2008	9:31	1/28/2008	13:49	15	2705	

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
818.3020.76	Ra 226	1.0	RS-005	100	9/1/2003

Spiked by: DBC on 10/22/2007
Spike Witness: EMF
Reviewed by: DBC DBC 1/28/08

1/28/2008.....6:54 PM

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Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: DBC
Prep. Date S: 10/19/2007
Prep. Date C: 10/22/2007
SOP Used: 783R8

		S	Purge (end)						Deeman. (end)		Count Start		Count		
	S	V	Date	Time	Flask	Counter	Scaler	CBKG	Date	Time	Date	Time	Duration	COUNT	REMARKS
W.O.#	ID	(L)	D1	T1	No.	No.	No.	#	D2	T2	D3	T3	(min.)	#	
07-22-513	ICV24	1	10/22/2007	17:00	1	B	2	19	1/25/2008	8:11	1/25/2008	12:29	15	1652	
07-22-513	ICV25	1	10/22/2007	17:00	2	B	2	32	1/25/2008	8:11	1/25/2008	12:12	15	2968	
07-22-513	ICV26	1	10/22/2007	17:00	20	D	5	62	1/25/2008	8:11	1/25/2008	12:29	15	2777	
07-22-513	ICV27	1	10/22/2007	17:00	21	D	5	48	1/25/2008	8:11	1/25/2008	12:12	15	2853	
07-22-513	ICV28	1	10/22/2007	17:00	40	A	7	38	1/25/2008	8:11	1/25/2008	16:23	15	2662	
07-22-513	ICV29	1	10/22/2007	17:00	41	A	7	50	1/25/2008	8:11	1/25/2008	12:12	15	2815	
07-22-513	ICV30	1	10/22/2007	17:00	3	B	2	32	1/25/2008	8:52	1/25/2008	13:10	15	3072	
07-22-513	ICV31	1	10/22/2007	17:00	4	B	2	24	1/25/2008	8:52	1/25/2008	12:52	15	2294	
07-22-513	ICV32	1	10/22/2007	17:00	22	D	5	53	1/25/2008	8:52	1/25/2008	13:10	15	2461	
07-22-513	ICV33	1	10/22/2007	17:00	23	D	5	59	1/25/2008	8:52	1/25/2008	12:52	15	2849	
07-22-513	ICV34	1	10/22/2007	17:00	42	A	7	20	1/25/2008	8:52	1/25/2008	13:10	15	1738	
07-22-513	ICV35	1	10/22/2007	17:00	44	A	7	51	1/25/2008	8:52	1/25/2008	12:52	15	2816	
07-22-513	ICV36	1	10/22/2007	17:00	6	B	2	26	1/25/2008	9:22	1/25/2008	13:44	15	1541	
07-22-513	ICV37	1	10/22/2007	17:00	8	B	2	49	1/25/2008	9:22	1/25/2008	13:27	15	2761	
07-22-513	ICV38	1	10/22/2007	17:00	24	D	5	90	1/25/2008	9:22	1/25/2008	13:44	15	3454	
07-22-513	ICV39	1	10/22/2007	17:00	25	D	5	104	1/25/2008	9:22	1/25/2008	13:27	15	3822	
07-22-513	ICV40	1	10/22/2007	17:00	45	A	7	81	1/25/2008	9:22	1/25/2008	13:44	15	3009	
07-22-513	ICV41	1	10/22/2007	17:00	46	A	7	53	1/25/2008	9:22	1/25/2008	13:27	15	2911	
07-22-513	ICV42	1	10/22/2007	17:00	9	B	2	16	1/25/2008	10:07	1/25/2008	14:26	15	2906	
07-22-513	ICV43	1	10/22/2007	17:00	10	B	2	33	1/25/2008	10:07	1/25/2008	14:09	15	2508	
07-22-513	ICV44	1	10/22/2007	17:00	26	D	5	52	1/25/2008	10:07	1/25/2008	14:26	15	3340	
07-22-513	ICV45	1	10/22/2007	17:00	27	D	5	87	1/25/2008	10:07	1/25/2008	14:09	15	3523	
07-22-513	ICV46	1	10/22/2007	17:00	47	A	7	36	1/25/2008	10:07	1/25/2008	14:26	15	2966	
07-22-513	ICV47	1	10/22/2007	17:00	48	A	7	22	1/25/2008	10:07	1/25/2008	14:09	15	2926	
07-22-513	ICV48	1	10/22/2007	17:00	12	B	2	25	1/25/2008	11:02	1/25/2008	15:19	15	2360	
07-22-513	ICV49	1	10/22/2007	17:00	13	B	2	29	1/25/2008	11:02	1/25/2008	15:02	15	578	
07-22-513	ICV50	1	10/22/2007	17:00	28	D	5	91	1/25/2008	11:02	1/25/2008	15:19	15	3463	
07-22-513	ICV51	1	10/22/2007	17:00	29	D	5	66	1/25/2008	11:02	1/25/2008	15:02	15	1512	
07-22-513	ICV52	1	10/22/2007	17:00	49	A	7	24	1/25/2008	11:02	1/25/2008	15:19	15	2475	
07-22-513	ICV53	1	10/22/2007	17:00	50	A	7	22	1/25/2008	11:02	1/25/2008	15:02	15	2715	
07-22-513	ICV54	1	10/22/2007	17:00	14	B	2	41	1/25/2008	11:33	1/25/2008	15:51	15	2844	
07-22-513	ICV55	1	10/22/2007	17:00	30	D	5	47	1/25/2008	11:33	1/25/2008	15:51	15	2768	
07-22-513	ICV56	1	10/22/2007	17:00	31	D	5	68	1/25/2008	11:33	1/25/2008	15:35	15	3240	

07-22-513	ICV57	1	10/22/2007	17:00	51	A	7	42	1/25/2008	11:33	1/25/2008	15:51	15	2361	
07-22-513	ICV59	1	10/22/2007	17:00	8	B	2	21	1/28/2008	9:31	1/28/2008	13:31	15	2268	
07-22-513	ICV62	1	10/22/2007	17:00	44	A	7	17	1/28/2008	9:31	1/28/2008	13:49	15	2714	
07-22-513	ICV63	1	10/22/2007	17:00	45	A	7	27	1/28/2008	9:31	1/28/2008	13:31	15	2985	

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
818.3020.76	Ra 226	1.0	RS-005	100	9/1/2003

Spiked by: DBC on 10/22/2007
Spike Witness: EMF
Reviewed by: DBC DBC 1/28/08

Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: DBC
Prep. Date S: 10/19/2007
Prep. Date C: 10/22/2007
SOP Used: 783R8

W.O.#	S ID	S V (L)	Purge (end) Date D1	Purge (end) Time T1	Flask No.	Counter No.	Scaler No.	CBKG #	Deeman. (end) Date D2	Deeman. (end) Time T2	Count Start Date D3	Count Start Time T3	Count Duration (min.)	COUNT #	REMARKS
07-22-513	ICV1	1	10/22/2007	12:00											
07-22-513	ICV2	1	10/22/2007												
07-22-513	ICV3	1	10/22/2007												
07-22-513	ICV4	1	10/22/2007												
07-22-513	ICV5	1	10/22/2007												
07-22-513	ICV6	1	10/22/2007												
07-22-513	ICV7	1	10/22/2007												
07-22-513	ICV8	1	10/22/2007												
07-22-513	ICV9	1	10/22/2007												
07-22-513	ICV10	1	10/22/2007												
07-22-513	ICV11	1	10/22/2007												
07-22-513	ICV12	1	10/22/2007												
07-22-513	ICV13	1	10/22/2007												
07-22-513	ICV14	1	10/22/2007												
07-22-513	ICV15	1	10/22/2007												
07-22-513	ICV16	1	10/22/2007												
07-22-513	ICV17	1	10/22/2007												
07-22-513	ICV18	1	10/22/2007												
07-22-513	ICV19	1	10/22/2007												
07-22-513	ICV20	1	10/22/2007												
07-22-513	ICV21	1	10/22/2007												
07-22-513	ICV22	1	10/22/2007												
07-22-513	ICV23	1	10/22/2007												
07-22-513	ICV24	1	10/22/2007		1	E	3	28	11/25/08	8:11	11/25/08	12:12	15	1196	
07-22-513	ICV25	1	10/22/2007		2	E	3	36				12:29		2597	
07-22-513	ICV26	1	10/22/2007		20	C	6	38				12:12		2757	
07-22-513	ICV27	1	10/22/2007		21	C	6	33				12:29		2633	
07-22-513	ICV28	1	10/22/2007		40	F	1	33				12:12		2275	
07-22-513	ICV29	1	10/22/2007		41	F	1	24				12:29		2156	
07-22-513	ICV30	1	10/22/2007		3	E	3	29		8:52		12:52		2505	
07-22-513	ICV31	1	10/22/2007		4	E	3	39				13:10		1916	
07-22-513	ICV32	1	10/22/2007		22	C	6	53				12:52		2405	
07-22-513	ICV33	1	10/22/2007		23	C	6	60				13:10		2773	
07-22-513	ICV34	1	10/22/2007		42	F	1	36				12:52		1524	
07-22-513	ICV35	1	10/22/2007		44	F	1	37				13:10		2285	
07-22-513	ICV36	1	10/22/2007		6	E	3	21		9:22		13:27		1096	
07-22-513	ICV37	1	10/22/2007		8	E	3	42				13:44		1921	
07-22-513	ICV38	1	10/22/2007		24	C	6	63				13:27		3335	
07-22-513	ICV39	1	10/22/2007		23	C	6	110				13:44		3335	

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07-22-513	ICV40	1	10/22/2007	17:00	45	F	1	49	1/25/08	9:22	1/25/08	13:27	15	2389	
07-22-513	ICV41	1	10/22/2007		46	F	1	53				13:44		2372	
07-22-513	ICV42	1	10/22/2007		9	E	3	19		10:07		14:09		1895	
07-22-513	ICV43	1	10/22/2007		10	E	3	35				14:26		2161	
07-22-513	ICV44	1	10/22/2007		26	C	6	53				14:09		2231	
07-22-513	ICV45	1	10/22/2007		27	C	6	61				14:26		2257	
07-22-513	ICV46	1	10/22/2007		47	F	1	44				14:09		2620	
07-22-513	ICV47	1	10/22/2007		48	F	1	24				14:26		2494	
07-22-513	ICV48	1	10/22/2007		12	E	3	44		11:02		15:02		2247	
07-22-513	ICV49	1	10/22/2007		13	E	3	27				15:19		427	
07-22-513	ICV50	1	10/22/2007		28	C	6	76				15:02		3492	
07-22-513	ICV51	1	10/22/2007		29	C	6	66				15:19		1310	
07-22-513	ICV52	1	10/22/2007		49	F	1	19				15:02		1941	
07-22-513	ICV53	1	10/22/2007		50	F	1	25				15:19		2124	
07-22-513	ICV54	1	10/22/2007		14	E	3	36		11:33		15:35		2220	
07-22-513	ICV55	1	10/22/2007		30	C	6	50						2767	
07-22-513	ICV56	1	10/22/2007		31	C	6	47				15:51		2981	
07-22-513	ICV57	1	10/22/2007		51	F	1	45				15:35		2361	
07-22-513	ICV58	1	10/22/2007		6	E	3	25	1/28/08	9:31	1/28/08	13:31	15	2151	
07-22-513	ICV59	1	10/22/2007		8	E	3	33				13:49		1665	
07-22-513	ICV60	1	10/22/2007		23	C	6	30				13:31		2585	
07-22-513	ICV61	1	10/22/2007		24	C	6	18				13:49		2062	
07-22-513	ICV62	1	10/22/2007		44	F	1	13				13:31		2156	
07-22-513	ICV63	1	10/22/2007		45	F	1	22				13:49		2705	
07-22-513	ICV64	1	10/22/2007		9	E	3	25		10:04		14:06		2005	
07-22-513	ICV65	1	10/22/2007		13	E	3	23				14:22		1952	
07-22-513	ICV66	1	10/22/2007												
07-22-513	ICV67	1	10/22/2007												
07-22-513	ICV68	1	10/22/2007								DBC				
07-22-513	ICV69	1	10/22/2007								1/28/08				
07-22-513	ICV70	1	10/22/2007												
07-22-513	ICV71	1	10/22/2007												
07-22-513	ICV72	1	10/22/2007												

Std./Ba Carrier ID	Std./ Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
818.3020.76	Ra 226	1.0	RS-005	100	9/1/2003

1/25/2008.....2:20 PM

Spiked by: DBC on 10/22/2007
Spike Witness:
Reviewed by: DBC 1/28/08

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Radium-226 in Water by Radon Emanation Technique for Calibration--Method 903.1

