Paragon Analytics

Radiochemistry Case Narrative

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

Kent & Sullivan

Ross Adams

Paragon WO 0405096

1. This report consists of the analytical results and supporting documentation for 29 soil samples received by Paragon on 5/11/04.

2. These samples were prepared and analyzed according to Paragon Analytics procedures SOP783R5. The analyses were completed on 7/12/04.

3. The analysis results for these samples are reported on a 'dry weight' basis in units of pCi/gram.

4. The requested MDC was not met for most of these samples. However, the reported activity is greater than the achieved MDC. Also, the requested MDC was not met for method blank RE040611-1MB. Both method blanks were counted for a maximum count time of 90 minutes and results are reported without further qualification. These samples are identified with an "M" or "M3" flag on the final reports. The reported activity for samples with an "M3" flag exceeds the achieved MDC. Please refer to NCR 5767.

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 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.

Radiochemistry Instrument Technician	7.16.04 Date
Radiochemistry Final Data Review	7/16/04 Date

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 1

SAMPLE RESULTS SUMMARY

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

Client Name: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:

Laboratory Name: Paragon Analytics
PAI Work Order: 0405096

Reported on: Friday, July 16, 2004 12:36:06 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405096-1	MSED-01	Sample	Ra-226	0.38 +/- 0.22	0.30	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-2	MSED-02	Sample	Ra-226	0.137 +/- 0.080	0.029	pCi/g	SOIL	RE040611-1	6/29/2004	
0405096-3	MSED-03	Sample	Ra-226	0.17 +/- 0.10	0.12	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-4	MSED-04	Sample	Ra-226	2.15 +/- 0.54	0.38	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-5	MSED-05	Sample	Ra-226	2.71 +/- 0.59	0.20	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-6	MSED-06	Sample	Ra-226	0.19 +/- 0.11	0.14	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-7	MSED-07	Sample	Ra-226	52.4 +/- 9.4	0.3	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-8	MSED-08	Sample	Ra-226	64 +/- 12	0	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-9	MSED-09	Sample	Ra-226	16.1 +/- 3.0	0.2	pCi/g	SOIL	RE040611-1	6/29/2004	M3

Comments:

Data Package ID: *REM0405096-1*

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: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:

Laboratory Name: Paragon Analytics
PAI Work Order: 0405096

Reported on: Friday, July 16, 2004 12:36:06 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405096-10	MSED-10	Sample	Ra-226	17.7 +/- 3.3	0.3	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-11	SSED-01	Sample	Ra-226	1.99 +/- 0.48	0.17	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-12	SSED-02	Sample	Ra-226	0.67 +/- 0.13	0.04	pCi/g	SOIL	RE040611-1	7/12/2004	
0405096-13	SSED-03	Sample	Ra-226	1.49 +/- 0.47	0.53	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-14	SSED-04	Sample	Ra-226	1.60 +/- 0.40	0.24	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-15	SSED-05	Sample	Ra-226	4.50 +/- 0.94	0.28	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-16	SSED-06	Sample	Ra-226	0.78 +/- 0.33	0.42	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-17	SSED-07	Sample	Ra-226	1.44 +/- 0.55	0.73	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-18	SSED-08	Sample	Ra-226	67 +/- 12	0	pCi/g	SOIL	RE040611-1	6/29/2004	M3

Comments:

Data Package ID: *REM0405096-1*

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: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:

Laboratory Name: Paragon Analytics
PAI Work Order: 0405096

Reported on: Friday, July 16, 2004 12:36:06 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405096-19	SSED-09	Sample	Ra-226	7.5 +/- 1.4	0.2	pCi/g	SOIL	RE040611-1	6/30/2004	M3
0405096-20	SSED-10	Sample	Ra-226	5.7 +/- 1.2	0.2	pCi/g	SOIL	RE040611-1	6/29/2004	M3
0405096-22	GEN-02	Sample	Ra-226	5.7 +/- 1.1	0.2	pCi/g	SOIL	RE040611-2	6/28/2004	M3
0405096-25	SOIL-01	Sample	Ra-226	11.7 +/- 2.2	0.2	pCi/g	SOIL	RE040611-2	6/28/2004	M3
0405096-26	SOIL-02	Sample	Ra-226	12.7 +/- 2.4	0.1	pCi/g	SOIL	RE040611-2	6/28/2004	M3
0405096-27	SOIL-04	Sample	Ra-226	122 +/- 22	0	pCi/g	SOIL	RE040611-2	6/28/2004	M3
0405096-28	SOIL-05	Sample	Ra-226	25.0 +/- 4.6	0.2	pCi/g	SOIL	RE040611-2	6/28/2004	M3
0405096-29	SOIL-07	Sample	Ra-226	3.93 +/- 0.82	0.18	pCi/g	SOIL	RE040611-2	6/28/2004	M3
0405096-30	SOIL-08	Sample	Ra-226	126 +/- 23	0	pCi/g	SOIL	RE040611-2	6/28/2004	M3

Comments:

Data Package ID: *REM0405096-1*

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: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:

Laboratory Name: Paragon Analytics
PAI Work Order: 0405096

Reported on: Friday, July 16, 2004 12:36:06 PM

Lab Sample ID	Client Sample ID	Sample Type	Nuclide	Result +/- 2 s TPU	MDC	Units	Matrix	Prep Batch	Date Analyzed	Flags
0405096-31	SOIL-09	Sample	Ra-226	5.3 +/- 1.0	0.3	pCi/g	SOIL	RE040611-2	6/28/2004	M3
0405096-32	SOIL-10	Sample	Ra-226	221 +/- 40	0	pCi/g	SOIL	RE040611-2	6/28/2004	M3

Comments:

Data Package ID: *REM0405096-1*

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

PARAGON ANALYTICS

Radiochemistry Data Package

Section 2

QC RESULTS SUMMARY

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Method Blank Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Lab ID: RE040611-1MB

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 11-Jun-04
Date Prepared: 11-Jun-04
Date Analyzed: 12-Jul-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 90 minutes

Final Aliquot: 2.00 g
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.063 +/- 0.046	0.069	U,M

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Method Blank Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Lab ID: RE040611-2MB

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 11-Jun-04
Date Prepared: 11-Jun-04
Date Analyzed: 12-Jul-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 90 minutes

Final Aliquot: 2.00 g
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.005 +/- 0.024	0.042	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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Laboratory Control Sample(s)

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Lab ID: RE040611-1LCS

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 11-Jun-04
Date Prepared: 11-Jun-04
Date Analyzed: 30-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes

Final Aliquot: 2.00 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	24.4 +/- 4.5	0.2	24.1	101	70 - 130	P,M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Laboratory Control Sample(s)

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Lab ID: RE040611-2LCS

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 11-Jun-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes

Final Aliquot: 2.00 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	22.1 +/- 4.1	0.3	24.1	91.8	70 - 130	P,M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Matrix Spike Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-09
Lab ID: 0405096-31MS

Sample Matrix: SOIL
Prep SOP: PAI 783
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.06 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Matrix Spike	Sample Results	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	26.3	5.3	0.3	23.4	89.6	70 - 130	P,M3

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 in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
N - Matrix Spike Recovery outside control limits
P - Matrix Spike 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:

MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Matrix Spike Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-05
Lab ID: 0405096-5MS

Sample Matrix: SOIL
Prep SOP: PAI 783
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.20 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Matrix Spike	Sample Results	MDC	Spike Added	% Rec	Control Limits	Lab Qualifier
13982-63-3	Ra-226	22.2	2.71	0.2	21.9	89.3	70 - 130	P,M3

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 in control at 100-110%. Quantitative yield is assumed.
Y2 - Chemical Yield outside default limits.
N - Matrix Spike Recovery outside control limits
P - Matrix Spike 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:

MDC - Minimum Detectable Concentration (see PAI SOP 709)

Data Package ID: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Duplicate Sample Results (DER)

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-01
Lab ID: 0405096-1DUP

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 12-Jul-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 90 minutes
Report Basis: Dry Weight

Final Aliquot: 2.01 g
Prep Basis: Dry Weight
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	0.38 +/- 0.22	0.204 +/- 0.059	0.78	2.13	M3

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
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Duplicate Sample Results (DER)

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-10
Lab ID: 0405096-10DUP

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.23 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Analyte	Sample Result +/- 2 s TPU	Duplicate Result +/- 2 s TPU	DER	Control Limit	Lab Qualifiers
13982-63-3	Ra-226	17.7 +/- 3.3	19.5 +/- 3.6	0.37	2.13	M3

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
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Duplicate Sample Results (DER)

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-08
Lab ID: 0405096-30DUP

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.01 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Analyte	Sample Result +/- 2 s TPU	Duplicate Result +/- 2 s TPU	DER	Control Limit	Lab Qualifiers
13982-63-3	Ra-226	126 +/- 23	121 +/- 22	0.18	2.13	M3

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
BDL - Below Detection Limit
NR - Not Reported

Data Package ID: *REM0405096-1*

PARAGON ANALYTICS
Radiochemistry Data Package

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Section 3

INDIVIDUAL SAMPLE RESULTS

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-01
Lab ID: 0405096-1

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.13 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.38 +/- 0.22	0.30	M3

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: *REM0405096-1*

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Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Duplicate Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-01
Lab ID: 0405096-1DUP

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 12-Jul-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 90 minutes
Report Basis: Dry Weight

Final Aliquot: 2.01 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.204 +/- 0.059	0.061	M3

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.

M - The requested MDC was not met.

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

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-02
Lab ID: 0405096-2

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.12 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.137 +/- 0.080	0.029	

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-03
Lab ID: 0405096-3

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.07 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.17 +/- 0.10	0.12	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-04
Lab ID: 0405096-4

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.02 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	2.15 +/- 0.54	0.38	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-05
Lab ID: 0405096-5

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.05 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	2.71 +/- 0.59	0.20	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-06
Lab ID: 0405096-6

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.12 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.19 +/- 0.11	0.14	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-07
Lab ID: 0405096-7

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.11 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	52.4 +/- 9.4	0.3	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-08
Lab ID: 0405096-8

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.12 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	64 +/- 12	0	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-09
Lab ID: 0405096-9

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.15 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	16.1 +/- 3.0	0.2	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-10
Lab ID: 0405096-10

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.06 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	17.7 +/- 3.3	0.3	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Duplicate Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: MSED-10
Lab ID: 0405096-10DUP

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.23 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	19.5 +/- 3.6	0.3	M3

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.

M - The requested MDC was not met.

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

W - DER is greater than Warning Limit of 1.42

D - DER is greater than Control Limit of 2.13

Abbreviations:

TPU - Total Propagated Uncertainty (see PAI SOP 743)

MDC - Minimum Detectable Concentration (see PAI SOP 709)

BDL - Below Detection Limit

Data Package ID: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: **Paragon Analytics**
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-01
Lab ID: 0405096-11

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 05-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.09 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1.99 +/- 0.48	0.17	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-02
Lab ID: 0405096-12

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 05-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 12-Jul-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 90 minutes
Report Basis: Dry Weight

Final Aliquot: 2.20 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.67 +/- 0.13	0.04	

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-03
Lab ID: 0405096-13

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 04-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.09 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1.49 +/- 0.47	0.53	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-04
Lab ID: 0405096-14

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 04-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.15 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1.60 +/- 0.40	0.24	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-05
Lab ID: 0405096-15

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 04-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.01 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	4.50 +/- 0.94	0.28	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-06
Lab ID: 0405096-16

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 04-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.18 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	0.78 +/- 0.33	0.42	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-07
Lab ID: 0405096-17

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 04-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.05 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	1.44 +/- 0.55	0.73	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-08
Lab ID: 0405096-18

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 05-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.25 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	67 +/- 12	0	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-09
Lab ID: 0405096-19

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 05-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 30-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.03 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	7.5 +/- 1.4	0.2	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SSED-10
Lab ID: 0405096-20

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 04-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 29-Jun-04

Prep Batch: RE040611-1
QCBatchID: RE040611-1-1
Run ID: RE040630-1
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.05 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	5.7 +/- 1.2	0.2	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: GEN-02
Lab ID: 0405096-22

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.25 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	5.7 +/- 1.1	0.2	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-01
Lab ID: 0405096-25

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.01 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	11.7 +/- 2.2	0.2	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-02
Lab ID: 0405096-26

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.07 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	12.7 +/- 2.4	0.1	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-04
Lab ID: 0405096-27

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.02 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	122 +/- 22	0	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-05
Lab ID: 0405096-28

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 06-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.17 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	25.0 +/- 4.6	0.2	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-07
Lab ID: 0405096-29

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.06 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	3.93 +/- 0.82	0.18	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-08
Lab ID: 0405096-30

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.19 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	126 +/- 23	0	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Duplicate Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-08
Lab ID: 0405096-30DUP

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.01 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	121 +/- 22	0	M3

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.
M - The requested MDC was not met.
M3 - The requested MDC was not met, but thereported activity is greater than the reported MDC.
W - DER is greater than Warning Limit of 1.42
D - DER is greater than Control Limit of 2.13

Abbreviations:

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

Data Package ID: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-09
Lab ID: 0405096-31

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.28 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	5.3 +/- 1.0	0.3	M3

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: *REM0405096-1*

Ra-226 by Radon Emanation - Method 903.1

PAI 783 Rev 5

Sample Results

Lab Name: Paragon Analytics
Work Order Number: 0405096
Client Name: Kent & Sullivan Inc.
ClientProject ID: Ross Adams

Field ID: SOIL-10
Lab ID: 0405096-32

Sample Matrix: SOIL
Prep SOP: PAI 783 Rev 5
Date Collected: 07-May-04
Date Prepared: 11-Jun-04
Date Analyzed: 28-Jun-04

Prep Batch: RE040611-2
QCBatchID: RE040611-2-1
Run ID: RE040628-1A
Count Time: 15 minutes
Report Basis: Dry Weight

Final Aliquot: 2.01 g
Prep Basis: Dry Weight
Moisture(%): NA
Result Units: pCi/g
File Name: Manual Entry

CASNO	Target Nuclide	Result +/- 2 s TPU	MDC	Lab Qualifier
13982-63-3	Ra-226	221 +/- 40	0	M3

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: *REM0405096-1*

PARAGON ANALYTICS
Radiochemistry Data Package

4

Section 4

RAW DATA

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

Laboratory Name: Paragon Analytics
PAI Work Order: 0405096

Prep SOP: PAI 783
Analytical SOP: PAI 783

Reported on: Friday, July 16, 2004
11:33:15 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
0405096-1	Ra-226	5/6/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.13 g	Alpha Scin	RE040630-1	6/29/2004	63.000	224.78%	15	0.38	0.30	pCi/g	NA	
SMP	Trg. Analyte	1:00:00 PM	RE040611-1-1	8:29:00 AM	9:59:00 AM	NA	2.13 g	A13	Manual Entry	2:53 PM	28.000	NA	NA	0.22	NA	Dry Weight	NA	M3
0405096-1	Ra-226	5/6/2004	RE040611-1	6/29/2004	7/12/2004	SOIL	2.01 g	Alpha Scin	RE040630-1	7/12/2004	293.000	250.25%	90	0.204	0.061	pCi/g	0.78	
DUP	Trg. Analyte	1:00:00 PM	RE040611-1-1	9:59:00 AM	8:35:00 AM	NA	2.01 g	A4	Manual Entry	1:57 PM	116.000	NA	NA	0.059	NA	Dry Weight	NA	M3
0405096-2	Ra-226	5/6/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.12 g	Alpha Scin	RE040630-1	6/29/2004	13.000	232.30%	15	0.137	0.029	pCi/g	NA	
SMP	Trg. Analyte	1:40:00 PM	RE040611-1-1	8:29:00 AM	9:59:00 AM	NA	2.12 g	C29	Manual Entry	2:53 PM	0.000	NA	NA	0.080	NA	Dry Weight	NA	
0405096-3	Ra-226	5/6/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.07 g	Alpha Scin	RE040630-1	6/29/2004	19.000	234.09%	15	0.17	0.12	pCi/g	NA	
SMP	Trg. Analyte	2:00:00 PM	RE040611-1-1	8:29:00 AM	9:59:00 AM	NA	2.07 g	D30	Manual Entry	2:53 PM	3.000	NA	NA	0.10	NA	Dry Weight	NA	M3
0405096-4	Ra-226	5/6/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.02 g	Alpha Scin	RE040630-1	6/29/2004	231.000	223.94%	15	2.15	0.38	pCi/g	NA	
SMP	Trg. Analyte	9:10:00 AM	RE040611-1-1	8:29:00 AM	10:42:00 AM	NA	2.02 g	A1	Manual Entry	3:17 PM	43.000	NA	NA	0.54	NA	Dry Weight	NA	M3
0405096-5	Ra-226	5/6/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.05 g	Alpha Scin	RE040630-1	6/29/2004	303.000	266.56%	15	2.71	0.20	pCi/g	NA	
SMP	Trg. Analyte	9:20:00 AM	RE040611-1-1	8:29:00 AM	10:42:00 AM	NA	2.05 g	B2	Manual Entry	3:17 PM	16.000	NA	NA	0.59	NA	Dry Weight	NA	M3
0405096-5	Ra-226	5/6/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.2 g	Alpha Scin	RE040630-1	6/29/2004	1882.000	197.69%	15	22.2	0.2	pCi/g	NA	89.3
MS	Trg. Analyte	9:20:00 AM	RE040611-1-1	8:29:00 AM	10:42:00 AM	NA	2.2 g	C31	Manual Entry	3:17 PM	7.000	NA	NA	4.1	NA	Dry Weight	NA	P,M3
0405096-6	Ra-226	5/7/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.12 g	Alpha Scin	RE040630-1	6/29/2004	27.000	259.43%	15	0.19	0.14	pCi/g	NA	
SMP	Trg. Analyte	8:30:00 AM	RE040611-1-1	8:47:00 AM	10:42:00 AM	NA	2.12 g	D20	Manual Entry	3:17 PM	7.000	NA	NA	0.11	NA	Dry Weight	NA	M3
0405096-7	Ra-226	5/7/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.11 g	Alpha Scin	RE040630-1	6/29/2004	5760.000	263.58%	15	52.4	0.3	pCi/g	NA	
SMP	Trg. Analyte	9:00:00 AM	RE040611-1-1	8:47:00 AM	12:08:00 PM	NA	2.11 g	A3	Manual Entry	4:10 PM	51.000	NA	NA	9.4	NA	Dry Weight	NA	M3
0405096-8	Ra-226	5/7/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.12 g	Alpha Scin	RE040630-1	6/29/2004	6581.000	246.92%	15	64	0	pCi/g	NA	
SMP	Trg. Analyte	9:15:00 AM	RE040611-1-1	8:47:00 AM	12:08:00 PM	NA	2.12 g	B4	Manual Entry	4:10 PM	13.000	NA	NA	12	NA	Dry Weight	NA	M3
0405096-9	Ra-226	5/7/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.15 g	Alpha Scin	RE040630-1	6/29/2004	1539.000	225.39%	15	16.1	0.2	pCi/g	NA	
SMP	Trg. Analyte	9:20:00 AM	RE040611-1-1	8:47:00 AM	12:08:00 PM	NA	2.15 g	C21	Manual Entry	4:10 PM	14.000	NA	NA	3.0	NA	Dry Weight	NA	M3

Comments:

Data Package ID: *REM0405096-1*

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 Recieved' while the Report Basis is 'Dry Weight'.

Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Recieved'.

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: 0405096

Prep SOP: PAI 783
Analytical SOP: PAI 783

Reported on: Friday, July 16, 2004
11:33:15 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
0405096-10	Ra-226	5/7/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.06 g	Alpha Scin	RE040630-1	6/29/2004	1460.000	202.10%	15	17.7	0.3	pCi/g	NA	
SMP	Trg. Analyte	10:10:00 AM	RE040611-1-1	8:47:00 AM	12:08:00 PM	NA	2.06 g	D22	Manual Entry	4:10 PM	17.000	NA	NA	3.3	NA	Dry Weight	NA	M3
0405096-10	Ra-226	5/7/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.23 g	Alpha Scin	RE040630-1	6/29/2004	2189.000	252.48%	15	19.5	0.3	pCi/g	0.37	
DUP	Trg. Analyte	10:10:00 AM	RE040611-1-1	8:47:00 AM	12:33:00 PM	NA	2.23 g	A6	Manual Entry	4:36 PM	39.000	NA	NA	3.6	NA	Dry Weight	NA	M3
0405096-11	Ra-226	5/5/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.09 g	Alpha Scin	RE040630-1	6/29/2004	170.000	201.38%	15	1.99	0.17	pCi/g	NA	
SMP	Trg. Analyte	4:15:00 PM	RE040611-1-1	8:47:00 AM	12:33:00 PM	NA	2.09 g	B8	Manual Entry	4:36 PM	6.000	NA	NA	0.48	NA	Dry Weight	NA	M3
0405096-12	Ra-226	5/5/2004	RE040611-1	6/29/2004	7/12/2004	SOIL	2.2 g	Alpha Scin	RE040630-1	7/12/2004	648.000	237.13%	90	0.67	0.04	pCi/g	NA	
SMP	Trg. Analyte	5:05:00 PM	RE040611-1-1	12:33:00 PM	8:35:00 AM	NA	2.2 g	B6	Manual Entry	1:57 PM	45.000	NA	NA	0.13	NA	Dry Weight	NA	
0405096-13	Ra-226	5/4/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.09 g	Alpha Scin	RE040630-1	6/29/2004	285.000	256.08%	15	1.49	0.53	pCi/g	NA	
SMP	Trg. Analyte	6:10:00 PM	RE040611-1-1	9:33:00 AM	12:33:00 PM	NA	2.09 g	D24	Manual Entry	4:36 PM	130.000	NA	NA	0.47	NA	Dry Weight	NA	M3
0405096-14	Ra-226	5/4/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.15 g	Alpha Scin	RE040630-1	6/29/2004	192.000	251.49%	15	1.60	0.24	pCi/g	NA	
SMP	Trg. Analyte	5:00:00 PM	RE040611-1-1	9:33:00 AM	12:59:00 PM	NA	2.15 g	A9	Manual Entry	5:28 PM	23.000	NA	NA	0.40	NA	Dry Weight	NA	M3
0405096-15	Ra-226	5/4/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.01 g	Alpha Scin	RE040630-1	6/29/2004	390.000	209.96%	15	4.50	0.28	pCi/g	NA	
SMP	Trg. Analyte	3:59:00 PM	RE040611-1-1	9:33:00 AM	12:59:00 PM	NA	2.01 g	B10	Manual Entry	5:28 PM	19.000	NA	NA	0.94	NA	Dry Weight	NA	M3
0405096-16	Ra-226	5/4/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.18 g	Alpha Scin	RE040630-1	6/29/2004	161.000	247.33%	15	0.78	0.42	pCi/g	NA	
SMP	Trg. Analyte	3:03:00 PM	RE040611-1-1	9:33:00 AM	12:59:00 PM	NA	2.18 g	C25	Manual Entry	5:28 PM	79.000	NA	NA	0.33	NA	Dry Weight	NA	M3
0405096-17	Ra-226	5/4/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.05 g	Alpha Scin	RE040630-1	6/29/2004	333.000	234.72%	15	1.44	0.73	pCi/g	NA	
SMP	Trg. Analyte	2:00:00 PM	RE040611-1-1	9:33:00 AM	12:59:00 PM	NA	2.05 g	D26	Manual Entry	5:28 PM	198.000	NA	NA	0.55	NA	Dry Weight	NA	M3
0405096-18	Ra-226	5/5/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.25 g	Alpha Scin	RE040630-1	6/29/2004	6841.000	229.61%	15	67	0	pCi/g	NA	
SMP	Trg. Analyte	12:40:00 PM	RE040611-1-1	9:33:00 AM	1:44:00 PM	NA	2.25 g	A12	Manual Entry	5:51 PM	34.000	NA	NA	12	NA	Dry Weight	NA	M3
0405096-19	Ra-226	5/5/2004	RE040611-1	6/24/2004	6/30/2004	SOIL	2.03 g	Alpha Scin	RE040630-1	6/30/2004	740.000	224.78%	15	7.5	0.2	pCi/g	NA	
SMP	Trg. Analyte	3:20:00 PM	RE040611-1-1	10:21:00 AM	9:41:00 AM	NA	2.03 g	A13	Manual Entry	2:39 PM	17.000	NA	NA	1.4	NA	Dry Weight	NA	M3

Comments:

Data Package ID: *REM0405096-1*

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 Recieved' while the Report Basis is 'Dry Weight'.