Analyst: DBC
Prep. Date S: 10/19/2007
Prep. Date C: 10/22/2007
SOP Used: 783R8

W.O.#	S ID	S V (L)	Purge (end) Date D1	Purge (end) Time T1	Flask No.	Counter No.	Scaler No.	CBKG #	Deeman. (end) Date D2	Deeman. (end) Time T2	Count Start Date D3	Count Start Time T3	Count Duration (min.)	COUNT #	REMARKS
07-22-513	ICV1	1	10/22/2007	17:00											
07-22-513	ICV2	1	10/22/2007												
07-22-513	ICV3	1	10/22/2007												
07-22-513	ICV4	1	10/22/2007												
07-22-513	ICV5	1	10/22/2007												
07-22-513	ICV6	1	10/22/2007												
07-22-513	ICV7	1	10/22/2007												
07-22-513	ICV8	1	10/22/2007												
07-22-513	ICV9	1	10/22/2007												
07-22-513	ICV10	1	10/22/2007												
07-22-513	ICV11	1	10/22/2007												
07-22-513	ICV12	1	10/22/2007												
07-22-513	ICV13	1	10/22/2007												
07-22-513	ICV14	1	10/22/2007												
07-22-513	ICV15	1	10/22/2007												
07-22-513	ICV16	1	10/22/2007												
07-22-513	ICV17	1	10/22/2007												
07-22-513	ICV18	1	10/22/2007												
07-22-513	ICV19	1	10/22/2007												
07-22-513	ICV20	1	10/22/2007												
07-22-513	ICV21	1	10/22/2007												
07-22-513	ICV22	1	10/22/2007												
07-22-513	ICV23	1	10/22/2007												
07-22-513	ICV24	1	10/22/2007		1	B	2	19	11/25/08	8:11	11/25/08	13:34	15	1652	
07-22-513	ICV25	1	10/22/2007		2	B	2	32				13:12		2968	
07-22-513	ICV26	1	10/22/2007		20	D	5	62				13:39		2777	
07-22-513	ICV27	1	10/22/2007		21	D	5	48			DBC 11/25/08	13:12		2853	
07-22-513	ICV28	1	10/22/2007		40	A	7	38			10:30	~~13:39~~		2662	
07-22-513	ICV29	1	10/22/2007		41	A	7	50				13:12		2815	
07-22-513	ICV30	1	10/22/2007		3	B	2	32		8:52		13:10		3072	
07-22-513	ICV31	1	10/22/2007		4	B	2	24				13:52		2294	
07-22-513	ICV32	1	10/22/2007		22	D	5	53				13:10		2461	
07-22-513	ICV33	1	10/22/2007		23	D	5	59				13:52		2849	
07-22-513	ICV34	1	10/22/2007		42	A	7	20				13:10		1738	
07-22-513	ICV35	1	10/22/2007		44	A	7	51				13:52		2816	
07-22-513	ICV36	1	10/22/2007		6	B	2	26		9:22		~~13:44~~		1541	
07-22-513	ICV37	1	10/22/2007		8	B	2	49			DBC 11/25/08 13:27	~~13:52~~		2761	
07-22-513	ICV38	1	10/22/2007		24	D	5	90				13:44		3454	
07-22-513	ICV39	1	10/22/2007		25	D	5	104				13:27		3822	

DBC 11/25/08

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07-22-513	ICV40	1	10/22/2007	17:00	45	A	7	81	1/25/08	9:22	1/25/08	13:44	15	3069	
07-22-513	ICV41	1	10/22/2007		46	A	7	53				17:27		2971	
07-22-513	ICV42	1	10/22/2007		9	B	2	16		10:07		14:26		2906	
07-22-513	ICV43	1	10/22/2007		10	B	2	33				14:09		2508	
07-22-513	ICV44	1	10/22/2007		26	D	5	52				14:26		3340	
07-22-513	ICV45	1	10/22/2007		27	D	5	87				14:09		3523	
07-22-513	ICV46	1	10/22/2007		47	A	7	36				14:26		2966	
07-22-513	ICV47	1	10/22/2007		48	A	7	22				14:09		2926	
07-22-513	ICV48	1	10/22/2007		12	B	2	25		11:02		15:19		2360	
07-22-513	ICV49	1	10/22/2007		13	B	2	29				15:02		578	
07-22-513	ICV50	1	10/22/2007		28	D	5	91				15:19		3463	
07-22-513	ICV51	1	10/22/2007		29	D	5	66				15:02		1512	
07-22-513	ICV52	1	10/22/2007		49	A	7	24				15:19		2475	
07-22-513	ICV53	1	10/22/2007		50	A	7	22				15:02		2715	
07-22-513	ICV54	1	10/22/2007		14	B	2	41		11:33		15:51		2844	
07-22-513	ICV55	1	10/22/2007		30	D	DBC 1/25/08 25	47				15:51		2768	
07-22-513	ICV56	1	10/22/2007		31	D	5	68				15:35		3240	
07-22-513	ICV57	1	10/22/2007		51	A	7	42				15:51		2361	
07-22-513	ICV58	1	10/28/2007		6	B	2	9	1/28/08	9:31	1/28/08	13:49	15	2630	
07-22-513	ICV59	1	10/22/2007		8	B	2	21				13:31		2268	
07-22-513	ICV60	1	10/22/2007		23	D	5	34				13:49		2720	
07-22-513	ICV61	1	10/22/2007		29	D	5	24				13:31		2131	
07-22-513	ICV62	1	10/22/2007		44	A	7	17				13:49		2714	
07-22-513	ICV63	1	10/22/2007		45	A	7	27				13:31		2985	
07-22-513	ICV64	1	10/22/2007		9	B	2	15		10:04		14:23		2683	
07-22-513	ICV65	1	10/22/2007		13	B	2	12				14:06		2564	
07-22-513	ICV66	1	10/22/2007												
07-22-513	ICV67	1	10/22/2007												
07-22-513	ICV68	1	10/22/2007								DBC				
07-22-513	ICV69	1	10/22/2007								1/28/08				
07-22-513	ICV70	1	10/22/2007												
07-22-513	ICV71	1	10/22/2007												
07-22-513	ICV72	1	10/22/2007												

Std./Ba Carrier ID	Std./ Carrier Type	Spike Vol. (ml)	pipet No.	Activity added (dpm)	Ref. date
818.3020.76	Ra 226	1.0	RS-005	100	9/1/2003

1/25/2008.....2:28 PM

Spiked by: DBC on 10/22/2007
Spike Witness:
Reviewed by: DBC 1/28/08

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Logbook No./Page 359605

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
Check Source	N/A	3E	Th	N/A						1/25/08	7:02	9593		DBC
		2B									7:03	9609		DBC
		6C									7:04	9457		DBC
		5D									7:05	9382		DBC
		1F									7:06	9461		DBC
		7A									7:07	9655		DBC
0722513-ICV24	N/A	3E	1	N/A	1/25/08	7:11	28	15	DBC	1/25/08	12:12	1196	15	DBC
-ICV25		2B	2				32		DBC			2968		DBC
-ICV25		3E	2			7:28	36		DBC		12:29	2597		DBC
-ICV24		2B	1				19		DBC			1652		DBC
-ICV26		6C	20			7:11	38		DBC		12:12	2757		DBC
-ICV27		5D	21				48		DBC			2853		DBC
-ICV27		6C	21			7:28	33		DBC		12:29	2633		DBC
-ICV26		5D	20				62		DBC			2777		DBC
-ICV28		1F	40			7:11	33		DBC		12:12	2275		DBC
-ICV29		7A	41				50		DBC			2815		DBC
-ICV29		1F	41			7:28	29		DBC		12:29	2156		DBC
-ICV28		7A	40				38		DBC		DBC 1/25/08 16:23	~~3672~~ 2662		DBC
-ICV30		3E	3			7:44	29		DBC		12:52	2505		DBC
-ICV31		2B	4				24		DBC			2294		DBC
-ICV31		3E	4			8:01	39		DBC		13:10	1916		DBC
-ICV30		2B	3				32		DBC			2072		DBC
-ICV32		6C	22			7:44	53		DBC		12:32	2405		DBC

Comments:

Reviewed by/date: DBC 1/25/08

Logbook No./Page 359606

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0722513 - ICV33	N/A	5D	23	N/A	1/25/08	7:44	59	15	DBC	1/25/08	12:52	2849	15	DBC
-ICV33		6C	23			8:01	60		DBC		13:10	2773		DBC
-ICV32		5D	22			↓	53		DBC		↓	2461		DBC
-ICV34		1F	42			7:44	30		DBC		12:52	1524		DBC
-ICV35		7A	44			↓	51		DBC		↓	2816		DBC
-ICV35		1F	44			8:01	37		DBC		13:10	2085		DBC
-ICV34		7A	42			↓	20		DBC		↓	1738		DBC
-ICV36		3E	6			8:18	21		DBC		13:27	1596		DBC
-ICV37		2B	8			↓	49		DBC		↓	2761		DBC
-ICV37		3E	8			8:34	42		DBC		13:44	1921		DBC
-ICV36		2B	6			↓	26		DBC		↓	1541		DBC
-ICV38		6C	24			8:18	63		DBC		13:27	3335		DBC
-ICV39		5D	25			↓	104		DBC		↓	3822		DBC
-ICV39		6C	25			8:34	116		DBC		13:44	3335		DBC
-ICV38		5D	24			↓	90		DBC		↓	3184		DBC
-ICV40		1F	45			8:18	49		DBC		13:27	2389		DBC
-ICV41		7A	46			↓	53		DBC		↓	2911		DBC
-ICV41		1F	46			8:34	53		DBC		13:44	2372		DBC
-ICV40		7A	45			↓	81		DBC		↓	3009		DBC
-ICV42		3E	9			8:55	19		DBC		14:09	1895		DBC
-ICV43		2B	10			↓	33		DBC		↓	2508		DBC
-ICV43		3E	10			9:15	35		DBC		14:26	2161		DBC
-ICV42		2B	9			↓	14		DBC		~~14:09~~ DBC 1/25/08	~~3292~~		DBC

Comments:

Reviewed by/date: DBC 1/25/08

Form 795r3.xls (11/14/05)

Logbook No./Page 359607

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Counts	Background Dur. (min.)	Background Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Counts	Sample Dur. (min.)	Sample Pos. Chk.
0722513-ICV44	N/A	6C	26	N/A	1/23/08	8:55	53	15	DBC	1/25/08	14:09	3523	15	DBC
-ICV45		5D	27			↓	87		DBC		↓	3523		DBC
-ICV45		6C	27			9:15	61		DBC		14:26	3257		DBC
-ICV44		5D	26			↓	52		DBC		↓	3340		DBC
-ICV46		1F	47			8:55	44		DBC		14:09	2626		DBC
-ICV47		7A	48			↓	20		DBC		↓	2926		DBC
-ICV47		1F	48			9:15	24		DBC		14:26	2494		DBC
-ICV46		7A	47			↓	36		DBC		↓	2966		DBC
-ICV48		3E	12			9:33	44		DBC		15:03	2247		DBC
-ICV49		2B	13			↓	29		DBC		↓	578		DBC
-ICV49		3E	13			9:49	27		DBC		15:19	427		DBC
-ICV48		2B	12			↓	25		DBC		↓	2360		DBC
-ICV50		3E 6C	28			9:33	76		DBC		15:03	3492		DBC
-ICV51		5D	29			↓	66		DBC		↓	1512		DBC
-ICV51		6C	29			9:49	60		DBC		15:19	1310		DBC
-ICV50		5D	28			↓	91		DBC		↓	3463		DBC
-ICV52		1F	49			9:33	19		DBC		15:03	1941		DBC
-ICV53		7A	50			↓	22		DBC		↓	2715		DBC
-ICV53		1F	50			9:49	25		DBC		15:19	2124		DBC
-ICV52		7A	49			↓	24		DBC		↓	2475		DBC
-ICV54		3E	14			10:10	36		DBC		15:35	2220		DBC
-ICV54		2B	14			10:27	41		DBC		15:51	2894		DBC
-ICV55		6C	30			10:10	50		DBC		15:35	2767		DBC

Comments:

Reviewed by/date: DBC 1/25/08

Logbook No./Page 359608

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0722513-ICV56	N/A	5D	31	N/A	1/25/08	10:10	66	15	DBC	1/25/08	15:35	2340	15	DBC
-ICV56		6C	31			10:27	47		DBC		15:51	2361		DBC
-ICV55		5D	30				47		DBC			2268		DBC
-ICV57		1F	51			10:10	45		DBC		15:35	2341		DBC
-ICV57		7A	51			10:27	42		DBC		15:51	2361		DBC
Check Source	N/A	3E	th	N/A						1/25/08	16:22	9587	1	DBC
		2B									16:23	9544		DBC
		6C									16:24	9537		DBC
		5D									16:25	9499		DBC
		1F									16:26	9397		DBC
		7A									16:29	9351		DBC
Check Source	N/A	3E	th	N/A						1/28/08	8:05	9667	1	DBC
		2B									8:06	9591		DBC
		6C									8:07	9563		DBC
		5D									8:08	9602		DBC
		1F									8:09	9532		DBC
		7A									8:10	9573		DBC
0722513-ICV58	N/A	3E	6	N/A	1/28/08	8:15	25	15	DBC	1/25/08	13:31	2151	15	DBC
-ICV59		2B	8				21		DBC			2268		DBC
-ICV59		3E	8			8:33	33		DBC		13:49	1665		DBC
-ICV58		2B	6				9		DBC			2630		DBC
-ICV60		6C	23			8:15	36		DBC		13:31	2585		DBC
-ICV61		5D	29				24		DBC			2131		DBC

Comments:

Reviewed by/date: DBC 1/28/08

Form 795r3.xls (11/14/05)

Logbook No./Page 359609

Paragon Analytics

Sample ID	Batch ID	Scalar / Detector ID	Flask ID	Run # of 20	Background Count Start Date	Background Count Start Time	Background Count Counts	Background Count Dur. (min.)	Background Count Pos. Chk.	Sample Count Start Date	Sample Count Start Time	Sample Count Counts	Sample Count Dur. (min.)	Sample Count Pos. Chk.
0722513-ICV61	N/A	6C	29	N/A	1/28/08	8:33	18	15	DBC	1/28/08	13:49	2062	15	DBC
-ICV60		5D	23			↓	34		DBC		↓	2720		DBC
-ICV62		1F	44			8:45	13		DBC		13:31	2156		DBC
-ICV63		7A	45			↓	27		DBC		↓	2985		DBC
-ICV63		1F	45			8:33	22		DBC		13:49	2105		DBC
-ICV62		7A	44			↓	17		DBC		↓	2714		DBC
-ICV64		3E	9			8:59	25		DBC		14:06	2005		DBC
-ICV65		2B	13			↓	12		DBC		↓	2564		DBC
-ICV65		3E	13			9:16	23		DBC		14:22	1952		DBC
-ICV64		2B	9			↓	13		DBC		↓	2683		DBC
Check Source	N/A	3E	Th	N/A						1/28/08	15:00	9552	1	DBC
		2B									15:01	9380		DBC
		6C									14:10	9434		DBC
		5D									14:11	9551		DBC
		1F									14:12	9405		DBC
		7A									14:13	9450		DBC

DBC 1/28/08

Comments:

Reviewed by/date: DBC 1/28/08

76
PROJECT 818.3020.76 Ra-226

Notebook No. _____
Continued From Page _____

Prepare a working dilution of 818.3020.31 to a final concentration of approximately 100 dpm/ml.