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

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: 0405096

Prep SOP: PAI 783
Analytical SOP: PAI 783

Reported on: Friday, July 16, 2004
11:33:15 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
0405096-20	Ra-226	5/4/2004	RE040611-1	6/24/2004	6/29/2004	SOIL	2.05 g	Alpha Scin	RE040630-1	6/29/2004	479.000	205.57%	15	5.7	0.2	pCi/g	NA	
SMP	Trg. Analyte	7:05:00 PM	RE040611-1-1	10:21:00 AM	1:44:00 PM	NA	2.05 g	C27	Manual Entry	5:51 PM	6.000	NA	NA	1.2	NA	Dry Weight	NA	M3
0405096-22	Ra-226	5/7/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.25 g	Alpha Scin	RE040628-1A	6/28/2004	820.000	267.56%	15	5.7	0.2	pCi/g	NA	
SMP	Trg. Analyte	12:35:00 PM	RE040611-2-1	6:03:00 PM	10:13:00 AM	NA	2.25 g	A2	Manual Entry	2:43 PM	43.000	NA	NA	1.1	NA	Dry Weight	NA	M3
0405096-25	Ra-226	5/6/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.01 g	Alpha Scin	RE040628-1A	6/28/2004	1324.000	246.92%	15	11.7	0.2	pCi/g	NA	
SMP	Trg. Analyte	4:00:00 PM	RE040611-2-1	6:03:00 PM	10:13:00 AM	NA	2.01 g	B4	Manual Entry	2:43 PM	19.000	NA	NA	2.2	NA	Dry Weight	NA	M3
0405096-26	Ra-226	5/6/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.07 g	Alpha Scin	RE040628-1A	6/28/2004	1243.000	208.01%	15	12.7	0.1	pCi/g	NA	
SMP	Trg. Analyte	3:40:00 PM	RE040611-2-1	6:03:00 PM	10:13:00 AM	NA	2.07 g	C22	Manual Entry	2:43 PM	4.000	NA	NA	2.4	NA	Dry Weight	NA	M3
0405096-27	Ra-226	5/6/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.02 g	Alpha Scin	RE040628-1A	6/28/2004	13736.000	247.85%	15	122	0	pCi/g	NA	
SMP	Trg. Analyte	3:04:00 PM	RE040611-2-1	6:03:00 PM	10:13:00 AM	NA	2.02 g	D23	Manual Entry	2:43 PM	3.000	NA	NA	22	NA	Dry Weight	NA	M3
0405096-28	Ra-226	5/6/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.17 g	Alpha Scin	RE040628-1A	6/28/2004	3130.000	252.48%	15	25.0	0.2	pCi/g	NA	
SMP	Trg. Analyte	3:10:00 PM	RE040611-2-1	6:03:00 PM	11:02:00 AM	NA	2.17 g	A6	Manual Entry	3:03 PM	23.000	NA	NA	4.6	NA	Dry Weight	NA	M3
0405096-29	Ra-226	5/7/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.06 g	Alpha Scin	RE040628-1A	6/28/2004	381.000	201.38%	15	3.93	0.18	pCi/g	NA	
SMP	Trg. Analyte	1:50:00 PM	RE040611-2-1	6:03:00 PM	11:02:00 AM	NA	2.06 g	B8	Manual Entry	3:03 PM	10.000	NA	NA	0.82	NA	Dry Weight	NA	M3
0405096-30	Ra-226	5/7/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.19 g	Alpha Scin	RE040628-1A	6/28/2004	15864.999	253.17%	15	126	0	pCi/g	NA	
SMP	Trg. Analyte	4:15:00 PM	RE040611-2-1	6:03:00 PM	11:02:00 AM	NA	2.19 g	C24	Manual Entry	3:03 PM	5.000	NA	NA	23	NA	Dry Weight	NA	M3
0405096-30	Ra-226	5/7/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.01 g	Alpha Scin	RE040628-1A	6/28/2004	13778.000	250.92%	15	121	0	pCi/g	0.18	
DUP	Trg. Analyte	4:15:00 PM	RE040611-2-1	6:48:00 PM	11:02:00 AM	NA	2.01 g	D25	Manual Entry	3:03 PM	3.000	NA	NA	22	NA	Dry Weight	NA	M3
0405096-31	Ra-226	5/7/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.28 g	Alpha Scin	RE040628-1A	6/28/2004	743.000	251.49%	15	5.3	0.3	pCi/g	NA	
SMP	Trg. Analyte	2:10:00 PM	RE040611-2-1	6:48:00 PM	11:36:00 AM	NA	2.28 g	A9	Manual Entry	3:37 PM	49.000	NA	NA	1.0	NA	Dry Weight	NA	M3
0405096-31	Ra-226	5/7/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.06 g	Alpha Scin	RE040628-1A	6/28/2004	2610.000	209.96%	15	26.3	0.3	pCi/g	NA	89.6
MS	Trg. Analyte	2:10:00 PM	RE040611-2-1	6:48:00 PM	11:36:00 AM	NA	2.06 g	B10	Manual Entry	3:37 PM	29.000	NA	NA	4.8	NA	Dry Weight	NA	P,M3

Comments:

Data Package ID: *REM0405096-1*

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 Recieved' while the Report Basis is 'Dry Weight'.

\# - Aliquot Basis is 'Dry Weight' while the Report Basis is 'As Recieved'.

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: 0405096

Prep SOP: PAI 783
Analytical SOP: PAI 783

Reported on: Friday, July 16, 2004
11:33:26 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
0405096-32	Ra-226	5/7/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2.01 g	Alpha Scin	RE040628-1A	6/28/2004	23636.000	234.82%	15	221	0	pCi/g	NA	
SMP	Trg. Analyte	4:40:00 PM	RE040611-2-1	6:48:00 PM	11:36:00 AM	NA	2.01 g	C26	Manual Entry	3:37 PM	3.000	NA	NA	40	NA	Dry Weight	NA	M3
RE040611-1	Ra-226	6/11/2004	RE040611-1	6/29/2004	7/12/2004	SOIL	2 g	Alpha Scin	RE040630-1	7/12/2004	152.000	212.25%	90	0.063	0.069	pCi/g	NA	
MB	Trg. Analyte	2:50:21 PM	RE040611-1-1	1:44:00 PM	10:02:00 AM	NA	2 g	A8	Manual Entry	3:51 PM	106.000	NA	NA	0.046	NA	Dry Weight	NA	U,M
RE040611-1	Ra-226	6/11/2004	RE040611-1	6/24/2004	6/30/2004	SOIL	2 g	Alpha Scin	RE040630-1	6/30/2004	2490.000	239.70%	15	24.4	0.2	pCi/g	NA	101
LCS	Trg. Analyte	2:50:21 PM	RE040611-1-1	10:21:00 AM	9:41:00 AM	NA	2 g	B14	Manual Entry	2:39 PM	13.000	NA	NA	4.5	NA	Dry Weight	NA	P,M3
RE040611-2	Ra-226	6/11/2004	RE040611-2	6/28/2004	7/12/2004	SOIL	2 g	Alpha Scin	RE040628-1A	7/12/2004	54.000	241.21%	90	0.005	0.042	pCi/g	NA	
MB	Trg. Analyte	2:56:10 PM	RE040611-2-1	11:36:00 AM	10:02:00 AM	NA	2 g	B9	Manual Entry	3:51 PM	50.000	NA	NA	0.024	NA	Dry Weight	NA	U
RE040611-2	Ra-226	6/11/2004	RE040611-2	6/21/2004	6/28/2004	SOIL	2 g	Alpha Scin	RE040628-1A	6/28/2004	2336.000	229.61%	15	22.1	0.3	pCi/g	NA	91.8
LCS	Trg. Analyte	2:56:10 PM	RE040611-2-1	6:48:00 PM	12:40:00 PM	NA	2 g	A12	Manual Entry	4:57 PM	29.000	NA	NA	4.1	NA	Dry Weight	NA	P,M3

Comments:

Data Package ID: *REM0405096-1*

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 Recieved' while the Report Basis is 'Dry Weight'.

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

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

Logbook No./Page 248270

Paragon Analytics, Inc.

Sample 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.
0418009.S12	1A	14	NA	6/23/04	09:51	23	15		6/23/04	18:38	12729	25	
↓ .S11	2B	13	↓	↓	↓	11	↓		↓	↓	11061	25	
CALIB SOURCE	1A	NA							6/24/04	07:59	9468	1	
↓	2B	↓							↓	08:00	9324	↓	↓
	6C									08:01	9539		
	4D									08:02	9640		
0418009.S13	1A	2	NA	6/24/04	08:03	49	15			13:49	11272	20	
.S14	2B	9	↓	↓	↓	34	↓			↓	10310	20	
.S14	1A	9			08:21	42				14:24	10714	20	
.S13	2B	2			↓	52				↓	10766	20	
.S15	1A	10			08:43	57				15:21	11801	25	
.S15	2B	10			09:22	34				16:12	11027	25	
0418009.ICV1	1A	1	1		10:07	39				16:54	6304	15	
↓ .ICV2	2B	3	↓	↓	↓	49	↓			↓	6836	↓	
CALIB. SOURCE	1A	NA								18:34	9452	1	
↓	2B	↓								18:35	9612	↓	↓
	6C									18:36	9473		
	4D									18:37	9472		
	1A								6/28/04	09:06	9382		
	2B									09:07	9476		
	6C									09:08	9347		
	4D									09:09	9287		
0405096.22	1A	2	1	6/28/04	09:12	43	15			14:43	820	15	

Comments:

000055

Form 795r2.xls (9/23/2002)

Reviewed by/date: 7/2/04

Logbook No./Page 248271

Paragon Analytics, Inc.

Sample 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.
0405096.25	2B	4	1	6/28/04	09:12	19	15		6/28/04	14:43	1324	15	
.26	6C	22	19			4					1243		
.27	4D	23				3					13736		
.28	1A	6	1		09:40	23				15:03	3130		
.29	2B	8				10					381		
.30	6C	24	19			5					15865		
.30 DUP	4D	25				3					13778		
.31	1A	9	1		10:18	49				15:37	743		
.31 MS	2B	10				29					2610		
.32	6C	26	19			3					23630		
RE040611.2.MB	4D	27				6					415		
.LCS	1A	12	1		11:02	29				16:57	2336		
CALIB. SOURCE	1A	NA							6/29/04	08:55	9419	1	
	2B									08:56	9435		
	6C									08:57	9458		
	4D									08:58	9448		
0405096.1	1A	13	1	6/29/04	09:08	28	15			14:53	63	15	
.1 DUP	2B	14				34					35		
.2	6C	29	19			0					13		
.3	4D	30				3					19		
.4	1A	1	2		09:33	43				15:17	231		
.5	2B	2				16					303		
.5 MS	6C	31	19			7					1882		

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 7/2/04

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Logbook No./Page 248272

Paragon Analytics, Inc.

Sample 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.
0405096.6	4D	20	20	6/29/04	09:33	7	15		6/29/04	15:17	27	15	
.7	1A	3	2		10:07	51				16:10	5760		
.8	2B	4				13					6581		
.9	6C	21	20			14					1539		
.10	4D	22				17					1460		
.10DUP	1A	6	2		10:54	39				16:36	2189		
.11	2B	8				6					170		
.12	6C	23	20			124					137		
.13	4D	24				130					285		
.14	1A	9	2		12:15	~~9923~~ 6/29/04				17:28	192		
.15	2B	10				6/29/04 19819					390		
.16	6C	25	20			79					161		
.17	4D	26				198					333		
.18	1A	12	2		12:40	34				17:51	6841		
.20	6C	27	20			6					479		
RE040611.1.MB	4D	28	19			4					16		
CALIB.SOURCE	1A	NA							6/30/04	08:29	9572	1	
	2B									08:30	9424		
	6C									08:31	9461		
	4D									08:32	9543		
0405096.19	1A	13	2	6/30/04	08:35	17	15			14:39	740	15	
RE040611.1.LCS	2B	14				13					2490		
0405095.7	6C	28	20			2					38		

Comments:

000057

Form 795r2.xls (9/23/2002)

Reviewed by/date: 7/2/04

Logbook No./Page 248276

Paragon Analytics, Inc.