1) Determine density of 1M HCl: (Lot # 063537) (Bal 12)
Mass of empty 100 ml Class A flask: 62.4699 g
Mass of 100 ml Class A flask + 100 ml 1M HCl: 163.9106 g
Net mass of 1M HCl: 101.4407
÷100 = density = 1.0144 g/ml

2) Transfer std to 1 L Nalgene bottle: (Bal 12)
Mass of bottle (w/o lid): 74.2161 g
Mass of bottle + std: 79.6285 g
Net mass of std. transferred: 5.4124 g

3) Dilute w 1M HCl (Bal 26)
Mass of bottle + std + 1M HCl: 1087.3 g
Mass of bottle (from above): 74.2161 g
Net mass of std: 1013.0839 g

4) Final Activity Calculation:

$$\frac{5.4124\,g \times 18451.8\,dpm/g \times 1.0144\,g/ml}{1013.0839\,g} = 99.998\,dpm/ml$$

5) Std. transferred to marinelli beaker for verification by γ-spec

RG 5/15/07

Stnd ID: 818.3020.76

RG 5/15/07

Description: Ra-226
Expiration: 5/3/2008
Activity: 100.00 dpm/mL
2s Uncertainty: 1.20 dpm/mL
Ref. Date: 9/1/2003
Ref Time: N/A
Prep Date: 4/30/2007 Prep by: KB
Matrix/Comp. 1M HCl
Half Life (y): 1.60E+03

Reverification Log		
Analysis Date	Initials	Expiration Date

RG 5/15/07

tinued on Page

RG 5/15/07
Read and Understood By

Kriptal Brown — Signed — 4/25/07 — Date
[signature] — Signed — 5/15/07 — Date

U.S. Department of Commerce
National Institute of Standards
and Technology
SRM 4967A
Radium-226
<15 kBq in 4% hydrochloric acid
CAUTION
RADIOACTIVE
MATERIAL

Prepare a primary dilution of RSO #818 (NIST 4967A) by diluting the entire stock solution to approx 40 ml w/ 1M HCl

1) Prepared 2L HCl in 1M solution by diluting 166 mL conc HCl, Fisher Lot # 060506, in 2L DI water.

2) Determine density of 1M HCl

Mass of 100 ml volumetric flask	= 56.4422 g	(Bal 12)
Mass of flask + acid	= 157.6815 g	↓
Net mass of 1M HCl	101.2393 g	
÷100 ml = density of 1M HCl	= 1.0124 g/ml.	

3) Transfer contents of ampoule to 40 ml VOA vial

Mass of VOA vial	= 24.9938 g	(Bal 12
Mass of vial + std	= 29.9415 g	↓
Net mass of std transferred	= 4.9477 g	

4) Dilute w/ 1M HCl

Mass of vial + std + HCl	= 64.9255 g	Bal 12
Mass of vial (from above)	24.9938 g	
Net mass of primary std.	= 39.9317 g	

5) Final Activity Calculation

$$\frac{(2482\ Bq/g)(4.9477\ g)(60\ Bq/dpm)}{(39.9317\ g)} = 18{,}451.8\ dpm/g$$

Ref date 9/1/03

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
5/10/06		5/18/06	

RSO #818 Rec'd 5/8/06 DJB

National Institute of Standards & Technology

Certificate

Standard Reference Material 4967A
Radium-226 Radioactivity Standard

This Standard Reference Material (SRM) consists of radioactive radium-226 chloride (and its radioactive decay products), non-radioactive barium chloride and hydrochloric acid dissolved in 5 mL of distilled water. The solution is contained in a flame-sealed NIST borosilicate-glass ampoule. The SRM is intended for the calibration of instruments and for the monitoring of radiochemical procedures.

Radiological Hazard: The SRM ampoule contains radium-226 with an activity of approximately 13 kBq. Radium-226 decays by alpha-particle emission. The progeny of radium-226 have a total activity of approximately 95 kBq and decay by alpha- and beta-particle emission. None of the alpha or beta particles escape from the SRM ampoule. During the decay process, X-rays and gamma rays with energies from 11 kev to 2.5 MeV are also emitted. Most of these photons escape from the SRM ampoule and can represent a radiation hazard. Approximate unshielded dose rates at several distances (as of the reference time) are given in note [a]*. Gaseous radon-222 will escape from the ampoule when it is opened. The SRM should be used only by persons qualified to handle radioactive material.

Chemical Hazard: The SRM ampoule contains hydrochloric acid (HCl) with a concentration of 1.0 mole per liter of water. The solution is corrosive and represents a health hazard if it comes in contact with eyes or skin. If the ampoule is to be opened to transfer the solution, the recommended procedure is given on page 2. The ampoule should be opened only by persons qualified to handle both radioactive material and strong acid solution

Storage and Handling: The SRM should be stored and used at a temperature between 5 °C and 65 °C. The solution in an unopened ampoule should remain stable and homogeneous until at least September 2013. The ampoule (or any subsequent container) should always be clearly marked as containing radioactive material. If the ampoule is transported it should be packed, marked, labeled, and shipped in accordance with the applicable national, international, and carrier regulations. The solution in the ampoule is a dangerous good (hazardous material) because of both the radioactivity and the strong acid.

Preparation: This Standard Reference Material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, M.P. Unterweger, Acting Group Leader. The overall technical direction and physical measurements leading to certification were provided by R. Collé and P. Volkovitsky of the Radioactivity Group. Statistical consultation was provided by S.D. Leigh of the NIST Statistical Engineering Division. The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program.

Lisa R. Karam, Acting Chief
Ionizing Radiation Division

Robert L. Watters, Jr., Chief
Measurement Services Division

Gaithersburg, Maryland 20899
December 2004

*Notes and references are on pages 5 to 7.

Recommended Procedure for Opening the SRM Ampoule

1) If the SRM solution is to be diluted, it is recommended that the diluting solution have a composition comparable to that of the SRM solution.

2) Wear eye protection, gloves, and protective clothing and work over a tray with absorbent paper in it. Work in a fume hood. In addition to the radioactive material, the solution usually contains strong acid or base and is corrosive.

3) Shake the ampoule to wet all of the inside surface of the ampoule. Return the ampoule to the upright position.

4) Check that all of the liquid has drained out of the neck of the ampoule. If necessary, gently tap the neck to speed the process.

5) Holding the ampoule upright, score the narrowest part of the neck with a scribe or diamond pencil.

6) Lightly wet the scored line. This reduces the crack propagation velocity and makes for a cleaner break.

7) Hold the ampoule upright with a paper towel, a wiper, or a support jig. Position the scored line away from you. Using a paper towel or wiper to avoid contamination, snap off the top of the ampoule by pressing the narrowest part of the neck away from you while pulling the tip of the ampoule towards you.

8) Transfer the solution from the ampoule using a pycnometer or a pipet with dispenser handle. NEVER PIPETTE BY MOUTH.

9) Seal any unused SRM solution in a flame-sealed glass ampoule, if possible, to minimize the evaporation loss.

See also reference [4]*.

*Notes and references are on pages 5 to 7.

PROPERTIES OF SRM 4967A

Certified values

Radionuclide	**Radium-226**
Reference time	**1200 EST, 01 September 2003**
Massic activity of the solution [b]*	**2482 Bq·g^{-1}**
Relative expanded uncertainty (k=2)	**1.20%** [c] [d]
Solution mass	**(5.086 ± 0.003) g** [e]
Solution density	**(1.017 ± 0.002) g·mL^{-1} at 21 °C** [e]

Uncertified values

Physical Properties:			
Source description	Liquid in flame-sealed NIST borosilicate-glass ampoule		
Ampoule specifications	Body outside diameter Wall thickness Barium content Lead-oxide content Other heavy elements	(16.5 ± 0.5) mm (0.60 ± 0.04) mm Less than 2.5% Less than 0.02% Trace quantities	
Chemical Properties:			
Solution composition	Chemical Formula	Concentration (mol·L^{-1})	Mass Fraction (g·g^{-1})
	H_2O	54	0.96
	HCl	1.0	0.04
	$BaCl_2$	4×10^{-4}	8×10^{-5}
	$^{226}RaCl_2$	3×10^{-7}	9×10^{-8}
Radiological Properties:			
Photon-emitting impurities	None detected [f]		
Half lives used	Radium-226: (1600 ± 7) a [g] [5] Radon-222: (3.8235 ± 0.0003) d [g] [5]		
Calibration method and measuring instrument(s)	Gravimetric dilution of SRM 4963, confirmed by comparison with solution standards, and derivatives thereof, from the NBS/NIST "1947 (1967 recalibrated) series" of radium-226 solution standards. The mass of radium-226 in these solution standards had previously been determined by comparison with the U.S. National Standards for radium-226. Conversion from mass of radium-226 to activity of radium-226 was done using the half life of radium-226 shown above. [h]		

*Notes and references are on pages 5 to 7.

EVALUATION OF THE UNCERTAINTY OF THE MASSIC ACTIVITY [c] [d]*

Input Quantity x_i, the source of uncertainty (and individual uncertainty components where appropriate)	Method Used To Evaluate $u(x_i)$, the standard uncertainty of x_i (A) denotes evaluation by statistical methods (B) denotes evaluation by other methods	Relative Uncertainty Of Input Quantity, $u(x_i)/x_i$, (%) [i]	Relative Sensitivity Factor, $\lvert\partial y/\partial x_i\rvert \cdot (x_i/y)$ [j]	Relative Uncertainty Of Output Quantity, $u_i(y)/y$, (%) [k]
Calibration of the "1947 (1967 recalibrated) series" of radium-226 solution standards in terms of mass of radium-226 [h]	Estimated (B)	0.34	1.0	0.34
Ratio of the mass of radium-226 in SRM 4967A to the mass of radium-226 in the "1947 (1967 recalibrated) series" of radium-226 solution standards	Weighted mean of the ratios obtained using seven different comparisons (B)	0.15	1.0	0.15
Corrections for the decay of radium-226	Standard uncertainty of the radium-226 half-life (A) [m]	0.44	0.016 [n]	0.007
Gravimetric measurements	Estimated (B)	0.10	1.0	0.10
Conversion of radium-226 mass to activity [p]	Standard uncertainty of the radium-226 half-life (A) [q]	0.44	1.0	0.44
Photon-emitting impurities	Limit of detection (B) [r]	100.	0.0001	0.01
Relative Combined Standard Uncertainty of the Output Quantity, $u_c(y)/y$, (%)				0.6
Coverage Factor, k				x 2
Relative Expanded Uncertainty of the Output Quantity, U/y, (%)				1.2

*Notes and references are on pages 5 to 7.

NOTES

[a] The Sievert is the SI unit for dose equivalent. See reference [1]. One μSv is equal to 0.1 mrem.

Distance from Ampoule (cm):	1	10	100
Approximate Dose Rate (μSv/h):	5	0.4	-

[b] **Massic activity** is the preferred name for the quantity activity divided by the total mass of the sample. See reference [1].

[c] The reported value, y, of massic activity (activity per unit mass) at the reference time was not measured directly but was derived from measurements and calculations of other quantities. This can be expressed as $y = f(x_1, x_2, x_3, \ldots x_n)$, where f is a mathematical function derived from the assumed model of the measurement process. The value, x_i, used for each input quantity i has a **standard uncertainty**, $u(x_i)$, that generates a corresponding uncertainty in y, $u_i(y) \equiv |\partial y/\partial x_i| \cdot u(x_i)$, called a **component of combined standard uncertainty** of y. The **combined standard uncertainty** of y, $u_c(y)$, is the positive square root of the sum of the squares of the components of combined standard uncertainty. The combined standard uncertainty is multiplied by a **coverage factor** of $k = 2$ to obtain U, the **expanded uncertainty** of y.

Since it can be assumed that the possible estimated values of the massic activity are approximately normally distributed with approximate standard deviation $u_c(y)$, the unknown value of the massic activity is believed to lie in the interval $y \pm U$ with a level of confidence of approximately 95 percent.

For further information on the expression of uncertainties, see references [2] and [3].

[d] The value of each component of combined standard uncertainty, and hence the value of the expanded uncertainty itself, is a best estimate based upon all available information, but is only approximately known. That is to say, the "uncertainty of the uncertainty" is large and not well known. This is true for uncertainties evaluated by statistical methods (e.g., the relative standard deviation of the standard deviation of the mean for the massic response is approximately 50%) and for uncertainties evaluated by other methods (which could easily be over estimated or under estimated by substantial amounts). The unknown value of the expanded uncertainty is believed to lie in the interval $U/2$ to $2U$ (i.e., within a factor of 2 of the estimated value).

[e] The stated uncertainty is two times the standard uncertainty.

[f] Estimated limits of detection for photon-emitting impurities, as of the reference time, expressed as massic photon emission rates, are:
$6 \times 10^0\ s^{-1} \cdot g^{-1}$ for energies between 22 and 182 keV,
$3 \times 10^0\ s^{-1} \cdot g^{-1}$ for energies between 190 and 347 keV,
$8 \times 10^{-1}\ s^{-1} \cdot g^{-1}$ for energies between 356 and 1455 keV, and
$3 \times 10^{-1}\ s^{-1} \cdot g^{-1}$ for energies between 1465 and 2750 keV,
provided that the photons are separated in energy by 4 keV or more from photons emitted in the decay of radium-226 and progeny.

[g] The stated uncertainty is the standard uncertainty.

[h] For further details on NBS/NIST radium series calibrations refer to reference [6]. The 1967 recalibrations of the "1947 series" and of the "1957 series" were made using pressurized "4π"γ ionization chamber (PIC) "A".

The master solution for SRM 4967A was directly compared with the "1947 (1967 recalibrated) series" of radium-226 solution standards using PIC "A", and was compared with solutions of the "1992 series" of radium solution standards (SRM 4967) using PIC "A", pulse-ionization-chamber radon analyses (see references [7] and [8]), and germanium photon spectrometry.