Sample 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.
0406158·10	2B	13	6	7/8/04	~~09:23~~ 09:39	19	15	BP	7/8/04	1423	29	15	BP
↓ ·11	1A	14	↓	↓	09:41	24	↓	BP	↓	1450	87	↓	↓
↓ ·12	2B	1	7	↓	09:55	11	↓	↓	↓	↓	16	↓	↓
RE040628·1·MB	1A	2	↓	↓	09:59	26	↓	↓	↓	1520	28	↓	BP
↓ ·LCS	2B	3	↓	↓	10:13	14	↓	↓	↓	↓	2489	↓	↓
Calib Source	1A	NA	→	→	→	→	→	→	7-8-04	1544	9334	1	BP
↓	2B	NA	→	→	→	→	→	→	↓	1546	9354	1	↓
↓	1A	↓	→	→	→	→	→	→	7/11/04	19:45	9541	↓	BP
↓	2B	↓	→	→	→	→	→	→	↓	19:46	9417	↓	↓
0405096·1DUP	1A	4	7	7/11/04	19:51	116	90	BP	7-12-04	13:57	293	90	BP
↓ ·12	2B	6	↓		↓	45	↓	↓		↓	648	↓	↓
RE040611·1·MB	1A	8	↓	7-12-04	0810	106	↓	BP	↓	1551	152	↓	↓
↓ ·2·MB	2B	9	↓	↓	↓	50	↓	↓	↓	↓	54	↓	↓
0405097-17	1A	10	↓	↓	0942	20	15	BP	↓	1532	42508	15	↓
↓ -19	2B	12	↓	↓	↓	11	↓	BP	↓	↓	30642	↓	↓
Calib. Source	1A	NA	→	→	→	→	→	→	7-13-04	0741	9658	1	BP
↓	2B	NA	→	→	→	→	→	→	↓	0742	9212	1	BP
0405097-19D	1A	13	7	7-13-04	0745	15	15	BP	↓	BP ~~0803~~		15	↓
↓ -21	2B	14	↓	↓	↓	6	↓	↓	↓	↓	↓	↓	↓
↓ -22	1A	1	8	↓	0803	28	↓	↓	↓	↓	↓	↓	↓
↓ -23	2B	2	↓	↓	↓	6	↓	↓	↓	↓	↓	↓	↓
↓ -24	1A	3	↓	↓	0822	31	↓	↓	↓	↓	↓	↓	↓
↓ -25	2B	4	↓	↓	↓	15	↓	↓	↓	↓	↓	↓	↓

NT 7/13/04

NT 7/13/04

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: NT 7/13/04

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 5

QUALITY ASSURANCE SUMMARY REPORTS

5

NCR # 005767

CONTROLLED

NON-CONFORMANCE REPORT

Paragon Analytics

Initiated by A. Fuda Date 6/30/04

Method/Procedure ^{226}Ra-903.1

Reason: X Non-Conformance

___ Client Inquiry

___ Other _____

Work Orders Affected 0405096

Clients Kent & Sullivan

SECTION I TYPE OF EVENT (circle as appropriate)

___ 1. LCS / Surrogate / IS / Tracer or Chemical Yield Criteria Not Met

___ 2. Calibration Criteria Not Met (ICAL, ICV, CCV)

___ 3. Method Requirements Not Met (HTV, MB, ____)

___ 4. Deviation from LQAP / SOP (i.e., PAI criteria not met)

✓ 5. Client Criteria Not Met (MDC, DER, _____)

___ 6. Equipment Failure or Laboratory Incident / Error

___ 7. Other _____

Explanation:- SAMPLES 0405096-1 DUP, -12 AND RE040630-1-MB DID NOT ACHIEVE THE CLIENT REQUESTED MDC OF 0.05 pCi/g. (AF 6/30/04)
- SAMPLE RE040611-2-MB DID NOT ACHIEVE THE CLIENT REQUESTED MDC OF 0.05 pCi/g.

Actions to Prevent Recurrence (Retrain, etc.): NONE - RANDOM OCCURRANCE

SECTION II NOTIFICATION

Client Contacted? (Y / N) Name:_____ Date:_____ Time: _____

SECTION III CORRECTIVE ACTIONS

___ 1. Submit for Re-Prep. or Clean-up

✓ 2. Re-analyze (RECOUNT)

___ 3. Resubmit Data (hc, edd, narrative)

___ 4. Document in Narrative

___ 5. Other _____

Approved by: DCB DPM [signature] PM

SECTION IV REQUEST FOR REWORK

Initial Batch ID: _____ Date: _____

Reworked Batch ID: _____ Date: _____

Outcome: _____ 6/30/04

Approved by: _____

Matrix Effect or Elevated / Sample Activity Suspected? (circle applicable)

SECTION V DISPOSITION **Use as is** **Repair** **Reject**

SECTION VI COMMENTS AFTER RECOUNT: 0405096-1DUP HAS ACTIVITY ABOVE MDC. 0405096-12 OK. RE040611-1-MB HAS ACTIVITY BELOW MDC BUT ALL SAMPLES HAVE ACTIVITY ABOVE MB-MDC (AF 6/11/04). RE040611-2-MB OK. ALL SAMPLES COUNTED FOR MAX COUNT TIME (90 MIN)

SECTION VII APPROVAL SIGNATURES

Project Manager (PM) Debbie Floyd Date 6/30/04

Department Manager (DPM) [signature] Date 6/30/04 (Verification of Disposition)

QA Manager [signature] Date 7/14/04

SECTION VIII DISTRIBUTION DJF PM KB Dept. Manager KDC Lab Director ____ Rpt.Group or ✓ Rad

RG

FORM 313r14.doc (3/8/04)

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PARAGON ANALYTICS
Radiochemistry Data Package

Section 6

LABORATORY BENCH SHEETS

6

Radiochemistry Instrument Worksheet

Paragon Analytics

Prep Batch: RE040611-1

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? Y / N 005767

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date Time	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts		Notes
1	0405096-1	SMP	2.1269	2.1269	g									
1	0405096-1	DUP	2.0097	2.0097	g	7/12/04 13:57	A	4	116	2.5025	90m	293		JP 7/16/04
1	0405096-2	SMP	2.1234	2.1234	g									
1	0405096-3	SMP	2.0729	2.0729	g									
1	0405096-4	SMP	2.015	2.015	g									
1	0405096-5	SMP	2.0518	2.0518	g									
1	0405096-5	MS	2.202	2.202	g									
1	0405096-6	SMP	2.1169	2.1169	g									
1	0405096-7	SMP	2.1147	2.1147	g									
1	0405096-8	SMP	2.1216	2.1216	g									
1	0405096-9	SMP	2.1451	2.1451	g									
1	0405096-10	SMP	2.0616	2.0616	g									
1	0405096-10	DUP	2.2287	2.2287	g									JP 7/16/04
1	0405096-11	SMP	2.0909	2.0909	g	7/12/04 13:57	B	6	45	2.3713	90m	648		
1	0405096-12	SMP	2.1965	2.1965	g									
1	0405096-13	SMP	2.0862	2.0862	g									
1	0405096-14	SMP	2.1521	2.1521	g									
1	0405096-15	SMP	2.0117	2.0117	g									
1	0405096-16	SMP	2.1799	2.1799	g									
1	0405096-17	SMP	2.051	2.051	g									
1	0405096-18	SMP	2.2472	2.2472	g									
1	0405096-19	SMP	2.0324	2.0324	g									
1	0405096-20	SMP	2.0477	2.0477	g									JP 7/16/04
1	RE040611-1	MB	2	2	g	7/12/04 15:51	A	8	106	2.1225	90m	152		
1	RE040611-1	LCS	2	2	g									

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Supersedes: ~~6/11/04 17:53~~ 7/13/04 6/29/04 08:49

Radiochemistry Instrument Worksheet

Paragon Analytics

Prep Batch: RE040611-1

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? (Y) / N 005767

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date Time	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts		Notes

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

000063

7/13/04

Supersedes: ~~6/11/04 17:53~~ 6/29/04 08:49

Radiochemistry Instrument Worksheet

Paragon Analytics

Prep Batch: RE040611-1

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? Y / N NA

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date Time	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts	Notes
1	0405096-1	SMP	2.1269	2.1269	g	6/29/04 14:53	A	13	28	2.2478	15m	63	
1	0405096-1	DUP	2.0097	2.0097	g		B	14	34	2.3970		35	
1	0405096-2	SMP	2.1234	2.1234	g		C	29	Ø	2.3230		13	
1	0405096-3	SMP	2.0729	2.0729	g		D	30	3	2.3409		19	
1	0405096-4	SMP	2.015	2.015	g	15:17	A	1	43	2.2394		231	
1	0405096-5	SMP	2.0518	2.0518	g		B	2	16	2.6656		303	
1	0405096-5	MS	2.202	2.202	g		C	31	7	1.9769		1882	
1	0405096-6	SMP	2.1169	2.1169	g		D	20	7	2.5943		27	
1	0405096-7	SMP	2.1147	2.1147	g	16:10	A	3	51	2.6358		5760	
1	0405096-8	SMP	2.1216	2.1216	g		B	4	13	2.4692		6581	
1	0405096-9	SMP	2.1451	2.1451	g		C	21	14	2.2539		1539	
1	0405096-10	SMP	2.0616	2.0616	g		D	22	17	2.0210		1460	
1	0405096-10	DUP	2.2287	2.2287	g	16:36	A	6	39	2.5248		2189	
1	0405096-11	SMP	2.0909	2.0909	g		B	8	6	2.0138		170	
1	0405096-12	SMP	2.1965	2.1965	g		C	23	124	2.4859		137	
1	0405096-13	SMP	2.0862	2.0862	g		D	24	130	2.5608		285	
1	0405096-14	SMP	2.1521	2.1521	g	17:28	A	9	23	2.5149		192	
1	0405096-15	SMP	2.0117	2.0117	g		B	10	19	2.0996		390	
1	0405096-16	SMP	2.1799	2.1799	g		C 6/30/04	25	79	2.4733		161	
1	0405096-17	SMP	2.051	2.051	g		D 6/30	26	198	2.3472		333	
1	0405096-18	SMP	2.2472	2.2472	g	17:51	~~A~~ 6/30	12	34	2.2961		6841	
1	0405096-19	SMP	2.0324	2.0324	g	6/30/04 14:39	~~B~~ A	13	17	2.2478		740	
1	0405096-20	SMP	2.0477	2.0477	g	6/29/04 17:51	C	27	6	2.0557		479	
1	RE040611-1	MB	2	2	g		D	28	4	2.5180		16	
1	RE040611-1	LCS	2	2	g	6/30/04 14:39	~~A~~ B	14	13	2.3970		2490	

6/30/04

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Supersedes: NA

Paragon Analytics

Radiochemistry Instrument Worksheet

Prep Batch: RE040611-1

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? Y / N _____

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date Time	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts		Notes

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

000065

Paragon Analytics

Radiochemistry Instrument Worksheet

Prep Batch: RE040611-2

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? Y / N 005767

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date Time	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts		Notes
1	0405096-22	SMP	2.247	2.247	g									
1	0405096-25	SMP	2.006	2.006	g									
1	0405096-26	SMP	2.071	2.071	g									
1	0405096-27	SMP	2.0189	2.0189	g									
1	0405096-28	SMP	2.1674	2.1674	g									
1	0405096-29	SMP	2.0619	2.0619	g									
1	0405096-30	SMP	2.1855	2.1855	g									
1	0405096-30	DUP	2.0084	2.0084	g									
1	0405096-31	SMP	2.2788	2.2788	g									
1	0405096-31	MS	2.0611	2.0611	g									
1	0405096-32	SMP	2.0066	2.0066	g									JP 7/16/04
1	RE040611-2	MB	2	2	g	7/12/04 15:51	B	9	50	2.4121	90M	54		
1	RE040611-2	LCS	2	2	g									

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

000068

Paragon Analytics

Radiochemistry Instrument Worksheet

Prep Batch: RE040611-2

Prep Procedure: Ra226_RnE

Analytical QASS / NCR? Y / N _____

Prep Num	LabID	QC Type	Init Alq	Fin Alq	Units	Cnt Date Time 6/28/04	Detector ID	Flask ID	Total Bkg Counts	Efficiency	Count Duration	Gross Counts		Notes
1	0405096-22	SMP	2.247	2	g	14:43	A	2	43	2.6756	15M	820		
1	0405096-25	SMP	2.006	2	g		B	4	19	2.4692		1324		
1	0405096-26	SMP	2.071	2	g		C	22	4	2.0801		1243		
1	0405096-27	SMP	2.0189	2	g		D	23	3	2.4785		13736		
1	0405096-28	SMP	2.1674	2	g	15:03	A	6	23	2.5248		3130		
1	0405096-29	SMP	2.0619	2	g		B	8	10	2.0138		381		
1	0405096-30	SMP	2.1855	2	g		C	24	5	2.5317		15865		
1	0405096-30	DUP	2.0084	2	g		D	25	3	2.5092		13778		
1	0405096-31	SMP	2.2788	2	g	15:37	A	9 49	49	2.5149		743		
1	0405096-31	MS	2.0611	2	g		B	10 29	29	2.0996		2610		
1	0405096-32	SMP	2.0066	2	g		C	26 3	3	2.3482		23636		
1	RE040611-2	MB	2	2	g		D	27 6	6	2.0354		415		
1	RE040611-2	LCS	2	2	g	16:57	A	12	29	2.2961		2336		

6/28/04

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

000067

Radiochemistry Prep Worksheet

Paragon Analytics

Prep Batch: RE040611-1

Prep Procedure: Ra226_RnE

Reviewed By: ATF **Review Date:** 7/13/04

Non-Routine Pre-Treatment? Y / N **Batch:** na **Re-Prep?** Y N **Batch:** na **Prep QASS /** NCR? Y / N 5767

Prep SOP: PAI 783 **Rev:** 5
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Adrienne Freda
Prep Date: 6/11/04
Prep Dept: RS

Balance: 13
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	0405096-1	SMP	X2	2.1269	2.1269	Dry Weight	06/24/04 08:29	06/29/04 09:59		
2	1	0405096-1	DUP	L5	2.0097	2.0097	Dry Weight	06/29/04 09:59	07/12/04 08:35		
3	1	0405096-2	SMP	963	2.1234	2.1234	Dry Weight	06/24/04 08:29	06/29/04 09:59		
4	1	0405096-3	SMP	X3	2.0729	2.0729	Dry Weight	06/24/04 08:29	06/29/04 09:59		
5	1	0405096-4	SMP	NA	2.015	2.015	Dry Weight	06/24/04 08:29	06/29/04 10:42		
6	1	0405096-5	SMP	A10	2.0518	2.0518	Dry Weight	06/24/04 08:29	06/29/04 10:42		
7	1	0405096-5	MS	X	2.202	2.202	Dry Weight	06/24/04 08:29	06/29/04 10:42	S1	
8	1	0405096-6	SMP	949	2.1169	2.1169	Dry Weight	06/24/04 08:47	06/29/04 10:42		
9	1	0405096-7	SMP	20	2.1147	2.1147	Dry Weight	06/24/04 08:47	06/29/04 12:08		
10	1	0405096-8	SMP	L6	2.1216	2.1216	Dry Weight	06/24/04 08:47	06/29/04 12:08		
11	1	0405096-9	SMP	995	2.1451	2.1451	Dry Weight	06/24/04 08:47	06/29/04 12:08		
12	1	0405096-10	SMP	T48	2.0616	2.0616	Dry Weight	06/24/04 08:47	06/29/04 12:08		
13	1	0405096-10	DUP	916	2.2287	2.2287	Dry Weight	06/24/04 08:47	06/29/04 12:33		
14	1	0405096-11	SMP	909	2.0909	2.0909	Dry Weight	06/24/04 08:47	06/29/04 12:33		
15	1	0405096-12	SMP	A11	2.1965	2.1965	Dry Weight	06/29/04 12:33	07/12/04 08:35		
16	1	0405096-13	SMP	A2	2.0862	2.0862	Dry Weight	06/24/04 09:33	06/29/04 12:33		
17	1	0405096-14	SMP	T10	2.1521	2.1521	Dry Weight	06/24/04 09:33	06/29/04 12:59		
18	1	0405096-15	SMP	T2	2.0117	2.0117	Dry Weight	06/24/04 09:33	06/29/04 12:59		
19	1	0405096-16	SMP	T14	2.1799	2.1799	Dry Weight	06/24/04 09:33	06/29/04 12:59		
20	1	0405096-17	SMP	X5	2.051	2.051	Dry Weight	06/24/04 09:33	06/29/04 12:59		
21	1	0405096-18	SMP	T9	2.2472	2.2472	Dry Weight	06/24/04 09:33	06/29/04 13:44		
22	1	0405096-19	SMP	911	2.0324	2.0324	Dry Weight	06/24/04 10:21	06/30/04 09:41		
23	1	0405096-20	SMP	T22	2.0477	2.0477	Dry Weight	06/24/04 10:21	06/29/04 13:44		
24	1	RE040611-1	MB	8824	2	2	Dry Weight	06/29/04 13:44	07/12/04 10:02		
25	1	RE040611-1	LCS	NA	2	2	Dry Weight	06/24/04 10:21	06/30/04 09:41	S1	

7/13/04

7/13/04

7/13/04

Spiked By: Adrienne Freda **Date:** 6/11/04

Witnessed By: Becky Kobliska **Date:** 6/11/04

Relinquished By: NT
Date: 7/14/04
Received By: [illegible]
Date:

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

000063

Comments

Supersedes: 6/11/04 17:53

Radiochemistry Prep Worksheet

Paragon Analytics

Prep Batch: RE040611-2

Prep Procedure: Ra226_RnE

Reviewed By: ATF **Review Date:** 7/13/04

Non-Routine Pre-Treatment? Y / (N) **Batch:** NA **Re-Prep?** Y / (N) **Batch:** NA **Prep QASS / NCR?** (Y) / N 5707

Prep SOP: PAI 783 **Rev:** 5
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Adrienne Freda
Prep Date: 6/11/04
Prep Dept: RS

Balance: 13
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	0405096-22	SMP	T28	2.247	2.247	Dry Weight	06/21/04 18:03	06/28/04 10:13		
2	1	0405096-25	SMP	X1	2.006	2.006	Dry Weight	06/21/04 18:03	06/28/04 10:13		
3	1	0405096-26	SMP	L22	2.071	2.071	Dry Weight	06/21/04 18:03	06/28/04 10:13		
4	1	0405096-27	SMP	NA	2.0189	2.0189	Dry Weight	06/21/04 18:03	06/28/04 10:13		
5	1	0405096-28	SMP	986	2.1674	2.1674	Dry Weight	06/21/04 18:03	06/28/04 11:02		
6	1	0405096-29	SMP	984	2.0619	2.0619	Dry Weight	06/21/04 18:03	06/28/04 11:02		
7	1	0405096-30	SMP	906	2.1855	2.1855	Dry Weight	06/21/04 18:03	06/28/04 11:02		
8	1	0405096-30	DUP	F19	2.0084	2.0084	Dry Weight	06/21/04 18:48	06/28/04 11:02		
9	1	0405096-31	SMP	924	2.2788	2.2788	Dry Weight	06/21/04 18:48	06/28/04 11:36		
10	1	0405096-31	MS	T1	2.0611	2.0611	Dry Weight	06/21/04 18:48	06/28/04 11:36	S1	
11	1	0405096-32	SMP	994	2.0066	2.0066	Dry Weight	06/21/04 18:48	06/28/04 11:36		
12	1	RE040611-2	MB	908	2	2	Dry Weight	06/28/04 11:36	07/12/04 10:02		
13	1	RE040611-2	LCS	A22	2	2	Dry Weight	06/21/04 18:48	06/28/04 12:40	S1	

Spiked By: Adrienne Freda **Date:** 6/11/04
Witnessed By: Becky Kobliska **Date:** 6/11/04

Relinquished By: NT
Date: 7/14/04
Received By: NA
Date:

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

000063

Comments

6/28

Paragon Analytics

Radiochemistry Prep Worksheet

Prep Batch: RE040611-1

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:** 5
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Adrienne Freda
Prep Date: 6/11/04
Prep Dept: RS

Balance: 13
Balance:

RECOUNT

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 ING	Prep Notes DEC
								6/24/04	6/29/04			
1	1	0405096-1	SMP	X2	2.1269	2	Dry Weight	08:29	09:59			
2	1	0405096-1	DUP	L5	2.0097	2	Dry Weight				6/29/04 09:59	7/12/04 08:35
3	1	0405096-2	SMP	963	2.1234	2	Dry Weight					
4	1	0405096-3	SMP	X3	2.0729	2	Dry Weight					
5	1	0405096-4	SMP	NA	2.015	2	Dry Weight		10:42			
6	1	0405096-5	SMP	A10	2.0518	2	Dry Weight					
7	1	0405096-5	MS	X	2.202	2	Dry Weight			S1		
8	1	0405096-6	SMP	949	2.1169	2	Dry Weight	08:47				
9	1	0405096-7	SMP	20	2.1147	2	Dry Weight		12:08			
10	1	0405096-8	SMP	L6	2.1216	2	Dry Weight					
11	1	0405096-9	SMP	995	2.1451	2	Dry Weight					
12	1	0405096-10	SMP	T48	2.0616	2	Dry Weight					
13	1	0405096-10	DUP	916	2.2287	2	Dry Weight		12:33			
14	1	0405096-11	SMP	909	2.0909	2	Dry Weight					
15	1	0405096-12	SMP	A11	2.1965	2	Dry Weight	09:33			6/29/04 12:33	7/12/04 08:35
16	1	0405096-13	SMP	A2	2.0862	2	Dry Weight					
17	1	0405096-14	SMP	T10	2.1521	2	Dry Weight		12:59			
18	1	0405096-15	SMP	T2	2.0117	2	Dry Weight					
19	1	0405096-16	SMP	T14	2.1799	2	Dry Weight					
20	1	0405096-17	SMP	X5	2.051	2	Dry Weight					
21	1	0405096-18	SMP	T9	2.2472	2	Dry Weight		13:44			
22	1	0405096-19	SMP	911	2.0324	2	Dry Weight	10:21 6/30/04	09:41			
23	1	0405096-20	SMP	T22	2.0477	2	Dry Weight	6/29/04	13:44			
24	1	RE040611-1	MB	8824	2	2	Dry Weight				6/29/04 13:00	7/12/04 10:02
25	1	RE040611-1	LCS	NA	2	2	Dry Weight	6/30/04	09:41	S1		

Spiked By: Adrienne Freda **Date:** 6/11/04
Witnessed By: BK **Date:** 6/11/04

Relinquished By: _____
Date: _____
Received By: _____
Date: _____

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

12/16/04

Comments

000073

Supersedes: _____

6/25 ?

Paragon Analytics

Radiochemistry Prep Worksheet

Prep Batch: RE040611-2

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:** 5
Prep SOP: NONE
Matrix Class: solid

Prep Analyst: Adrienne Freda
Prep Date: 6/11/04
Prep Dept: RS

Balance: 13
Balance:

RECOUNT

Samp Num	Prep Num	LabID	QC Type	Dish No.	Init Alq g	Fin Alq g	Prep Basis	Ingrowth Date/Time 6/21/04	Decay Date/Time 6/28/04	Standards	Prep Notes ING	Prep Notes DEC
1	1	0405096-22	SMP	T28	2.247	2	Dry Weight	18:03	10:13			
2	1	0405096-25	SMP	X1	2.006	2	Dry Weight					
3	1	0405096-26	SMP	L22	2.071	2	Dry Weight					
4	1	0405096-27	SMP	NA	2.0189	2	Dry Weight					
5	1	0405096-28	SMP	986	2.1674	2	Dry Weight		11:02			
6	1	0405096-29	SMP	984	2.0619	2	Dry Weight					
7	1	0405096-30	SMP	906	2.1855	2	Dry Weight					
8	1	0405096-30	DUP	F19	2.0084	2	Dry Weight	18:48				
9	1	0405096-31	SMP	924	2.2788	2	Dry Weight		11:36			
10	1	0405096-31	MS	T1	2.0611	2	Dry Weight			S1		
11	1	0405096-32	SMP	994	2.0066	2	Dry Weight					
12	1	RE040611-2	MB	908	2	2	Dry Weight				6/28/04 11:36	7/12/04 10:02
13	1	RE040611-2	LCS	A22	2	2	Dry Weight		12:40	S1		

Spiked By: Adrienne Freda **Date:** 6/11/04
Witnessed By: BK **Date:** 6/11/04

Relinquished By: _____
Date: _____
Received By: _____
Date: _____

Spike Solution Information

Soln #	Nuclide	SolnID	Prep Conc	Units	Prep Date	Aliquot	Units	Pipet ID
S1	RA-226	580.2613.34	106.911	DPM/ml	06/11/04	1	ml	RS009

12/15/04

000071

Comments

PROJECT KENT & SULLIVAN Notebook No. 2770

Continued From Page

6/2/04 W.O. # 04-05-096 / (Th^{I50}, U^{I50}, RA226(903.1))

in oven - 5/28 @ 1740
OUT oven - 6/1 @ 1430

S.O.P. - 721 - R11
balance #15, oven #1
5 balls, shake 15 min.