The radium-226 in SRM 4967A was chemically purified approximately 55 years ago. The lead-210 and its daughter radionuclides are not in equilibrium.

[i] Relative standard uncertainty of the input quantity x_i.

[j] The relative change in the output quantity y divided by the relative change in the input quantity x_i. If $|\partial y/\partial x_i|\cdot(x_i/y) = 1.0$, then a 1% change in x_i results in a 1% change in y. If $|\partial y/\partial x_i|\cdot(x_i/y) = 0.05$, then a 1% change in x_i results in a 0.05% change in y.

k] Relative component of combined standard uncertainty of output quantity y, rounded to two significant figures or less. The relative component of combined standard uncertainty of y is given by $u_i(y)/y \equiv |\partial y/\partial x_i|\cdot u(x_i)/y = |\partial y/\partial x_i|\cdot(x_i/y)\cdot u(x_i)/x_i$. The numerical values of $u(x_i)/x_i$, $|\partial y/\partial x_i|\cdot(x_i/y)$, and $u_i(y)/y$, all dimensionless quantities, are listed in columns 3, 4, and 5, respectively. Thus, the value in column 5 is equal to the value in column 4 multiplied by the value in column 3. The input quantities are independent, or very nearly so. Hence the covariances are zero or negligible.

[m] The relative standard uncertainty of $\lambda\cdot t$ is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainty of t is negligible.

[n] $|\partial y/\partial x_i|\cdot(x_i/y) = |\lambda\cdot t|$

[p] The U.S. National Standards for radium-226 are certified in terms of mass of radium-226, as were all radium-226 SRMs prior to the "1992 series". Beginning with the "1992 series", radium-226 solution SRMs are now certified in terms of the massic activity of radium-226.

[q] The relative standard uncertainty of the activity of radium-226 per unit mass of radium-226 is determined by the relative standard uncertainty of λ (i.e., of the half life). The relative standard uncertainties of the atomic weight of radium-226 and of Avogadro's number are negligible.

[r] The standard uncertainty for each undetected impurity that might reasonably be expected to be present is estimated to be equal to the estimated limit of detection for that impurity, i.e. $u(x_i)/x_i =$ 100%. $|\partial y/\partial x_i|\cdot(x_i/y)$ = {(response per Bq of impurity)/(response per Bq of Ra-226)}·{(Bq of impurity)/(Bq of Ra-226)}. Thus $u_i(y)/y$ is the relative change in y if the impurity were present with a massic activity equal to the estimated limit of detection.

REFERENCES

[1] International Organization for Standardization (ISO), *ISO Standards Handbook - Quantities and Units*, 1993. Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.

[2] International Organization for Standardization (ISO), *Guide to the Expression of Uncertainty in Measurement*, 1993 (corrected and reprinted, 1995). Available from Global Engineering Documents, 12 Inverness Way East, Englewood, CO 80112, U.S.A. Telephone 1-800-854-7179.

[3] B. N. Taylor and C. E. Kuyatt, *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*, NIST Technical Note 1297, 1994. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20407, U.S.A.

[4] National Council on Radiation Protection and Measurements Report No. 58, *A Handbook of Radioactivity Measurements Procedures*, Second Edition, 1985. Available from the National Council on Radiation Protection and Measurements, 7910 Woodmont Avenue, Bethesda, MD 20814 U.S.A.

[5] Evaluated Nuclear Structure Data File (ENSDF), September 2003.

[6] W.B. Mann, L.L. Stockman, W.J. Youden, A. Schwebel, P.A. Mullen and S.B. Garfinkel, Preparation of New Solution Standards of Radium, *Journal of Research of the National Bureau of Standards* **62** (1959) 21-26.

[7] R. Collé, J.M.R. Hutchinson and M.P. Unterweger, The NIST Primary Radon-222 Measurement System, *Journal of Research of the National Institute of Standards and Technology* **95** (1990) 155-165.

[8] J.M.R. Hutchinson, J. Cessna, R. Collé and P. Hodge, An International Radon-In-Air Measurement Intercomparison Using a New Transfer Standard, *Applied Radiation and Isotopes* **43** (1992) 175-189.

Ra-226 Standard Verification: For Use In Ra-Sr Lab

Std: 818.3020.76
Date 5/3/2007

Known Act.:	1666.633	dps	45044.1	pCi/L

	Det	Act. (pCi/L)	Act. (pCi/mL)	Ave Act	2 Std Dev	% Recovery	Ave Rec w/in 5% (PAI)	2 Std Dev w/in 10% Ave (ICPT)
Count 1	3	45100	45.1			100.1%	101.8%	0.034
Count 2	8	45500	45.5			101.0%	Pass	Pass
Count 3	9	46900	46.9	45833.3	1543.4	104.1%		

r:\inst\gamma\302076Ra226

RG 5/15/07

070567D03.SPC Analyzed by JPA

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

****

Geo 1 / Water

Sample ID: 0716004-1 RA-226 STD VER

Sampling Start:	09/01/2003 10:00:00	Counting Start:	05/03/2007 09:22:07
Sampling Stop:	09/01/2003 10:00:00	Decay Time.	3.22E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	7200 Sec
Sample Size	1.00E+000 L	Real Time	7287 Sec
Collection Efficiency	1.0000	Spc. File	.070567D03.SPC

Detector #: 3 (Detector 3)

Energy(keV)= -1.25 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/03/2007
FWHM(keV) = 0.67 + 0.021*En + 6.56E-04*En^2 + 0.00E+00*En^3 01/06/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	45.91	94.19	473	210	169	4866	1.18 a	
2	47.87	98.09	26	112	92	2086	0.43 b	NET< CL
3	52.70	107.75	244	159	128	3328	0.86 a	
4	74.38	151.03	4977	219	138	3849	0.90 a	HiResid Wide Pk
5	76.87	156.02	7566	259	158	4619	0.93 b	HiResid
6	79.36	160.98	23	192	158	4619	0.93 c	NET< CL HiResid
7	80.87	164.00	0	192	158	4619	0.92 d	NET< CL HiResid
8	83.87	170.00	2	192	158	4619	0.92 e	NET< CL HiResid
9	86.89	176.03	2792	219	158	4619	0.92 f	HiResid
10	89.87	181.97	454	197	158	4619	0.93 g	HiResid
11	94.88	191.98	-0	192	158	4619	0.99 h	NET< CL HiResid
12	99.17	200.55	-0	1312	1079	42341	9.03 i	NET< CL HiResid
13	101.42	205.05	23	192	158	4619	0.92 j	NET< CL HiResid
14	186.17	374.30	11076	291	165	4646	1.14 a	
15	224.52	450.89	70	132	108	2343	0.90 a	NET< CL
16	241.98	485.75	9658	251	129	2835	1.20 a	
17	258.94	519.63	635	133	101	2147	1.06 a	

070567D03.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
18	274.68	551.06	443	151	119	2632	1.27 a	
19	285.49	572.66	85	129	105	2186	1.14 a	NET< CL
20	295.21	592.06	21510	324	114	2381	1.30 a	
21	349.70	700.88	609	211	168	3490	2.63 a	Wide Pk
22	351.87	705.22	35484	395	97	1745	1.33 b	
23	386.87	775.12	170	86	67	1028	0.80 a	
24	389.08	779.53	290	99	76	1234	1.02 b	
25	454.44	910.06	313	113	88	1268	1.70 a	
26	460.96	923.09	100	76	60	761	0.94 b	
27	462.35	925.87	131	76	60	761	1.01 c	
28	469.85	940.84	100	89	71	943	1.29 a	
29	474.29	949.71	103	113	91	1297	1.81 b	
30	480.39	961.89	249	108	85	1179	1.60 c	
31	486.99	975.07	264	108	85	1179	1.72 d	
32	498.62	998.30	45	67	54	609	0.90 a	NET< CL
33	510.97	1022.96	487	148	117	1672	2.64 a	Wide Pk
34	533.76	1068.47	92	66	52	614	0.93 a	
35	572.84	1146.52	40	53	43	448	0.78 a	NET< CL
36	580.13	1161.09	246	84	64	792	1.40 a	
37	609.32	1219.38	26717	337	66	809	1.65 a	HiResid
38	632.86	1266.39	48	57	45	445	1.18 a	
39	665.49	1331.56	745	90	58	632	1.59 a	
40	675.53	1351.61	47	59	47	454	1.26 a	NET< CL
41	703.17	1406.81	276	112	88	1069	2.73 a	Wide Pk
42	719.87	1440.15	259	76	57	591	1.71 a	
43	751.89	1504.11	24	76	62	638	1.93 a	NET< CL
44	768.49	1537.26	2326	122	62	668	1.81 a	HiResid
45	786.18	1572.59	560	93	66	696	2.14 a	
46	806.27	1612.71	571	85	58	592	1.88 a	
47	838.94	1677.94	300	78	57	636	1.85 a	
48	934.15	1868.10	1235	101	60	660	1.96 a	
49	964.64	1929.00	142	72	56	580	2.04 a	
50	1052.21	2103.87	112	65	51	478	1.99 a	
51	1069.88	2139.16	114	74	58	553	2.40 a	
52	1120.39	2240.04	5518	163	56	536	2.27 a	
53	1134.01	2267.25	68	73	58	556	2.39 a	
54	1155.40	2309.96	592	83	55	523	2.26 a	
55	1183.12	2365.33	51	54	43	349	1.87 a	
56	1208.06	2415.13	151	73	57	507	2.62 a	
57	1238.27	2475.46	1912	107	50	415	2.39 a	
58	1281.17	2561.14	452	73	49	410	2.28 a	
59	1377.77	2754.07	1383	96	50	397	2.54 a	
60	1385.34	2769.18	269	72	53	422	2.79 b	
61	1401.64	2801.73	374	71	49	400	2.51 a	
62	1408.39	2815.20	729	81	49	400	2.49 b	
63	1509.32	3016.78	607	83	55	469	2.73 a	
64	1538.72	3075.49	153	62	47	365	2.45 a	
65	1543.29	3084.63	150	68	52	414	2.78 b	
66	1583.64	3165.21	190	67	50	383	2.72 a	

070567D03.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
67	1594.84	3187.56	41	43	33	225	1.68	b
68	1661.62	3320.95	293	51	31	160	2.42	a
69	1684.55	3366.73	26	27	21	95	1.34	a
70	1729.72	3456.94	781	69	33	164	2.72	a
71	1764.61	3526.62	4057	134	33	157	3.12	a HiResid
72	1847.66	3692.48	538	61	33	152	3.22	a
73	1874.41	3745.90	39	24	17	58	1.42	a

070567D03.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET030427.BKG (WEEKLY BKG 070427-3)

Bkg.File Detector #: 3

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	52.70	244	159	129	240	160	129	
8	83.87	2	192	158	-5	193	159	NET<CL
9	86.89	2792	219	158	2787	220	158	
14	186.17	11076	291	165	11042	291	166	
20	295.21	21510	324	114	21497	325	114	
22	351.87	35484	395	97	35462	395	98	
33	510.97	487	148	117	303	151	121	
37	609.32	26717	337	66	26708	337	68	

070567D03.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0716004-1 RA-226 STD VER

Sampling Start:	09/01/2003 10:00:00	Counting Start:	05/03/2007 09:22:07
Sampling Stop:	09/01/2003 10:00:00	Decay Time.	3.22e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	7200 Sec
Sample Size	1.00e+000 L	Real Time	7287 Sec
Collection Efficiency	1.0000	Spectrum File	.070567D03.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 3 (Detector 3)

Efficiency File: (D03)(Sh01).EFF (Geo 1 Eff Cal)

Eff.=1/[2.99E-03*En^-3.90E+00 + 1.44E+02*En^8.10E-01] 01/07/2007

Library File: . RA-226(186 KEV).LIB (Ra-226 std ver. (186 keV))

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.21		4.51E+04 +- 1.19E+03	1.37E+03	6.79E+02	1.40E+07

MEASURED TOTAL: 4.51E+04 +- 1.19E+03 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	45.91	94.19	473	210	169	4866	1.18	1070DEsc
2	47.87	98.09	26	112	92	2086	0.43	Deleted
3	52.70	107.75	240	160	129	3328	0.86	Unknown
4	74.38	151.03	4977	219	138	3849	0.90	Unknown
5	76.87	156.02	7566	259	158	4619	0.93	Unknown
6	79.36	160.98	23	192	158	4619	0.93	Deleted
7	80.87	164.00	0	192	158	4619	0.92	Deleted
8	83.87	170.00	-5	193	159	4619	0.92	Deleted
9	86.89	176.03	2787	220	158	4619	0.92	Unknown
10	89.87	181.97	454	197	158	4619	0.93	Unknown
11	94.88	191.98	0	192	158	4619	0.99	Deleted
12	99.17	200.55	0	1312	1079	42341	9.03	Deleted
13	101.42	205.05	23	192	158	4619	0.92	Deleted
15	224.52	450.89	70	132	108	2343	0.90	Deleted
16	241.98	485.75	9658	251	129	2835	1.20	Unknown

UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
17	258.94	519.63	635	133	101	2147	1.06	1281DEsc
18	274.68	551.06	443	151	119	2632	1.27	Unknown
19	285.49	572.66	85	129	105	2186	1.14	Deleted
20	295.21	592.06	21497	325	114	2381	1.30	Unknown
21	349.70	700.88	609	211	168	3490	2.63	Unknown
22	351.87	705.22	35462	395	98	1745	1.33	Unknown
23	386.87	775.12	170	86	67	1028	0.80	1408DEsc
24	389.08	779.53	290	99	76	1234	1.02	Unknown
25	454.44	910.06	313	113	88	1268	1.70	Unknown
26	460.96	923.09	100	76	60	761	0.94	Unknown
27	462.35	925.87	131	76	60	761	1.01	Unknown
28	469.85	940.84	100	89	71	943	1.29	Unknown
29	474.29	949.71	103	113	91	1297	1.81	Unknown
30	480.39	961.89	249	108	85	1179	1.60	Unknown
31	486.99	975.07	264	108	85	1179	1.72	1509DEsc
32	498.62	998.30	45	67	54	609	0.90	Deleted
33	510.97	1022.96	303	151	121	1672	2.64	Unknown
34	533.76	1068.47	92	66	52	614	0.93	Unknown
35	572.84	1146.52	40	53	43	448	0.78	Deleted
36	580.13	1161.09	246	84	64	792	1.40	Unknown
37	609.32	1219.38	26708	337	68	809	1.65	1120SEsc
38	632.86	1266.39	48	57	45	445	1.18	Unknown
39	665.49	1331.56	745	90	58	632	1.59	Unknown
40	675.53	1351.61	47	59	47	454	1.26	Deleted
41	703.17	1406.81	276	112	88	1069	2.73	Unknown
42	719.87	1440.15	259	76	57	591	1.71	Unknown
43	751.89	1504.11	24	76	62	638	1.93	Deleted
44	768.49	1537.26	2326	122	62	668	1.81	1281SEsc
45	786.18	1572.59	560	93	66	696	2.14	Unknown
46	806.27	1612.71	571	85	58	592	1.88	Unknown
47	838.94	1677.94	300	78	57	636	1.85	Unknown
48	934.15	1868.10	1235	101	60	660	1.96	Unknown
49	964.64	1929.00	142	72	56	580	2.04	Unknown
50	1052.21	2103.87	112	65	51	478	1.99	Unknown
51	1069.88	2139.16	114	74	58	553	2.40	Unknown
52	1120.39	2240.04	5518	163	56	536	2.27	Unknown
53	1134.01	2267.25	68	73	58	556	2.39	Unknown
54	1155.40	2309.96	592	83	55	523	2.26	Unknown
55	1183.12	2365.33	51	54	43	349	1.87	Unknown
56	1208.06	2415.13	151	73	57	507	2.62	Unknown
57	1238.27	2475.46	1912	107	50	415	2.39	Unknown
58	1281.17	2561.14	452	73	49	410	2.28	Unknown
59	1377.77	2754.07	1383	96	50	397	2.54	Unknown
60	1385.34	2769.18	269	72	53	422	2.79	Unknown
61	1401.64	2801.73	374	71	49	400	2.51	Unknown
62	1408.39	2815.20	729	81	49	400	2.49	Unknown
63	1509.32	3016.78	607	83	55	469	2.73	Unknown
64	1538.72	3075.49	153	62	47	365	2.45	Unknown
65	1543.29	3084.63	150	68	52	414	2.78	Unknown

070567D03.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
66	1583.64	3165.21	190	67	50	383	2.72	Unknown
67	1594.84	3187.56	41	43	33	225	1.68	Unknown
68	1661.62	3320.95	293	51	31	160	2.42	Unknown
69	1684.55	3366.73	26	27	21	95	1.34	Unknown
70	1729.72	3456.94	781	69	33	164	2.72	Unknown
71	1764.61	3526.62	4057	134	33	157	3.12	Unknown
72	1847.66	3692.48	538	61	33	152	3.22	Unknown
73	1874.41	3745.90	39	24	17	58	1.42	Unknown

c:\SEEKER\BIN\070567d03.res Analysis Results Saved.

070689D08.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0716004-2 RA-226 STD VER

Sampling Start:	09/01/2003 10:00:00	Counting Start:	05/04/2007 09:05:53
Sampling Stop:	09/01/2003 10:00:00	Decay Time.	3.22E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	7200 Sec
Sample Size	1.00E+000 L	Real Time	7291 Sec
Collection Efficiency	1.0000	Spc. File	.070689D08.SPC

Detector #: 8 (Detector 8)

Energy(keV) = -0.42 + 0.500*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/04/2007
FWHM(keV) = 0.68 + 0.010*En + 6.24E-04*En^2 + 0.00E+00*En^3 04/02/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.50	93.74	12556	303	168	5692	0.74 a	HiResid
2	53.17	107.07	2236	194	140	4331	0.70 a	HiResid
3	59.09	118.89	253	396	325	14593	1.61 a	NET< CL Wide Pk
4	60.23	121.19	76	126	103	2919	0.40 b	NET< CL
5	61.02	122.75	939	462	377	17512	1.98 c	
6	74.89	150.48	15543	374	229	9712	1.00 a	HiResid
7	77.19	155.07	28938	425	210	8143	0.98 b	HiResid
8	79.31	159.30	1444	193	146	4741	0.64 c	HiResid
9	81.14	162.97	31	144	118	3421	0.41 d	NET< CL HiResid
10	83.83	168.34	376	175	140	4348	0.65 e	HiResid
11	87.30	175.27	8703	306	200	6822	1.08 f	HiResid
12	89.65	179.96	2773	279	212	7122	1.33 g	HiResid
13	94.93	190.52	43	171	140	3978	0.78 h	NET< CL HiResid
14	186.48	373.44	13882	305	160	4712	0.98 a	
15	242.35	485.07	12850	271	122	2762	1.05 a	
16	259.22	518.78	825	148	112	2319	1.00 a	
17	274.88	550.08	719	201	160	3537	1.69 a	
18	295.65	591.57	28207	366	119	2402	1.12 a	
19	352.48	705.12	46329	451	110	2049	1.17 a	
20	387.38	774.86	283	123	97	1611	1.11 a	
21	389.56	779.21	433	138	108	1841	1.29 b	

070689D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
22	406.60	813.26	135	137	111	1944	1.34 a	
23	455.55	911.07	265	96	75	1099	1.08 a	
24	462.44	924.83	194	101	80	1186	1.23 a	
25	470.39	940.71	45	60	48	571	0.59 a	NET< CL
26	475.55	951.03	66	70	56	713	0.82 b	
27	481.32	962.56	278	93	71	998	1.09 c	
28	487.70	975.31	416	112	86	1284	1.53 d	
29	511.34	1022.53	454	155	122	1848	2.62 a	Wide Pk
30	534.56	1068.93	233	89	69	868	1.35 a	
31	544.62	1089.04	97	92	74	948	1.46 a	
32	580.91	1161.54	342	85	63	741	1.37 a	
33	583.21	1166.15	96	79	63	741	1.28 b	
34	610.23	1220.13	34135	381	78	1053	1.49 a	
35	650.10	1299.79	64	63	50	502	1.10 a	
36	666.34	1332.24	986	96	60	618	1.51 a	
37	704.11	1407.71	294	81	60	630	1.50 a	
38	720.84	1441.14	221	78	60	617	1.54 a	
39	743.62	1486.66	86	57	44	416	1.03 a	
40	769.29	1537.94	3109	142	72	799	1.78 a	
41	786.94	1573.21	699	99	69	743	1.82 a	
42	807.11	1613.52	606	88	60	635	1.54 a	
43	822.08	1643.42	109	79	62	639	1.57 a	
44	827.73	1654.72	123	90	72	767	1.93 b	
45	840.02	1679.27	327	87	65	689	1.57 a	
46	935.09	1869.23	1621	113	65	720	1.88 a	
47	965.20	1929.39	171	70	54	563	1.40 a	
48	1053.37	2105.56	167	76	59	578	1.89 a	
49	1070.41	2139.61	68	43	32	259	0.83 a	
50	1121.46	2241.61	6934	182	61	593	2.13 a	
51	1156.38	2311.39	675	83	53	492	1.81 a	
52	1183.01	2364.59	68	65	52	451	1.90 a	
53	1209.23	2416.98	180	65	49	406	2.01 a	
54	1239.26	2476.99	2370	119	57	517	2.19 a	
55	1254.18	2506.80	67	79	64	574	2.61 a	
56	1282.02	2562.42	563	82	55	473	2.23 a	
57	1378.73	2755.66	1703	105	54	475	2.41 a	
58	1386.27	2770.73	335	75	54	475	2.47 b	
59	1402.50	2803.16	485	78	53	481	2.29 a	
60	1408.87	2815.90	862	87	53	481	2.23 b	
61	1509.98	3017.92	811	92	60	569	2.64 a	
62	1539.93	3077.76	100	49	37	285	1.46 a	
63	1544.12	3086.13	136	66	51	443	2.25 b	
64	1584.07	3165.95	251	61	43	313	2.22 a	
65	1595.77	3189.33	38	35	27	177	1.03 a	
66	1662.34	3322.34	336	58	37	223	2.39 a	
67	1684.62	3366.86	73	40	29	153	2.07 a	
68	1693.88	3385.35	86	33	22	106	1.55 b	
69	1730.38	3458.30	1111	79	35	191	2.65 a	
70	1765.24	3527.95	5073	149	36	194	3.00 a	

070689D08.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
71	1838.78	3674.88	79	35	25	108	2.18	a
72	1848.07	3693.44	756	68	33	158	3.16	b
73	1873.18	3743.63	37	34	26	121	2.06	a

070689D08.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab

GammaScan

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Background File:. . . . . DET080427.BKG (WEEKLY BKG 070427-8)

Bkg.File Detector #: 8

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
1	46.50	12556	303	168	12495	304	169	
2	53.17	2236	194	140	2225	195	141	
6	74.89	15543	374	229	15502	375	230	
7	77.19	28938	425	210	28901	426	211	
10	83.83	376	175	140	362	176	141	
11	87.30	8703	306	200	8690	307	200	
14	186.48	13882	305	160	13842	306	161	
18	295.65	28207	366	119	28196	366	119	
19	352.48	46329	451	110	46318	451	110	
29	511.34	454	155	122	254	158	127	
33	583.21	96	79	63	77	81	65	
34	610.23	34135	381	78	34123	382	79	
50	1121.46	6934	182	61	6931	182	61	

070689D08.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0716004-2 RA-226 STD VER

Sampling Start:	09/01/2003 10:00:00	Counting Start:	05/04/2007 09:05:53
Sampling Stop:	09/01/2003 10:00:00	Decay Time.	3.22e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	7200 Sec
Sample Size	1.00e+000 L	Real Time	7291 Sec
Collection Efficiency	1.0000	Spectrum File	.070689D08.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 8 (Detector 8)

Efficiency File: (D08)(Sh01).EFF (Geo 1 Eff Cal)

Eff.=1/[4.54E-01*En^-1.29E+00 + 1.21E+02*En^8.83E-01] 04/03/2007

Library File: . RA-226(186 KEV).LIB (Ra-226 std ver. (186 keV))

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.21		4.55E+04 +- 1.01E+03	1.07E+03	5.28E+02	1.40E+07

MEASURED TOTAL: 4.55E+04 +- 1.01E+03 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.50	93.74	12495	304	169	5692	0.74	Unknown
2	53.17	107.07	2225	195	141	4331	0.70	Unknown
3	59.09	118.89	253	396	325	14593	1.61	Deleted
4	60.23	121.19	76	126	103	2919	0.40	Deleted
5	61.02	122.75	939	462	377	17512	1.98	Unknown
6	74.89	150.48	15502	375	230	9712	1.00	Unknown
7	77.19	155.07	28901	426	211	8143	0.98	Unknown
8	79.31	159.30	1444	193	146	4741	0.64	Unknown
9	81.14	162.97	31	144	118	3421	0.41	Deleted
10	83.83	168.34	362	176	141	4348	0.65	Unknown
11	87.30	175.27	8690	307	200	6822	1.08	Unknown
12	89.65	179.96	2773	279	212	7122	1.33	Unknown
13	94.93	190.52	43	171	140	3978	0.78	Deleted
15	242.35	485.07	12850	271	122	2762	1.05	Unknown
16	259.22	518.78	825	148	112	2319	1.00	1282DEsc

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
17	274.88	550.08	719	201	160	3537	1.69	Unknown
18	295.65	591.57	28196	366	119	2402	1.12	Unknown
19	352.48	705.12	46318	451	110	2049	1.17	Unknown
20	387.38	774.86	283	123	97	1611	1.11	1409DEsc
21	389.56	779.21	433	138	108	1841	1.29	Unknown
22	406.60	813.26	135	137	111	1944	1.34	Unknown
23	455.55	911.07	265	96	75	1099	1.08	Unknown
24	462.44	924.83	194	101	80	1186	1.23	Unknown
25	470.39	940.71	45	60	48	571	0.59	Deleted
26	475.55	951.03	66	70	56	713	0.82	Unknown
27	481.32	962.56	278	93	71	998	1.09	Unknown
28	487.70	975.31	416	112	86	1284	1.53	1510DEsc
29	511.34	1022.53	254	158	127	1848	2.62	Unknown
30	534.56	1068.93	233	89	69	868	1.35	Unknown
31	544.62	1089.04	97	92	74	948	1.46	Unknown
32	580.91	1161.54	342	85	63	741	1.37	Unknown
33	583.21	1166.15	77	81	65	741	1.28	Unknown
34	610.23	1220.13	34123	382	79	1053	1.49	1121SEsc
35	650.10	1299.79	64	63	50	502	1.10	Unknown
36	666.34	1332.24	986	96	60	618	1.51	Unknown
37	704.11	1407.71	294	81	60	630	1.50	Unknown
38	720.84	1441.14	221	78	60	617	1.54	Unknown
39	743.62	1486.66	86	57	44	416	1.03	1765DEsc
40	769.29	1537.94	3110	142	72	799	1.78	1282SEsc
41	786.94	1573.21	699	99	69	743	1.82	Unknown
42	807.11	1613.52	606	88	60	635	1.54	Unknown
43	822.08	1643.42	109	79	62	639	1.57	Unknown
44	827.73	1654.72	123	90	72	767	1.93	1848DEsc
45	840.02	1679.27	327	87	65	689	1.57	Unknown
46	935.09	1869.23	1621	113	65	720	1.88	Unknown
47	965.20	1929.39	171	70	54	563	1.40	Unknown
48	1053.37	2105.56	167	76	59	578	1.89	Unknown
49	1070.41	2139.61	68	43	32	259	0.83	Unknown
50	1121.46	2241.61	6931	182	61	593	2.13	Unknown
51	1156.38	2311.39	675	83	53	492	1.81	Unknown
52	1183.01	2364.59	68	65	52	451	1.90	Unknown
53	1209.23	2416.98	180	65	49	406	2.01	Unknown
54	1239.26	2476.99	2370	119	57	517	2.19	Unknown
55	1254.18	2506.80	67	79	64	574	2.61	1765SEsc
56	1282.02	2562.42	563	82	55	473	2.23	Unknown
57	1378.73	2755.66	1703	105	54	475	2.41	Unknown
58	1386.27	2770.73	335	75	54	475	2.47	Unknown
59	1402.50	2803.16	485	78	53	481	2.29	Unknown
60	1408.87	2815.90	862	87	53	481	2.23	Unknown
61	1509.98	3017.92	811	92	60	569	2.64	Unknown
62	1539.93	3077.76	100	49	37	285	1.46	Unknown
63	1544.12	3086.13	136	66	51	443	2.25	Unknown
64	1584.07	3165.95	251	61	43	313	2.22	Unknown
65	1595.77	3189.33	38	35	27	177	1.03	Unknown

070689D08.SPC Analyzed by

UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
66	1662.34	3322.34	336	58	37	223	2.39	Unknown
67	1684.62	3366.86	73	40	29	153	2.07	Unknown
68	1693.88	3385.35	86	33	22	106	1.55	Unknown
69	1730.38	3458.30	1111	79	35	191	2.65	Unknown
70	1765.24	3527.95	5073	149	36	194	3.00	Unknown
71	1838.78	3674.88	79	35	25	108	2.18	Unknown
72	1848.07	3693.44	756	68	33	158	3.16	Unknown
73	1873.18	3743.63	37	34	26	121	2.06	Unknown

c:\SEEKER\BIN\070689d08.res Analysis Results Saved.