Sample #	Sample/can/balls(g)	can/balls(g)	ground sample(g)	TYPE sample
04-05-096 - 1	127.0	96.6	30.4	SOIL
- 2	128.1	97.4	30.7	
- 3	127.1	96.5	30.6	
- 4	127.7	97.4	30.3	
- 5	127.7	97.3	30.4	
- 7	127.5	97.0	30.5	
- 8	126.8	96.8	30.0	
- 9	127.3	97.0	30.3	
- 10	127.2	97.1	30.1	
- 11	127.6	97.3	30.3	
- 12	127.8	97.3	30.5	
- 13	127.8	97.4	30.4	
- 14	127.6	97.2	30.4	
- 15	128.0	97.8	30.2	
- 16	127.8	97.4	30.4	
- 17	127.7	97.2	30.5	

C.O. - 6/2/04

Continued on Page 51

Read and Understood By

Carson R. O'Dell 6/2/04 — Signed, Date

T Elhart 6/2/04 — Signed, Date

3

6/2/04 W.O. #04-05-096 (Th^{I50}, U^{I50}, RA226(903.1))

in oven - 5/28 @ 1740
OUT oven - 6/1 @ 1430

S.O.P. - 721 - R11
balance #15, oven #1
5 balls, shake 15 min.

Sample #	sample/can/balls (g)	can/balls (g)	ground sample (g)	Type sample
04-05-096-18	128.3	97.4	30.9	SOIL
-19	127.4	97.3	30.1	
-20	127.7	97.4	30.3	
-21	128.1	97.4	30.7	
-22	126.9	96.4	30.5	
-23	124.3	96.9	27.4	
-24	127.5	97.0	30.5	
-25	127.8	97.7	30.1	
-26	127.5	96.9	30.6	
-27	124.8	97.4	27.4	
-28	120.9	96.8	24.1	
-29	128.0	97.3	30.7	
-30	128.4	97.3	31.1	
-31	127.4	97.3	30.1	
-32	128.4	97.5	30.9	

C.O. - 6/2/04

Continued on Page

Read and Understood By

Carson R. O'Dell 6/2/04 — Signed, Date
T Elhart 6/2/04 — Signed, Date

SAMPLE CONDITION FORM (SOLIDS)

ANALYST: [illegible] 6/11/04

ANALYSIS DATE: 6/11/04 METHOD: Pb REM

WORK ORDER	SAMPLE ID	SAMPLE CONDITION		
		Dry/Wet	TEXTURE	Remarks
0405096	1-20	DRY	GROUND	NA

[illegible] 6/11/04

000074

SAMPLE CONDITION FORM (SOLIDS)

ANALYST: [illegible]

ANALYSIS DATE: 6/11/04 METHOD: REM

WORK ORDER	SAMPLE ID	SAMPLE CONDITION		
		Dry/Wet	TEXTURE	Remarks
0405096	22	DRY	GROUND	NA
↓	25-32	↓	↓	↓

[illegible] 6/11/04

PARAGON ANALYTICS
Radiochemistry Data Package

Section 7

STANDARDS TRACEABILITY DOCUMENTS

7

Prepare a working level spiking solution at approximately 50 pCi/mL by diluting 580.1808.69 with 1.4 M HCl

1) Determine the density of 1.4 M HCl

Mass of empty Class A volumetric flask	62.4702 g	Bal #12
Mass of flask + 100 mL 1.4 M HCl	164.4606 g	+
Net mass of 1.4 M HCl	101.9904 g	

Lot = H613 X41A11 $\rho = 1.0199$ g/mL

2) Transfer 580.1808.69 into 1L Bottle

Mass of empty 1 L bottle w/o lid	74.2507 g	Bal #12
Mass of 1L bottle + standard	79.2699	+
Net mass of standard transferred	5.0192 g	

3) Add 1.4 M HCl to final dilution

Mass of empty 1L bottle w/o lid from above	74.2507	Bal #12
Mass of bottle, std, + 1.4 M HCl	1054.7	Bal #26
Net mass of std + 1.4 M HCl	980.4493 = 980.4	

4) Final Activity Calculation

$$\frac{(2729\ \text{Bq/g})(60\ \tfrac{\text{dpm}}{\text{Bq}})(5.0706\text{g})(5.0192\text{g})(1.0199\ \text{g/mL})}{(40.3256\text{g})(\overset{980.4\text{g}}{\cancel{980.4493}})} = 107.50\ \tfrac{\text{dpm}}{\text{mL}}$$

$= 48.42$ pCi/mL

RG 12/23/03

Stnd ID: 580.2613.34

Description: Ra-226
Expiration: 12/15/04
Activity: 107.50 dpm/mL
2s Uncertainty: 0.85 dpm/mL
Ref. Date: 9/9/91
Ref Time: N/A
Prep Date: 12/15/03 Prep by: CRW
Matrix/Comp. 1.4 M HCl
Half Life (y): 1.60E+03

RG 12/23/03

RG 12/23/03

RG 12/23/03

Continued on Page

Read and Understood By

Signed 12/15/03 Date Signed 12/23/03 Date

6/6/01 Ref Date: 9-9-91

Prepare a primary dilution of Ra^{226}. Transfer RSO # 580 (SRM 4967) to a 40 ml VOA vial and dilute to capacity with 1.4 M HCl.

1) Determine ~~Denot~~ RLF 6/6/01 mass of standard transferred

Bal 12

Mass of ampule (opened) + beaker = 40.6099
Mass of empty ampule + beaker = 35.7393
Net Mass of standard transferred = 5.0706 g

2) Dilute standard to final volume with 1.4M HCl

Mass of empty VOA vial w/lid = 27.3231 g Bal 12
VOA + Std. + 1.4M HCl = 67.6486 g
Final mass of primary std. = 40.3256 g

3) Final Activity calculation:

$$\frac{(2729\ Bq/g)(60\ \frac{dpm}{Bq})(5.0706\ g)(1.0219\ g/ml)}{40.3256\ g} = 21{,}039.8\ dpm/ml$$

Density of 1.4M HCl = 1.0219 g/ml. For calculation, see p. 70 (Notebook 1808)

Added after "Z" out:
Standard Reverified: 3/28/03
Expires: 3/28/2004

RG 4/28/03 - May require NCR for CPT work!

RG 7/10/01

Reverified: 2/15/02
Expires: 2/15/03
RG 10/21/02

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
R. Foul	6/6/01	Bernadette Allegro	7/10/01

National Institute of Standards & Technology

PAI FP 00580
Rec'd 5-02-01

Certificate

Standard Reference Material 4967
Radioactivity Standard

Radionuclide	Radium-226 (1)*
Source identification	SRM 4967
Source description	Liquid in a 5-mL, flame-sealed NIST borosilicate-glass ampoule (2)
Solution composition	Approximately 1.4 mol•L^{-1} HCl(3) containing 1.74 mg $BaCl_2$ per gram of solution(4) and Ra^{+2} (5)
Solution density	1.019 ± 0.001 g•mL^{-1} at 22 °C (6)
Solution mass	5.1167 ± 0.0027 g (7)
Radium-226 activity concentration	2729 Bq•g^{-1} (8)
Reference time	1200 EST 9 September 1991
Overall uncertainty	1.18 percent (9)
Half life	1600 ± 7 years (10)
Calibration method	NIST pressurized "4π"γ ionization chamber "A" calibrated with the national radium standards(11); and confirmatory measurements (12)

This standard reference material was prepared in the Physics Laboratory, Ionizing Radiation Division, Radioactivity Group, Dale D. Hoppes, Group Leader.

Gaithersburg, MD
January 1992

William P. Reed, Chief
Standard Reference Materials Program

*Notes on back

NOTES

(1) This standard was prepared by gravimetric dilutions of the "1947 series" of ^{226}Ra standards which were recalibrated at NIST (NBS) in 1967. The "age" of the radium, with accompanying in-growth of ^{210}Pb, is at least 44.3 years.

(2) Approximately five milliliters of solution. Ampoule specifications:

body diameter	16.5 ± 0.5 mm
wall thickness	0.60 ± 0.04 mm
barium content	less than 2.5 percent
lead oxide content	less than 0.02 percent
other heavy elements	trace quantities

(3) Corresponding to a 14.9% (by weight) solution of NIST, high-purity, vacuum-distilled hydrochloric acid (nominal 10 $mol \cdot L^{-1}$) in doubly-distilled water.

(4) The $BaCl_2$ reagent used to prepare the carrier solution was measured in a NaI(Tl) well counter and found to contain ≤ 0.01 Bq ^{226}Ra per gram of $BaCl_2$.

(5) The atom ratio of barium carrier to radium in the solution is approximately 2.5×10^4.

(6) The uncertainty in the density is three times the standard deviation of the mean for three independent gravimetric determinations. Confirmatory measurements based on the total master solution mass and individually dispensed masses in known volumes were in agreement.

(7) Mean mass of the dispensed solution in the ampoule. The uncertainty is three times the standard deviation of 19 individually weighed masses of solution from which the mean mass was calculated.

(8) Corresponding to 7.461×10^{-8} g ^{226}Ra per gram of solution assuming a conversion factor of 36.576 $kBq \cdot \mu g^{-1}$.

(9) The overall uncertainty, 1.18 percent, was formed by taking three times the quadratic combination of the standard deviation of the mean, or approximations thereof, for the following component uncertainties:

a) four ion chamber "A" measurements on samples of 2 dilutions	0.051 percent
b) twenty-two comparative ion chamber "A" measurements on 8 "1947(1967 recalibrated) series" of ^{226}Ra standards	0.040 percent
c) ion chamber calibration for the "1947(1967 recalibrated) series" [with respect to the "radiation balance" primary measurements on the "1957 series" and national radium standards (see note 11)]	0.34 percent
d) gravimetric dilution factor	0.1 percent
e) half-life correction	0.0046 percent
f) ^{226}Ra mass to activity conversion	0.16 percent

(10) NCRP Report No. 58, 2nd ed., Appendix A3 (Feb. 1985).

(11) For further details on NIST (NBS) radium series calibrations see W.B. Mann, et al., J. Res. NBS 62, 21-26 (1959). The 1967 recalibration of the "1947 series" and "1957 series" intercomparisons were made with chamber "A".

(12) For confirmation, this ^{226}Ra standard series was also directly compared against preparations of the "1947" (1967 recalibration)", "1978", and "1984" ^{226}Ra series by ^{222}Rn analyses with the NIST pulse-ionization-chamber Primary Radon Measurement System [R. Collé, et al., J. Res. NIST 95 155-165 (1990); J.M.R. Hutchinson, et al., Appl. Rad. Isot. 43, 175-189 (1992)], by liquid scintillation counting, and by NaI(Tl) well-crystal and Ge γ-spectrometry.

For further information please contact R. Collé, (301) 975-5527.

PARAGON ANALYTICS
Radiochemistry Data Package

Section 8

CHAIN OF CUSTODY

8

Paragon Analytics

Sample Number(s) Cross-Reference Table

Paragon OrderNum: 0405096
Client Name: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:
Client PO Number:

Client Sample	Lab Sample Number	COC Number	Matrix	Date Collected	Time Collected
MSED-01	0405096-1		SOIL	06-May-04	13:00
MSED-02	0405096-2		SOIL	06-May-04	13:40
MSED-03	0405096-3		SOIL	06-May-04	14:00
MSED-04	0405096-4		SOIL	06-May-04	9:10
MSED-05	0405096-5		SOIL	06-May-04	9:20
MSED-06	0405096-6		SOIL	07-May-04	8:30
MSED-07	0405096-7		SOIL	07-May-04	9:00
MSED-08	0405096-8		SOIL	07-May-04	9:15
MSED-09	0405096-9		SOIL	07-May-04	9:20
MSED-10	0405096-10		SOIL	07-May-04	10:10
SSED-01	0405096-11		SOIL	05-May-04	16:15
SSED-02	0405096-12		SOIL	05-May-04	17:05
SSED-03	0405096-13		SOIL	04-May-04	18:10
SSED-04	0405096-14		SOIL	04-May-04	17:00
SSED-05	0405096-15		SOIL	04-May-04	15:59
SSED-06	0405096-16		SOIL	04-May-04	15:03
SSED-07	0405096-17		SOIL	04-May-04	14:00
SSED-08	0405096-18		SOIL	05-May-04	12:40
SSED-09	0405096-19		SOIL	05-May-04	15:20
SSED-10	0405096-20		SOIL	04-May-04	19:05
GEN-01	0405096-21		SOIL	07-May-04	12:40
GEN-02	0405096-22		SOIL	07-May-04	12:35
GEN-03	0405096-23		SOIL	07-May-04	12:50
GEN-04	0405096-24		SOIL	07-May-04	13:06
SOIL-01	0405096-25		SOIL	06-May-04	16:00
SOIL-02	0405096-26		SOIL	06-May-04	15:40
SOIL-04	0405096-27		SOIL	06-May-04	15:04
SOIL-05	0405096-28		SOIL	06-May-04	15:10
SOIL-07	0405096-29		SOIL	07-May-04	13:50
SOIL-08	0405096-30		SOIL	07-May-04	16:15
SOIL-09	0405096-31		SOIL	07-May-04	14:10
SOIL-10	0405096-32		SOIL	07-May-04	16:40

Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) 0405096

Chain-of-Custody

Date _____ Page 2 of 9

Project Name / No.: _____ Sampler(s): _____ (circle one) Turnaround: Standard or Rush (Due _____) Dispose or Return to Client

Report To:
Phone:
Fax:
Company:
Address: All pose!

circle method or specify under comments

Sample ID	Date (2004)	Time *	Lab ID	Matrix	No. of Containers	VOCs SW8260B E524.2 CLMO	BTEX (only) SW8021B	SVOCs SW8270C E625 CLMO	OC Pesticides SW8081A E608 CLMO	PCBs SW8082 E608 CLMO	OP Pesticides SW8141A E614	Herbicides SW8151A E615	TCLP Organics SW1311 8260B 8270C 8081A 8151A	TCLP Metals SW 1311 6010B 7471	Total Metals SW6010B 7470 7471 E200 ILMO	Dissolved Metals SW6010B 7470 E200 ILMO	Reactive CN / S SW846 Chapter 7	Hexavalent Chromium SW7196A Alkaline Digest? Y / N	Inorganic Anions ** SW9056 E300.0	pH SW9040B 9045C	Oil & Grease SW9071A E413.2	TPH GRO DRO SW8015B (both)	TOX SW9020B	Gross Alpha / Beta SW9310 E900.0	Actinides by PAI SOP (circle) Pu / U / Am / Th / Cm	Total Uranium	Tritium E906.0	Total Alpha-Emitting Radium SW9315 E903.0	Radium 226 SW9315 E903.0 Radium 228 SW9320 E904.0	Strontium 89 D5811-95 Strontium 90 D5811-95	Gamma Isotopes ** E901.1	The isotopic	[illegible]
(X) [illegible]	[illegible]	0800		W	2										(B)									X									
(X) [illegible]	[illegible]	0810		W	2										(B)									X									
[illegible]	5-6	[illegible]	1	SED	2										(C)											X			X			X	
[illegible]	5-6	[illegible]	2		3										(C)											X			X			X	
[illegible]	5-6	[illegible]	3		2/4										(C)											X			X			X	
[illegible]	5-6	[illegible]	4		3										(C)											X			X			X	X
[illegible]	5-6	[illegible]	5		3										(C)											X			X			X	
[illegible]	[illegible]	[illegible]	6		4										(C)											X			X			X	
[illegible]	[illegible]	[illegible]	7		3										(C)											X			X			X	

Comments:
metals
[illegible] pending methanol [illegible] samples
[illegible] 700-01.
(X) [illegible] # 0405095 [illegible] 5/12/04

Form 202r4.xls (1/3/01)

Relinquished By: (1)	Relinquished By: (2)
Signature: Gerald Werrell	Signature:
Printed Name: Gerald Werrell	Printed Name:
Date: 5-10-04 Time: 10:00	Date: Time:
Company: Kent + Sullivan	Company:

Received By: (1)	Received By: (2)
Signature: [illegible]	Signature:
Printed Name: Amy Wolf	Printed Name:
Date: 5/11/04 Time: 11:45	Date: Time:
Company: Paragon Analytics	Company:

* Time Zone (circle one): EST CST MST PST

** Indicate specific analytes under comments.

Distribution: white / yellow (Paragon); pink retained by originator.

000082

Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) 0405096

Chain-of-Custody

Date _____ Page 3 of 9

Project Name / No.: _____ Sampler(s): _____ (circle one) Turnaround: Standard or Rush (Due _____) Dispose or Return to Client

Report To:
Phone:
Fax:
Company:
Address: See pg 1

circle method or specify under comments

Sample ID	Date 2004	Time *	Lab ID	Matrix	No. of Containers	VOCs SW8260B E624 E8242 CLMC__	BTEX (only) SW8021B	SVOCs SW8270C E625 CLMC__	OC Pesticides SW8081A E608 E508 CLMC__	PCBs SW8082 E508 E508 CLMC__	OP Pesticides SW8141A E614	Herbicides SW8151A E615	TCLP Organics SW1311 8260B 8270C 8081A 8151A	TCLP Metals SW 1311 6010B 7471	Total Metals SW6010B 7470 7471 E200 ILMO__	Dissolved Metals SW6010B 7470 E200 ILMO__	Reactive CN / S SW846 Chapter 7	Hexavalent Chromium SW7196A Alkaline Digest? Y / N	Inorganic Anions ** SW9056 E300.0	pH SW9040B 9045C	Oil & Grease SW9071A E413.2	TPH GRO DRO SW8015B (both)	TOX SW9020B	Gross Alpha / Beta SW9310 E900.0	Actinides by PAI SOP (circle) Pu / U / Am / Th / Cm	~~Total~~ Uranium ~~by KPA D5174-91~~	Tritium E906.0	Total Alpha-Emitting Radium SW9315 E903.0	Radium 226 SW9315 E903.0 Radium 228 SW9320 E904.0	Strontium 89 D5811-95 Strontium 90 D5811-95	Gamma Isotopes ** E901.1	Pu - isotopic	
[illegible]	5/1	0915	8	SED	3										C											X			X			X	
[illegible]	↓	0920	9	↓	3										C											X			X			X	
[illegible]	↓	1010	10	↓	3										C											X			X			X	
SSED 01	5/1	1015	11	SED	3										C											X			X			X	
SSED 02	5/1	1105	12	↓	3										C											X			X			X	
SSED 03	5/1	[illegible]	13	↓	3										C											X			X			X	
SSED 04	↓	1130	14	↓	3										C											X			X			X	
SSED 05	↓	1149	15	↓	3										C											X			X			X	
SSED 06	↓	1203	16	↓	3										C											X			X			X	

Comments:
[illegible] pending [illegible]

Form 202r4.xls (1/3/01)

Relinquished By: (1)	Relinquished By: (2)
Signature [signature]	Signature
Printed Name Gerald Varrick	Printed Name
Date 5-10-04 Time 1000	Date Time
Company Kent + Sullivan	Company

Received By: (1)	Received By: (2)
Signature [signature]	Signature
Printed Name Amy Wolf	Printed Name
Date 5/11/04 Time 1645	Date Time
Company Paragon Analytics	Company

* Time Zone (circle one): EST CST MST PST

** Indicate specific analytes under comments.

Distribution: white / yellow (Paragon); pink retained by originator.

00008

Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) 0405096

Chain-of-Custody

Date _____ Page 4 of 9

Project Name / No.: _____ Sampler(s): _____ (circle one) Turnaround: Standard or Rush (Due _____) Dispose or Return to Client

Report To:
Phone:
Fax:
Company:
Address:

See pg 1

circle method or specify under comments

Sample ID	Date 2004	Time *	Lab ID	Matrix	No. of Containers	VOCs SW8260B E624 E524.2 CLMO	BTEX (only) SW8021B	SVOCs SW8270C 8270 E525 CLMO	OC Pesticides SW8081A E608 E509 CLMO	PCBs SW8082 E608 E508 CLMO	OP Pesticides SW8141A E614	Herbicides SW8151A E615	TCLP Organics SW1311 8260B 8270C 8081A 8151A	TCLP Metals SW1311 6010B 7471	Total Metals SW6010B 7470 7471 E200 ILMO	Dissolved Metals SW6010B 7470 E200 ILMO	Reactive CN / S SW846 Chapter 7	Hexavalent Chromium SW7196A Alkaline Digest? Y / N	Inorganic Anions ** SW9056 E300.0	pH SW9040B 9045C	Oil & Grease SW9071A E413.2	TPH GRO DRO SW8015B (both) GRO DRO	~~TOX~~ TOC SW9060	Gross Alpha / Beta SW9310 E900.0	Actinides by PAI SOP (circle) Pu / U / Am / Th / Cm	~~Total~~ Uranium ~~by KPA D5174-91~~ isotopic	Tritium E906.0	Total Alpha-Emitting Radium SW9315 E903.0	Radium 226 SW9315 E903.0 Radium 228 SW9320 E904.0	Strontium 89 D5811-95 Strontium 90 D5811-95	Gamma Isotopes ** E901.1	Th - isotopic
SSeb-01	5-4	1400	17	soil	3										(C)											X			X			X
SSeb-02	5-5	1240	18		3										(C)											X			X			X
SSeb-03	5-5	1520	19		3										(C)											X			X			X
SSeb-04	5-4	1905	20		3										(C)											X			X			X
GEN-01	5-7	1240	21	soil	02																	X	X									
GEN-02	5-7	1235	22		5										(C)							X	X			X			X			X
GEN-03	5-7	1250	23		2																	X	X									
GEN-04	5-7	1300	24		2																	X	X									

Comments:
(C) these samples pending metal results from samples OSA-01, 100-01, and 100-01.

Form 202r4.xls (1/3/01)

Relinquished By: (1)	Relinquished By: (2)
Signature Gerald Warrick	Signature
Printed Name Gerald Warrick	Printed Name
Date 5-10-04 Time 9:00	Date Time
Company Gerald Warrick	Company

Received By: (1)	Received By: (2)
Signature Amy Wilt	Signature
Printed Name Amy Wilt	Printed Name
Date 5/11/04 Time 1645	Date Time
Company Paragon Analytics	Company

* Time Zone (circle one): EST CST MST PST

** Indicate specific analytes under comments.

Distribution: white / yellow (Paragon); pink retained by originator.

000085

Paragon Analytics, Inc.

225 Commerce Drive Fort Collins, CO 80524
800-443-1511 or (970) 490-1511 (970) 490-1522 Fax

Accession Number (LAB ID) 0405096

Chain-of-Custody

Date _____ Page 5 of 9

Project Name / No.: _____ Sampler(s): _____ (circle one) Turnaround: Standard or Rush (Due _____) Dispose or Return to Client

Report To:
Phone:
Fax:
Company:
Address:

All by 1

circle method or specify under comments

Sample ID	Date 2004	Time *	Lab ID	Matrix	No. of Containers	VOCs SW8260B E624.2 ILMO	BTEX (only) SW8021B	SVOCs SW8270C E625 ILMO	OC Pesticides SW8081A E608 ILMO	PCBs SW8082 E608 ILMO	OP Pesticides SW8141A E614	Herbicides SW8151A E615	TCLP Organics SW1311 8260B 8270C 8081A 8151A	TCLP Metals SW 1311 6010B 7471	Total Metals SW6010B 7470 7471 E200 ILMO	Dissolved Metals SW6010B 7470 E200 ILMO	Reactive CN / S SW846 Chapter 7	Hexavalent Chromium SW7196A Alkaline Digest? Y / N	Inorganic Anions ** SW9056 E300.0	pH SW9040B 9045C	Oil & Grease SW9071A E413.2	TPH GRO DRO SW8015B (both)	TOX SW9020B	Gross Alpha / Beta SW9310 E900.0	Actinides by PAI SOP (circle) Pu / U / Am / Th / Cm	Total Uranium by KPA D5174-91	Tritium E906.0	Total Alpha-Emitting Radium SW9315 E903.0	Radium 226 SW9315 E903.0 Radium 228 SW9320 E904.0	Strontium 89 D5811-96 Strontium 90 D5811-96	Gamma Isotopes ** E901.1	Tc-99 Isotopic	
SOIL 01	5-6	1600	25	SOIL	3										C											X			X			X	
SOIL 02	5-6	1540	26	SOIL	3										C											X			X			X	
SOIL 04	5-6	1504	27	SOIL	3										C											X			X			X	
SOIL 05	5-6	1510	28	SOIL	3										C											X			X			X	
SOIL 07	5-7	1350	29	SOIL	3										C											X			X			X	
SOIL 08	5-7	1615	30	SOIL	3										C											X			X			X	
SOIL 09	5-7	1410	31	SOIL	3										C											X			X			X	
SOIL 10	5-7	1640	32	SOIL	3										C											X			X			X	
(X) HR-01	5-6	1900		KK	1										C											X			X			X	

Comments:
(X) on COC # 0405097
[illegible] 5/12/04

Relinquished By: (1)	Relinquished By: (2)
Signature: Gerald Warrick	Signature
Printed Name: Gerald Warrick	Printed Name
Date: 5-10-04 Time: 10:00	Date Time
Company: Kent + Sullivan	Company

Received By: (1)	Received By: (2)
Signature: [illegible]	Signature
Printed Name: Amy Wolf	Printed Name
Date: 5/11/04 Time: 1645	Date Time
Company: Paragon Analytics	Company

Form 202r4.xls (1/3/01)

* Time Zone (circle one): EST CST MST PST

** Indicate specific analytes under comments.

Distribution: white / yellow (Paragon); pink retained by originator.