070732D09.SPC Analyzed by

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SEEKER G A M M A A N A L Y S I S R E S U L T S PS Version 1.8.4

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0716004-3 RA-226 STD VER

Sampling Start:	09/01/2003 10:00:00	Counting Start:	05/07/2007 09:55:14
Sampling Stop:	09/01/2003 10:00:00	Decay Time.	3.23E+004 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	7200 Sec
Sample Size	1.00E+000 L	Real Time	7265 Sec
Collection Efficiency	1.0000	Spc. File	.070732D09.SPC

Detector #: 9 (Detector 9)

Energy(keV)= -1.00 + 0.500*Ch + 2.08E-07*Ch^2 + 0.00E+00*Ch^3 05/07/2007
FWHM(keV) = 0.81 + 0.004*En + 8.32E-04*En^2 + 0.00E+00*En^3 03/12/2007
Where En = Sqrt(Energy in keV)

Search Sensitivity: 1.00 | Sigma Multiplier: 2.00 | Search Start/End: 80/4000

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.56	95.11	736	224	179	5928	1.04 a	
2	53.06	108.10	214	193	157	4943	0.83 a	
3	74.76	151.49	6466	305	213	8366	0.96 a	HiResid Wide Pk
4	77.18	156.33	15365	350	203	7596	0.96 b	HiResid
5	79.51	161.00	12	176	145	4656	0.61 c	NET< CL HiResid
6	80.33	162.63	-1	552	454	19847	2.72 d	NET< CL HiResid
7	83.92	169.81	17	201	165	5487	0.85 e	NET< CL HiResid
8	87.21	176.39	4489	236	159	5128	0.85 f	HiResid
9	89.84	181.66	1916	207	155	4821	0.80 g	HiResid
10	92.52	187.00	4	183	151	4581	0.79 h	NET< CL HiResid
11	94.97	191.90	148	182	149	4452	0.76 i	NET< CL HiResid
12	98.15	198.27	154	203	166	5093	0.98 j	NET< CL HiResid
13	186.29	374.49	12326	306	174	5568	0.96 a	
14	242.09	486.02	14238	290	136	3420	1.06 a	
15	258.99	519.81	784	163	126	2936	1.05 a	
16	274.55	550.92	940	257	206	5210	1.90 a	Wide Pk
17	292.50	586.80	105	125	102	2086	0.87 a	

070732D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
18	295.32	592.43	30844	386	131	2920	1.10 b	
19	350.16	702.03	522	203	163	3905	1.89 a	Wide Pk
20	352.09	705.89	50902	470	107	2278	1.16 b	
21	386.98	775.63	312	101	77	1365	0.90 a	
22	389.15	779.96	365	102	77	1365	0.78 b	
23	396.10	793.86	92	96	77	1361	0.85 a	
24	405.89	813.43	194	149	120	2516	1.54 a	
25	414.63	830.88	52	110	90	1702	0.96 a	NET< CL
26	439.45	880.49	85	117	95	1663	1.27 a	NET< CL
27	454.80	911.15	329	113	88	1436	1.23 a	
28	460.78	923.11	51	89	72	1094	0.93 a	NET< CL
29	462.54	926.62	135	91	72	1094	1.01 b	
30	470.21	941.95	156	97	77	1173	1.22 a	
31	474.60	950.73	52	65	52	670	0.66 b	NET< CL
32	480.80	963.11	351	83	61	838	0.85 c	
33	487.27	976.03	454	112	85	1340	1.32 d	
34	509.96	1021.38	205	117	93	1433	1.60 a	
35	511.12	1023.70	38	60	48	573	0.66 b	NET< CL
36	512.00	1025.45	301	136	108	1719	2.01 c	
37	534.07	1069.56	153	80	63	830	1.03 a	
38	580.42	1162.16	272	88	67	894	1.14 a	
39	609.62	1220.49	37970	402	80	1110	1.40 a	HiResid
40	639.38	1279.95	75	105	85	1064	2.00 a	NET< CL
41	665.74	1332.61	1060	99	61	688	1.32 a	
42	683.27	1367.61	118	130	106	1320	2.73 a	Wide Pk
43	703.51	1408.04	274	95	73	884	1.62 a	
44	720.06	1441.11	278	93	72	904	1.77 a	
45	723.86	1448.70	47	64	51	575	1.12 b	NET< CL
46	741.05	1483.03	62	70	56	647	1.33 a	
47	742.90	1486.72	83	65	51	566	1.09 b	
48	753.03	1506.96	78	70	56	642	1.24 a	
49	768.62	1538.08	3430	142	66	813	1.62 a	HiResid
50	786.22	1573.23	738	91	60	696	1.45 a	
51	806.58	1613.90	772	97	65	780	1.57 a	
52	821.23	1643.16	85	78	62	747	1.45 a	
53	839.44	1679.53	445	92	67	829	1.56 a	
54	934.34	1869.02	1742	111	60	710	1.52 a	
55	964.30	1928.85	189	75	57	639	1.48 a	
56	1052.63	2105.18	169	87	68	748	2.12 a	
57	1070.51	2140.87	114	64	50	485	1.39 a	
58	1105.05	2209.82	64	52	41	387	1.06 a	
59	1120.76	2241.18	7534	186	56	603	1.87 a	
60	1134.06	2267.74	132	60	46	438	1.55 a	
61	1155.63	2310.80	887	91	56	583	1.98 a	
62	1208.37	2416.05	176	67	51	498	1.76 a	
63	1238.61	2476.40	2742	122	52	494	1.89 a	
64	1253.86	2506.83	191	85	66	672	2.85 a	
65	1281.29	2561.57	562	77	50	464	1.89 a	
66	1378.16	2754.86	1966	106	48	433	2.02 a	

070732D09.SPC Analyzed by

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET/MDA COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
67	1385.88	2770.27	357	70	48	433	1.94	b
68	1402.04	2802.51	570	78	51	462	2.10	a
69	1408.42	2815.24	1078	93	54	497	2.26	b
70	1461.65	2921.42	78	43	33	249	1.17	a
71	1509.72	3017.31	845	92	59	589	2.27	a
72	1539.13	3075.99	236	88	68	663	3.08	a
73	1543.79	3085.28	110	62	48	419	1.89	b
74	1583.78	3165.04	240	59	41	309	2.04	a
75	1595.33	3188.09	101	62	48	383	2.48	a
76	1600.01	3197.42	94	47	36	255	1.66	b
77	1661.87	3320.79	408	60	36	223	2.29	a
78	1684.83	3366.57	88	40	30	161	1.99	a
79	1693.52	3383.90	106	43	31	174	2.13	b
80	1730.26	3457.17	1183	80	34	193	2.47	a
81	1765.20	3526.84	5666	156	34	188	2.43	a HiResid
82	1838.90	3673.78	104	40	29	141	2.31	a
83	1848.12	3692.16	790	66	29	141	2.35	b
84	1873.80	3743.36	53	37	28	130	2.31	a

070732D09.SPC Analyzed by

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SEEKER B A C K G R O U N D S U B T R A C T R E S U L T S Vers. 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Background File:. . . . . DET090504.BKG (WEEKLY BKG 070504-9)

Bkg.File Detector #: 9

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BACKGROUND SUBTRACT RESULTS

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PK#	ENERGY (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	OLD CR.LEVEL	NEW NET COUNTS	NEW UN-CERTAINTY	NEW CR.LEVEL	FLAG
3	74.76	6466	305	213	6457	306	214	
4	77.18	15365	350	203	15343	350	204	
5	79.51	12	176	145	43	179	147	NET<CL
7	83.92	17	201	165	11	202	166	NET<CL
8	87.21	4489	236	160	4514	237	160	
9	89.84	1916	207	155	1899	209	156	
10	92.52	4	183	151	-52	185	153	NET<CL
13	186.29	12326	306	174	12285	307	175	
18	295.32	30844	386	131	30828	386	132	
19	350.16	522	203	163	507	203	163	
34	509.96	205	117	93	8	121	99	NET<CL
39	609.62	37970	402	80	37954	402	82	
70	1461.65	78	43	33	23	45	36	NET<CL
81	1765.20	5666	156	34	5661	156	34	

070732D09.SPC Analyzed by

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SEEKER F I N A L A C T I V I T Y R E P O R T Version 2.2.1

Paragon Analytics, Div. of DataChem Lab
GammaScan

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Geo 1 / Water

Sample ID: 0716004-3 RA-226 STD VER

Sampling Start:	09/01/2003 10:00:00	Counting Start:	05/07/2007 09:55:14
Sampling Stop:	09/01/2003 10:00:00	Decay Time.	3.23e+004 Hrs
Buildup Time.	0.00e+000 Hrs	Live Time	7200 Sec
Sample Size	1.00e+000 L	Real Time	7265 Sec
Collection Efficiency	1.0000	Spectrum File	.070732D09.SPC
Cr. Level Confidence Interval:	95 %	Det. Limit Confidence Interval:	95 %

Detector #: 9 (Detector 9)

Efficiency File: (D09)(Sh01).EFF (Geo 1 Eff Cal)
Eff=10^[-2.32E+01 +2.03E+01*L +-4.73E+00*L^2 +0.00E+00*L^3] 03/13/2007
Eff.=10^[-6.06E+00 +5.69E+00*L +-2.18E+00*L^2 +2.41E-01*L^3] Above 180.00 keV

Library File: . RA-226(186 KEV).LIB (Ra-226 std ver. (186 keV))

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET T	Concentration (pCi/L)	MDA	Critical Level	Halflife (hrs)
Ra-226	186.21		4.69E+04 +- 1.17E+03	1.34E+03	6.67E+02	1.40E+07

MEASURED TOTAL: 4.69E+04 +- 1.17E+03 pCi/L

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	46.56	95.11	736	224	179	5928	1.04	1071DEsc
2	53.06	108.10	214	193	157	4943	0.83	Unknown
3	74.76	151.49	6457	306	214	8366	0.96	Unknown
4	77.18	156.33	15343	350	204	7596	0.96	Unknown
5	79.51	161.00	43	179	147	4656	0.61	Deleted
6	80.33	162.63	-1	552	454	19847	2.72	Deleted
7	83.92	169.81	11	202	166	5487	0.85	Deleted
8	87.21	176.39	4514	237	160	5128	0.85	Unknown
9	89.84	181.66	1899	209	156	4821	0.80	Unknown
10	92.52	187.00	-52	185	153	4581	0.79	Deleted
11	94.97	191.90	148	182	149	4452	0.76	Deleted
12	98.15	198.27	154	203	166	5093	0.98	Deleted
14	242.09	486.02	14238	290	136	3420	1.06	Unknown
15	258.99	519.81	784	163	126	2936	1.05	1281DEsc

070732D09.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
16	274.55	550.92	940	257	206	5210	1.90	Unknown
17	292.50	586.80	105	125	102	2086	0.87	Unknown
18	295.32	592.43	30828	386	132	2920	1.10	Unknown
19	350.16	702.03	507	203	163	3905	1.89	Unknown
20	352.09	705.89	50902	470	108	2278	1.16	Unknown
21	386.98	775.63	312	101	77	1365	0.90	1408DEsc
22	389.15	779.96	365	102	77	1365	0.78	Unknown
23	396.10	793.86	92	96	77	1361	0.85	Unknown
24	405.89	813.43	194	149	120	2516	1.54	Unknown
25	414.63	830.88	52	110	90	1702	0.96	Deleted
26	439.45	880.49	85	117	95	1663	1.27	Deleted
27	454.80	911.15	329	113	88	1436	1.23	Unknown
28	460.78	923.11	51	89	72	1094	0.93	Deleted
29	462.54	926.62	135	91	72	1094	1.01	Unknown
30	470.21	941.95	156	97	77	1173	1.22	Unknown
31	474.60	950.73	52	65	52	670	0.66	Deleted
32	480.80	963.11	351	83	61	838	0.85	Unknown
33	487.27	976.03	454	112	85	1340	1.32	1510DEsc
34	509.96	1021.38	8	121	99	1433	1.60	Deleted
35	511.12	1023.70	38	60	48	573	0.66	Deleted
36	512.00	1025.45	301	136	108	1719	2.01	Unknown
37	534.07	1069.56	153	80	63	830	1.03	Unknown
38	580.42	1162.16	272	88	67	894	1.14	Unknown
39	609.62	1220.49	37954	402	82	1110	1.40	1121SEsc
40	639.38	1279.95	75	105	85	1064	2.00	Deleted
41	665.74	1332.61	1060	99	61	688	1.32	Unknown
42	683.27	1367.61	118	130	106	1320	2.73	Unknown
43	703.51	1408.04	274	95	73	884	1.62	Unknown
44	720.06	1441.11	278	93	72	904	1.77	Unknown
45	723.86	1448.70	47	64	51	575	1.12	Deleted
46	741.05	1483.03	62	70	56	647	1.33	1254SEsc
47	742.90	1486.72	83	65	51	566	1.09	1765DEsc
48	753.03	1506.96	78	70	56	642	1.24	Unknown
49	768.62	1538.08	3430	142	66	813	1.62	1281SEsc
50	786.22	1573.23	738	91	60	696	1.45	Unknown
51	806.58	1613.90	772	97	65	780	1.57	Unknown
52	821.23	1643.16	85	78	62	747	1.45	Unknown
53	839.44	1679.53	445	92	67	829	1.56	Unknown
54	934.34	1869.02	1742	111	60	710	1.52	Unknown
55	964.30	1928.85	189	75	57	639	1.48	Unknown
56	1052.63	2105.18	169	87	68	748	2.12	Unknown
57	1070.51	2140.87	114	64	50	485	1.39	Unknown
58	1105.05	2209.82	64	52	41	387	1.06	Unknown
59	1120.76	2241.18	7534	186	56	603	1.87	Unknown
60	1134.06	2267.74	132	60	46	438	1.55	Unknown
61	1155.63	2310.80	887	91	56	583	1.98	Unknown
62	1208.37	2416.05	176	67	51	498	1.76	Unknown
63	1238.61	2476.40	2742	122	52	494	1.89	Unknown
64	1253.86	2506.83	191	85	66	672	2.85	1765SEsc

070732D09.SPC Analyzed by

UNKNOWN,SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
65	1281.29	2561.57	562	77	50	464	1.89	Unknown
66	1378.16	2754.86	1966	106	48	433	2.02	Unknown
67	1385.88	2770.27	357	70	48	433	1.94	Unknown
68	1402.05	2802.51	570	78	51	462	2.10	Unknown
69	1408.42	2815.24	1078	93	54	497	2.26	Unknown
70	1461.65	2921.42	23	45	36	249	1.17	Deleted
71	1509.72	3017.31	845	92	59	589	2.27	Unknown
72	1539.13	3075.99	236	88	68	663	3.08	Unknown
73	1543.79	3085.28	110	62	48	419	1.89	Unknown
74	1583.78	3165.04	240	59	41	309	2.04	Unknown
75	1595.33	3188.09	101	62	48	383	2.48	Unknown
76	1600.01	3197.42	94	47	36	255	1.66	Unknown
77	1661.87	3320.79	408	60	36	223	2.29	Unknown
78	1684.83	3366.57	88	40	30	161	1.99	Unknown
79	1693.52	3383.90	106	43	31	174	2.13	Unknown
80	1730.26	3457.17	1183	80	34	193	2.47	Unknown
81	1765.20	3526.84	5661	156	34	188	2.43	Unknown
82	1838.90	3673.78	104	40	29	141	2.31	Unknown
83	1848.12	3692.16	790	66	29	141	2.35	Unknown
84	1873.80	3743.36	53	37	28	130	2.31	Unknown

c:\SEEKER\BIN\070732d09.res Analysis Results Saved.

Paragon Analytics

Gamma Spectrometer Run Log

Date: 5/3/07

Reviewed By/Date: JRG 5/4/07

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID/Comments	Saved?
GS070420-4 LCS	JRG	1	8	30	8:20	JRG	070593 D01.SPC	JRG
GS070423-1 LCS	JRG	4	1	↓	↓	↓	070548 D04.SPC	JRG
0704229-2	JRG	6	13	30	8:25	JRG	070675 D06.SPC	JRG
↓ -2 D	JRG	9	↓	↓	↓	↓	070714 D09.SPC	JRG
GS070430-4 LCS	JRG	8	6	30	8:31	JRG	070683 D08.SPC	JRG
GS070425-2 LCS	JRG	4	1	30	9:08	JRG	070549 D04.SPC	JRG
GS070420-4 MB	JRG	1	8	500	↓	↓	070594 D01.SPC	JRG
0704229-4	JRG	6	13	30	9:22	JRG	070676 D06.SPC	JRG
GS070502-5 MB	JRG	9	↓	↓	↓	↓	070715 D09.SPC	JRG
GS070502-5 LCS	JRG	8	↓	↓	↓	↓	070684 D08.SPC	JRG
0716004-1	JRG	3	1	120	↓	↓	070567 D03.SPC	JRG
0704229-1	JRG	4	1	270	10:02	JRG	070551 D04.SPC	JRG
↓ -3	JRG	6	↓	↓	↓	↓	070677 D06.SPC	JRG
0704248-3	JRG	8	↓	↓	↓	↓	070685 D08.SPC	JRG
0705006-1	JRG	9	↓	300	↓	↓	070717 D09.SPC	JRG
0705006-3	JRG	3	1	285	11:31	JRG	070570 D03.SPC	JRG
0704245-17	JRG	4	6	500	15:52	JRG	070552 D04.SPC	JRG
↓ -65	JRG	6	↓	↓	↓	↓	070678 D06.SPC	JRG
GS070430-4 MB	JRG	8	↓	↓	↓	↓	070686 D08.SPC	JRG
0704229-1 D	JRG	9	1	300	↓	↓	070718 D09.SPC	JRG
GS070502-4 A,B,C MB	JRG	3	1	↓	16:37	JRG	070571 D03.SPC	JRG

JRG 5/4/07

1 Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

2 Calibration geometry.

3 Count duration.

KEY:
* sample was counted on a puck
↑ sample was counted with air flow arrow pointing up
↓ sample was counted with air flow arrow pointing down

ERASE

324784 B

Form 754r12b.doc (3/7/2007)

Gamma Spectrometer Run Log

Date: 5/4/07

Reviewed By/Date: JRK 5/7/07

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID/Comments	Saved?
0704063-2	JRG	1	9↑	60	8:56	JRK	070596D01.SPC	JRG
0704179-17	JRG	3	13	120	↓	↓	070574D03.SPC	JRG
↓ -17D	JRG	4	↓	↓	↓	↓	070555D04.SPC	JRG
0704181-6	JRG	6	↓	90	↓	↓	070680D06.SPC	JRG
6S070502-4 LCS	JRG	9	1	30	↓	↓	070720D09.SPC	JRG
0716004-2	JRG	8	1	120	9:05	JRG	070689D08.SPC	JRG
0704181-11	JRG	9	13	180	9:34	JRG	070723D09.SPC	JRG
0705031-1	JRG	3	7*	60	11:24	JRG	070575D03.SPC	JRG
↓ -9	JRG	4	↓	↓	↓	↓	070556D04.SPC	JRG
↓ -17	JRG	6	↓	↓	↓	↓	070681D06.SPC	JRG
0705031-9D	JRG	3	7*	60	12:30	JRG	070576D03.SPC	JRG
↓ -26	JRG	4	↓	↓	↓	↓	070557D04.SPC	JRG
↓ -27	JRG	6	↓	↓	↓	↓	070682D06.SPC	JRG
0705031-28	JRG	9	7*	60	12:44	JRG	070724D09.SPC	JRG
0705031-29	JRG	3	7*	60	13:46	JRG	070577D03.SPC	JRG
↓ -30	JRG	4	↓	↓	↓	↓	070558D04.SPC	JRG
↓ -31	JRG	6	↓	↓	14:59 JRG 5/4/07	↓	070683D06.SPC	JRG
6S070504-2 MB	JRG	9	↓	↓	13:46	↓	070725D09.SPC	JRG
6S070504-2 LCS	JRG	4	7*	30	14:54	JRG	070559D04.SPC	JRG
070504-1	JJO	1	WBK6	1000	17:24	JRG	070597D01.SPC	JJO
↓ -2	JJO	2	↓	↓	↓	↓	070682D02.SPC 2 to 5/5/07	JJO
↓ -3	JJO	3	↓	↓	↓	↓	070578D03.SPC	JJO
↓ -4	JJO	4	↓	↓	↓	↓	070560D04.SPC	JJO
↓ -6	JJO	6	↓	↓	↓	↓	070684D06.SPC	JJO

1 Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

2 Calibration geometry.

3 Count duration.

KEY:
* sample was counted on a puck
↑ sample was counted with air flow arrow pointing up
↓ sample was counted with air flow arrow pointing down

UPPASS

324785 B

Form 754r12b.doc (3/7/2007)

Gamma Spectrometer Run Log

Date: 5/7/07

Reviewed By/Date: JRK 5/8/07

Sample ID	Ver[1]	Det. No.	Geo[2]	Count Dur. (min.)[3]	Start Time	Analyst	File ID/Comments	Saved?
070507-8	JRK	8	WBK6	1000	9:51	JRK	070698D08.SPC	JRK
0704179-6	JRK	1	11	90	9:55	JRK	070602D01.SPC	JRK
-6D	JRK	3	↓	↓	↓	↓	070584D03.SPC	JRK
-11	JRK	4	↓	180	↓	↓	070567D04.SPC	JRK
6S070427-1 MB	JRK	6	13	↓	↓	↓	070690D06.SPC	JRK
0716004-3	JRK	9	1	120	↓	↓	070732D09.SPC	JRK
0713001-2 (824)	JRK	2	1	60	10:16	JRK	070690D02.SPC	JRK
6S070430-5 MB	JRK	1	11	180	11:41	JRK	070603D01.SPC	JRK
6S070430-5 LCS	JRK	3	↓	30	↓	↓	070585D03.SPC	JRK
0713002-2 (824)	JRK	2	1	60	12:25	JRK	070691D02.SPC	JRK
6S070427-1 LCS	JRK	3	13	30	12:36	JRK	070586D03.SPC	JRK
0713002-2 (718)	JRK	2	1	60	13:35	JRK	070692D02.SPC	JRK
0704246-1	JRK	3	11	120	14:22	JRK	070587D03.SPC	JRK
-1D	JRK	4	↓	↓	↓	↓	070568D04.SPC	JRK
-2	JRK	6	↓	↓	↓	↓	JRK 5/7/07 6 070691D09.SPC	JRK
-3	JRK	9	↓	↓	↓	↓	070733D09.SPC	JRK
0704246-4	JRK	1	11	120	14:49	JRK	070604D01.SPC	JRK
0713008-2 (829)	JRK	2	13	30	14:54	JRK	070693D02.SPC	JRK
0713008-2 (817)	JRK	2	13	30	15:45	JRK	070694D02.SPC	JRK
0704172-7	JRK	3	1	300	16:42	JRK	070588D03.SPC	JRK
-8	JRK	4	↓	↓	↓	↓	070569D04.SPC	JRK
-9	JRK	6	↓	↓	↓	↓	070692D06.SPC	JRK
-10	JRK	9	↓	↓	↓	↓	070734D09.SPC	JRK
0704246-5	JRK	1	11	120	17:04	JRK	070605D01.SPC	JRK

1 Analyst will verify the position, detector, and geometry when the sample is removed from the detector.

2 Calibration geometry.

3 Count duration.

KEY:
* sample was counted on a puck
↑ sample was counted with air flow arrow pointing up
↓ sample was counted with air flow arrow pointing down

RELEASE

324789 B

WS 4/30/07 ~~SR 89 Eff planchets~~ ^{226}Ra Standard Verification

Paragon Analytics

315028 A

WORKSHEET FOR IN-HOUSE OR RUSH SAMPLES / Ra/Sr Lab

Matrix liquid Prep Analyst ALB Prep Date 4/30/07 Analyte ^{226}Ra Analytical Batch _____

Pretreatment? (Y / (N)) Batch _____ Count Date / Time _____ Superseded _____

Paragon WO No.	Sample Wt. (g/L)	Sample Aliq. (g/L)	Aliquot Basis (Dry / AR)	Spike Information	Remarks Count Date	Det. No.	Filename	POS Ckd By
0716004 - 1	N/A	N/A	AR	S1	5/3/07	3	070567 D03.SPC	JRG
↓ - 2	↓	↓	↓	↓	5/4/07	8	070689 D08.SPC	JRG
↓ - 3	↓	↓	↓	↓	5/7/07	9	070732 D09.SPC	JRG
				BG 5/10/07				

Balance No. N/A Spiked By N/A Date N/A Spike Witness N/A Date N/A QASS? (Y / N) No. _____

	Isotope	No	Act / mL	Vol	P	Total Act (dpm)	Decay Corrected		Relinquished by / Date	Received by / Date
Spike 1	818.3020.76	^{226}Ra	99.998 dpm/mL	1 L		99998 dpm		1		
Spike 2										
Spike 3						BG 5/10/07		2		
Spike 4										

Electronic Benchsheet No. (if / when generated) _____ Reviewed by / Date BG 5/10/07

315028 B

WORKSHEET FOR IN-HOUSE OR RUSH SAMPLES / Ra/Sr Lab

Paragon Analytics

Initials RLS Date 4/30/07 Method (SOP / Rev) 798 Matrix liquid

COMMENTS

^{226}Ra Standard Verification

① 1 L of standard poured into a 6ea 1 marinelli

Reviewed by / Date RG 5/10/07

Page 2 of 2 Form 798r1.doc (6/12/2004)

Radiochemistry Solution Report

Solution Id:	818.3020.76	Name:	Ra226 Working Standard	Type:	IS
		Lot:		Vendor Name:	

Final Vol:	998.7026	Dept:	RD	Prep By	KAB	on	4/25/2007	Reviewed By	rxg	on	5/15/2007
Units:	mL	Location:	RADSTD	Opened By		on		Verified By	JRK	on	5/3/2007
Matrix:	LIQUID	ExpireDate:	5/2/2008	Received By		on		Deactivated By		on	

Comment:

Component Name	Component ID	Volume Added	Units
Ra226 Intermediate Standard	818.3020.31	5.4124	g

CompName	Calibrated Primary Act/Conc	Calibration Date	Reference Date	1/2 Life (Yrs)	Final Act/Conc	Summed Conc	Units
Rn-222	67081.02	9/1/2003	5/15/2007	1600 (Prnt)	44.9720342003953		pCi/ml
Ra-226	67081.02	9/1/2003	5/15/2007	1600	44.9720265832253		pCi/ml

Associated Parent IDs

818	818.3020.31

Abbreviations: NC = Not Calculated for reagents when the volume added is not entered.
NE = Not Entered

(Prnt) = Secular equilibrium; parent half life used to calculate concentration.

Parent Solutions Sub Report

Solution Id: 818 | Name: Ra226 Primary Standard | Type: PS

Final Vol: 5.086 Units: g Matrix: LIQUID

CompName	Calibration Date	Reference Date	Decay Corrected Act/Conc	Units
Rn-222	9/1/2003	5/15/2007	2.3315857681424E-102	pCi/g
Ra-226	9/1/2003	5/15/2007	66973.5287867548	pCi/g

Solution Id: 818.3020.31 | Name: Ra226 Intermediate Standard | Type: IS

Final Vol: 39.9317 Units: g Matrix: LIQUID

CompName	Calibration Date	Reference Date	Decay Corrected Act/Conc	Units
Ra-226	9/1/2003	5/15/2007	8298.29229564024	pCi/g
Rn-222	9/1/2003	5/15/2007	2.8889294900283E-103	pCi/g

Abbreviations: NC = Not Calculated for reagents when the volume added is not entered.
NE = Not Entered

(Prnt) = Secular equilibrium; parent half life used to calculate concentration.

Daily Checks

DBC 1/29/08

4/29/08

Lucas Cell + PMT Daily Performance Check Summary - Detector E, Scalar #3

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 1300kV
Historical control limits established:

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
1	1/22/2008	1	9402	OK	8462	10342
2	1/22/2008	1	9593	OK	8462	10342
3	1/23/2008	1	9383	OK	8462	10342
4	1/23/2008	1	9495	OK	8462	10342
5	1/24/2008	1	9365	OK	8462	10342
6	1/24/2008	1	9480	OK	8462	10342
7	1/25/2008	1	9593	OK	8462	10342
8	1/25/2008	1	9587	OK	8462	10342
9	1/28/2008	1	9667	OK	8462	10342
10	1/28/2008	1	9552	OK	8462	10342

Lucas Cell + PMT Daily Performance Check Summary - Detector B, Scalar #2

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 1100kV
Historical control limits established:

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
1	1/22/2008	1	9661	OK	8695	10627
2	1/22/2008	1	9636	OK	8695	10627
3	1/23/2008	1	9383	OK	8695	10627
4	1/23/2008	1	9399	OK	8695	10627
5	1/24/2008	1	9674	OK	8695	10627
6	1/24/2008	1	9357	OK	8695	10627
7	1/25/2008	1	9609	OK	8695	10627
8	1/25/2008	1	9544	OK	8695	10627
9	1/28/2008	1	9667	OK	8695	10627
10	1/28/2008	1	9380	OK	8695	10627

Lucas Cell + PMT Daily Performance Check Summary - Detector C, Scalar #6

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 900 kV
Historical control limits established:

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
1	1/22/2008	1	9621	OK	8659	10583
2	1/22/2008	1	9590	OK	8659	10583
3	1/23/2008	1	9569	OK	8659	10583
4	1/23/2008	1	9618	OK	8659	10583
5	1/24/2008	1	9578	OK	8659	10583
6	1/24/2008	1	9440	OK	8659	10583
7	1/25/2008	1	9457	OK	8659	10583
8	1/25/2008	1	9537	OK	8659	10583
9	1/28/2008	1	9563	OK	8659	10583
10	1/28/2008	1	9434	OK	8659	10583

Lucas Cell + PMT Daily Performance Check Summary - Detector D, Scalar #5

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 900kV
Historical control limits established:

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
1	1/22/2008	1	9449	OK	8505	10393
2	1/22/2008	1	9504	OK	8505	10393
3	1/23/2008	1	9677	OK	8505	10393
4	1/23/2008	1	9424	OK	8505	10393
5	1/24/2008	1	9470	OK	8505	10393
6	1/24/2008	1	9451	OK	8505	10393
7	1/25/2008	1	9382	OK	8505	10393
8	1/25/2008	1	9499	OK	8505	10393
9	1/28/2008	1	9602	OK	8505	10393
10	1/28/2008	1	9551	OK	8505	10393

Lucas Cell + PMT Daily Performance Check Summary - Detector F, Scalar #1

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 900 kV
Historical Control Limits Established:

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
1	1/22/2008	1	9509	OK	8559	10459
2	1/22/2008	1	9341	OK	8559	10459
3	1/23/2008	1	9371	OK	8559	10459
4	1/23/2008	1	9422	OK	8559	10459
5	1/24/2008	1	9301	OK	8559	10459
6	1/24/2008	1	9454	OK	8559	10459
7	1/25/2008	1	9401	OK	8559	10459
8	1/25/2008	1	9397	OK	8559	10459
9	1/28/2008	1	9332	OK	8559	10459
10	1/28/2008	1	9405	OK	8559	10459

Lucas Cell + PMT Daily Performance Check Summary - Detector A, Scalar #7

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 1100 kV
Historical Control Limits Established:

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
1	1/22/2008	1	9563	OK	8607	10519
2	1/22/2008	1	9675	OK	8607	10519
3	1/23/2008	1	9383	OK	8607	10519
4	1/23/2008	1	9472	OK	8607	10519
5	1/24/2008	1	9436	OK	8607	10519
6	1/24/2008	1	9573	OK	8607	10519
7	1/25/2008	1	9655	OK	8607	10519
8	1/25/2008	1	9351	OK	8607	10519
9	1/28/2008	1	9573	OK	8607	10519
10	1/28/2008	1	9450	OK	8607	10519

ICV 0722513-ICV45 Cell 27, detector C

818,302076

Spike amount: 1ml

Activity: 100 dpm

Ref. date: 9/11/03

Spike date: 10/22/07

$t_{1/2} = 1600y$

$t_i = 1608d;\ 4.405\ y$

Decay Corrected Activity

$$A_{dc} = [e^{(\ln 0.5)(t_i/t_{1/2})}]100 = 99.8061\ dpm/mL$$

$$A_{dc} = 45.37\ pCi/mL$$

Activity

$$A = \frac{(SCpm - CBKG)\lambda_3 t_3}{2.22Evy(1-e^{-\lambda_1 t_1})(e^{-\lambda_2 t_2})(1-e^{-\lambda_3 t_3})}$$

$$A = \frac{0.4027}{(4.862)(1)\cancel{(0.0321)}\cancel{(0.998)}(0.8679)(0.0019)}$$ DBC 1/28/08

$A = 45.25$ pCi OK

SCpm = 217.13

CBKg = 4.07

$\lambda_3 = 0.000126$

$t_3 = 15$ min

$\lambda_2 = 0.007554$

$t_2 = 4.3167$

$\lambda_1 = 0.181286$

$t_1 = 94.7132$

$V = 1$

$y = 1$

$E = 2.1902$

DBC 1/28/08

Radionetric Recovery

$$\frac{45.25}{45.37} \times 100\% = 99.74\%$$

% Diff = 1.03%

OK

Daily Performance Checks

THE SOURCE INC.
Radiation standards and check sources
2810 Siler Lane Santa Fe, NM 87501
(505)473-9538 FAX(505)473-5805

Paragon # 191
recd 3-21-96

REF.PO# 65-1924

Certificate of Calibration

(Alpha Sources)

The Thorium 230 alpha source was measured in a proportional counter using P-10 as counting gas. The alpha emissions from the surface of the source were measured at its plateau voltage to determine its 2pi cpm rate. Corrections were applied for background, coincidence loss and backscatter factors when applicable. The source is referenced to NIST 90TH4704627A used in establishing traceablilty.

Active Diameter(or area) 44mm
Total Diameter(or area) 47mm
9,150 cpm
18,000 dpm
0.00812 microcurie
08/20/92 date of measurement
92TH4703015 source serial number

Mounting Material SS
Thickness 0.79mm
± 460 cpm 2pi
± 900 dpm 4pi

Michael A. Ortiz — Calibration Manager
Charles L. Gonzales — Q.A. Manager

The total uncertainty of the measurement at the 99% confidence interval is 5.0 percent.

AC005

Lucas Cell + PMT Daily Performance Check Summary - Detector B, Scalar #2

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 1100kV
Historical control limits established: 3/19/2008

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
54	5/5/2008	1	9577	OK	9106	9874
55	5/5/2008	1	9578	OK	9106	9874
56	5/6/2008	1	9479	OK	9106	9874
57	5/6/2008	1	9472	OK	9106	9874
58	5/14/2008	1	9274	OK	9106	9874
59	5/14/2008	1	9417	OK	9106	9874
60	5/15/2008	1	9405	OK	9106	9874
61	5/15/2008	1	9570	OK	9106	9874
62	5/16/2008	1	9624	OK	9106	9874
63	5/16/2008	1	9556	OK	9106	9874
64	5/22/2008	1	9313	OK	9106	9874
65	5/22/2008	1	9420	OK	9106	9874
66	6/17/2008	1	9312	OK	9106	9874
67	6/17/2008	1	9620	OK	9106	9874
68	6/23/2008	1	9528	OK	9106	9874
69	6/23/2008	1	9381	OK	9106	9874

Lucas Cell + PMT Daily Performance Check Summary - Detector C, Scalar #6

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 900 kV
Historical control limits established: 3/19/2008

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
54	5/5/2008	1	9313	OK	9239	9705
55	5/5/2008	1	9343	OK	9239	9705
56	5/6/2008	1	9572	OK	9239	9705
57	5/6/2008	1	9654	OK	9239	9705
58	5/14/2008	1	9399	OK	9239	9705
59	5/14/2008	1	9341	OK	9239	9705
60	5/15/2008	1	9299	OK	9239	9705
61	5/15/2008	1	9555	OK	9239	9705
62	5/16/2008	1	9596	OK	9239	9705
63	5/16/2008	1	9422	OK	9239	9705
64	5/22/2008	1	9517	OK	9239	9705
65	5/22/2008	1	9590	OK	9239	9705
66	6/17/2008	1	9326	OK	9239	9705
67	6/17/2008	1	9469	OK	9239	9705
68	6/23/2008	1	9402	OK	9239	9705
69	6/23/2008	1	9499	OK	9239	9705

Lucas Cell + PMT Daily Performance Check Summary - Detector D, Scalar #5

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 900kV
Historical control limits established: 3/19/2008

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
54	5/5/2008	1	9346	OK	9121	9857
55	5/5/2008	1	9504	OK	9121	9857
56	5/6/2008	1	9537	OK	9121	9857
57	5/6/2008	1	9451	OK	9121	9857
58	5/14/2008	1	9438	OK	9121	9857
59	5/14/2008	1	9590	OK	9121	9857
60	5/15/2008	1	9366	OK	9121	9857
61	5/15/2008	1	9491	OK	9121	9857
62	5/16/2008	1	9503	OK	9121	9857
63	5/16/2008	1	9373	OK	9121	9857
64	5/22/2008	1	9706	OK	9121	9857
65	5/22/2008	1	9301	OK	9121	9857
66	6/17/2008	1	9501	OK	9121	9857
67	6/17/2008	1	9545	OK	9121	9857
68	6/23/2008	1	9523	OK	9121	9857
69	6/23/2008	1	9451	OK	9121	9857

Lucas Cell + PMT Daily Performance Check Summary - Detector F, Scalar #1

r:\inst\alphscnt\dailychk.xls
Operating Voltage: 900 kV
Historical Control Limits Established: 3/19/2008

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
54	5/5/2008	1	9584	OK	9178	9706
55	5/5/2008	1	9353	OK	9178	9706
56	5/6/2008	1	9311	OK	9178	9706
57	5/6/2008	1	9358	OK	9178	9706
58	5/14/2008	1	9360	OK	9178	9706
59	5/14/2008	1	9517	OK	9178	9706
60	5/15/2008	1	9454	OK	9178	9706
61	5/15/2008	1	9441	OK	9178	9706
62	5/16/2008	1	9569	OK	9178	9706
63	5/16/2008	1	9409	OK	9178	9706
64	5/22/2008	1	9413	OK	9178	9706
65	5/22/2008	1	9423	OK	9178	9706
66	6/17/2008	1	9526	OK	9178	9706
67	6/17/2008	1	9607	OK	9178	9706
68	6/23/2008	1	9488	OK	9178	9706
69	6/23/2008	1	9508	OK	9178	9706

Lucas Cell + PMT Daily Performance Check Summary - Detector A, Scalar #7

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Operating Voltage: 1100 kV
Historical Control Limits Established: 3/19/2008

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
54	5/5/2008	1	9368	OK	9183	9825
55	5/5/2008	1	9527	OK	9183	9825
56	5/6/2008	1	9512	OK	9183	9825
57	5/6/2008	1	9541	OK	9183	9825
58	5/14/2008	1	9390	OK	9183	9825
59	5/14/2008	1	9505	OK	9183	9825
60	5/15/2008	1	9628	OK	9183	9825
61	5/15/2008	1	9487	OK	9183	9825
62	5/16/2008	1	9535	OK	9183	9825
63	5/16/2008	1	9586	OK	9183	9825
64	5/22/2008	1	9547	OK	9183	9825
65	5/22/2008	1	9475	OK	9183	9825
66	6/17/2008	1	9507	OK	9183	9825
67	6/17/2008	1	9528	OK	9183	9825
68	6/23/2008	1	9537	OK	9183	9825
69	6/23/2008	1	9478	OK	9183	9825