000088

Paragon Analytics, Inc. -- Fort Collins, Colorado

CONDITION OF SAMPLE UPON RECEIPT FORM

CLIENT: Kent + Sullivan WORKORDER NO: 0405096

PROJECT MANAGER: Debbie Fazio INITIALS: DW DATE: 5/12/04

1. Does this project require any special handling in addition to standard Paragon procedures?		Yes	No
IS PRE-SCREENING REQUIRED? (radiochemistry, DOE, etc.)		Yes	No
2. Are custody seals on shipping containers intact? How many custody seals are provided? 2 each	N/A	Yes	No
3. Are the custody seals on sample containers intact?	N/A	Yes	No
4. Is there a Chain-of-Custody (COC) or other representative documents, letters, or shipping memos?		Yes	No
5. Is the COC complete? Relinquished: Yes ✓ No___ Analyses Requested: Yes ✓ No___	N/A	Yes	No
6. Is the COC in agreement with the samples received? No. of Samples: Yes ✓ No___ Sample ID's: Yes ✓ No___ Matrix: Yes ✓ No___ No. of Containers: Yes ✓ No___	N/A	Yes	No
7. Were COC (if applicable) and sample labels legible?		Yes	No
8. Were airbills present and/or removable?	N/A	Yes	No
9. Are all aqueous samples requiring chemical preservation preserved correctly (excluding volatile organics)?	N/A	Yes	No
Are all aqueous **non-preserved** samples at the correct pH?		Yes	No
10. Is there enough sample for requested analyses? If so, were samples placed in the proper containers?		Yes	No
11. Are all samples within holding times for the requested analyses?		Yes	No
12. Were all sample containers received intact? (not broken or leaking, etc.)		~~Yes~~ DW 5/12/04	No
13. Are samples requiring no headspace (volatiles, reactive cyanide/sulfide, radon), headspace free? **Size of bubble:** ___ **< green pea;** ___ **> green pea** (List sample IDs and affected containers on Page 2)	N/A	Yes	No
14. Were samples checked for and free from the presence of residual chlorine?	N/A	Yes	No
15. Were the sample(s) shipped on ice?	N/A	Yes	No
16. Were cooler temperatures measured at 0.1 - 6 °C ? **IR Gun Used*: 1 2**	N/A	Yes	No
17. Were all samples cooled that should have been cooled?	N/A	Yes	No

Cooler #'s	724	598	597	749	868	22	
Temperature	10°	10°	9°	15°	12°	14°	°C

Project Manager Signature / Date: Debbie Fazio 5/14/04

A NO RESPONSE TO ANY QUESTION EXCEPT # 1 REQUIRES THE COMPLETION OF PAGE 2 OF THIS FORM

* IR Gun #1 (original): Raytek, SN SC-PM3/T29403
IR Gun #2 (newer): Oakton, SN 2SCIR1201

Paragon Analytics, Inc. -- Fort Collins, Colorado

CONDITION OF SAMPLE UPON RECEIPT FORM

CLIENT: Kent + Sullivan **WORKORDER NO:** 2405096

PROJECT MANAGER: Debbie Fazio **INITIALS:** DW **DATE:** 5/12/04

- ☐ **Custody seals** broken (on outside of shipping container or on sample containers).
- ☐ No Chain-of-Custody (**COC**) present.
- ☐ **Number of samples** on the COC do not match the number of samples received.
- ☐ Aqueous samples **not preserved correctly** (see pH discussion below).
- ☐ SVOC samples contained **residual chlorine** (list sample IDs and affected containers below).
- ☒ Samples received at **inappropriate temperature**.
- ☐ **Insufficient sample** to perform requested analyses.
- ☐ Extraction or analytical **holding times** expired in transit.
- ☒ **Broken/leaking bottles** and intact bottles received in same cooler (list affected sample IDs below).
- ☐ **No analyses requested.**
- ☐ **Incorrect sample type** received.
- ☐ VOAs, reactive CN/S, radon not **headspace** free (list sample IDs and affected vials below).
- ☐ **Airbills** not present and/or removable (record applicable shipper's tracking number below).
- ☐ Other (describe below).

Describe discrepancy:

- All samples received between 9° - 15° C. Refer to page 1 for cooler temperatures and refer to DOT Survey pages for cooler contents. Insufficient ice packed with samples
- Sample #17, bottle 3: Container received with a small crack in lid, no loss of sample was apparent, lid was replaced during sample check-in.

Was the client contacted? ___ No: ✓ Yes: Name Sue Kent Date/Time 5/14/04

Was the pH of any sample adjusted by the laboratory? ___ No: ___ Yes (see Table below):

NOTE: No pH adjustments shall be made without prior consent of Project Manager. After pH adjustment, hold metals and radchem samples ≥ 16 hr before analysis.

Sample ID	*Initial pH*	*Final pH (wait 30 min)*	*Type of Reagent Used*	*Lot No. of Reagent Used*	*Initials / Date / Time*

Was the laboratory directed to proceed with the analysis of any samples yielding the presence of residual chlorine? ___ No: ___ Yes (see notes above).

Project Manager Signature / Date: 5/14/04

SAMPLE LOGIN / DOT SURVEY

Client: Kent & Sullivan

Workorder No: 0405096 & 0405097

Project Manager: Debbie Fazio

Initials: AW

Date: 05/12/04

COOLER #: 924

External Micro R Meter Reading (μ R/hr): 190

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-1-1	MSED-01	< background
0405096-1-2	MSED-01	< background
0405096-2-1	MSED-02	< background
0405096-2-2	MSED-02	< background
0405096-2-3	MSED-02	< background
0405096-3-1	MSED-03	< background
0405096-3-2	MSED-03	< background
0405096-3-3	MSED-03	< background
0405096-7-1	MSED-07	< background
0405096-7-2	MSED-07	< background
0405096-7-3	MSED-07	35
0405096-8-1	MSED-08	75
0405096-8-2	MSED-08	< background
0405096-8-3	MSED-08	30
0405096-9-1	MSED-09	< background
0405096-9-2	MSED-09	< background
0405096-9-3	MSED-09	150
0405096-10-1	MSED-10	> background
0405096-10-2	MSED-10	30
0405096-10-3	MSED-10	40
0405096-16-1	SSED-06	< background
0405096-16-2	SSED-06	< background
0405096-16-3	SSED-06	< background
0405097-2-1	MR-01	70
0405097-2-2	MR-01	60
0405097-2-3	MR-01	80
0405097-3-1	MR-02	85
0405097-3-2	MR-02	85
0405097-3-3	MR-02	85
0405097-17-1	300-01	800

If applicable, was the client contacted? **YES / NO / NA** Client Rep. Name: Sue Kent Date/Time: 5/14/04

Project Manager Signature/ Date: 5/14/04

000089

SAMPLE LOGIN / DOT SURVEY

Client: Kent & Sullivan

Workorder No: 0405096 & 0405097

Project Manager: Debbie Fazio

Initials: AW

Date: 05/12/04

COOLER #: 898

External Micro R Meter Reading (μ R/hr): 140

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-4-1	MSED-04	< background
0405096-4-2	MSED-04	< background
0405096-4-3	MSED-04	< background
0405096-11-1	SSED-01	< background
0405096-11-2	SSED-01	< background
0405096-11-3	SSED-01	< background
0405096-26-1	SOIL-02	< background
0405096-26-2	SOIL-02	< background
0405096-26-3	SOIL-02	< background
0405096-27-1	SOIL-04	< background
0405096-27-2	SOIL-04	40
0405096-27-3	SOIL-04	< background
0405096-28-1	SOIL-05	30
0405096-28-2	SOIL-05	< background
0405096-28-3	SOIL-05	< background
0405097-4-1	GR-01	< background
0405097-6-1	GR-03	< background
0405097-13-1	GR-10	< background
0405097-14-1	QM-01	< background
0405097-16-1	QM-03	< background
0405097-18-1	300-02	45
0405097-19-1	700-01	1000
0405097-19-2	700-01	950
0405097-19-3	700-01	1100

If applicable, was the client contacted? YES / NO / NA Client Rep. Name: Sue Kent Date/Time: 5/14/04

Project Manager Signature/ Date: 5/14/04

SAMPLE LOGIN / DOT SURVEY

Client: Kent & Sullivan

Workorder No: 0405096 & 0405097

Project Manager: Debbie Fazio

Initials: AW

Date: 05/12/04

COOLER #: 897

External Micro R Meter Reading (μ R/hr): 320

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-5-1	MSED-05	< background
0405096-5-2	MSED-05	< background
0405096-5-3	MSED-05	< background
0405096-21-1	GEN-01	28
0405096-21-2	GEN-01	28
0405096-22-1	GEN-02	30
0405096-22-2	GEN-02	29
0405096-22-3	GEN-02	< background
0405096-22-4	GEN-02	< background
0405096-22-5	GEN-02	< background
0405096-23-1	GEN-03	< background
0405096-23-2	GEN-03	< background
0405096-24-1	GEN-04	< background
0405096-24-2	GEN-04	< background
0405097-9-1	GR-06	30
0405097-11-1	GR-08	< background
0405097-15-1	QM-02	< background
0405097-20-1	700-02	250
0405097-24-1	900-02	1500
0405097-25-1	900-03	300
0405097-27-1	900-05	100

If applicable, was the client contacted? **YES / NO / NA** Client Rep. Name: Sue Kitt Date/Time: 5/14/04

Project Manager Signature/ Date: 5/14/04

000091

SAMPLE LOGIN / DOT SURVEY

Client: Kent & Sullivan

Workorder No: 0405096 & 0405097

Project Manager: Debbie Fazio

Initials: AW

Date: 05/12/04

COOLER #: 749

External Micro R Meter Reading (μ R/hr): 300

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-6-1	MSED-06	40
0405096-12-1	SSED-02	40
0405096-12-2	SSED-02	< background
0405096-12-3	SSED-02	< background
0405096-18-1	SSED-08	< background
0405096-18-2	SSED-08	< background
0405096-18-3	SSED-08	30
0405096-19-1	SSED-09	< background
0405096-19-2	SSED-09	< background
0405096-19-3	SSED-09	< background
0405096-25-1	SOIL-01	< background
0405096-25-2	SOIL-01	< background
0405096-25-3	SOIL-01	< background
0405097-1-1	HR-01	140
0405097-5-1	GR-02	< background
0405097-7-1	GR-04	90
0405097-28-1	OSA-01	1200
0405097-28-2	OSA-01	1100
0405097-28-3	OSA-01	1200

If applicable, was the client contacted? **YES / NO / NA** Client Rep. Name: Sue Kent Date/Time: 5/14/04

Project Manager Signature/ Date: 5/14/04

SAMPLE LOGIN / DOT SURVEY

Client: Kent & Sullivan

Workorder No: 0405096 & 0405097

Project Manager: Debbie Fazio

Initials: AW

Date: 05/12/04

COOLER #: 868

External Micro R Meter Reading (μ R/hr): 320

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-13-1	SSED-03	< background
0405096-13-2	SSED-03	< background
0405096-13-3	SSED-03	< background
0405096-14-1	SSED-04	< background
0405096-14-2	SSED-04	< background
0405096-14-3	SSED-04	< background
0405096-15-1	SSED-05	< background
0405096-15-2	SSED-05	< background
0405096-15-3	SSED-05	< background
0405096-17-1	SSED-07	< background
0405096-17-2	SSED-07	< background
0405096-17-3	SSED-07	< background
0405096-20-1	SSED-10	< background
0405096-20-2	SSED-10	< background
0405096-20-3	SSED-10	< background
0405097-8-1	GR-05	< background
0405097-10-1	GR-07	< background
0405097-12-1	GR-09	< background
0405097-21-1	700-03	800
0405097-21-2	700-03	950
0405097-21-3	700-03	850
0405097-26-1	900-04	95
0405097-29-1	OSA-02	180
0405097-29-2	OSA-02	150
0405097-29-3	OSA-02	160
0405097-30-1	OSA-03	200
0405097-30-2	OSA-03	250
0405097-30-3	OSA-03	150

If applicable, was the client contacted? **YES / NO / NA** Client Rep. Name: Sue Kurt Date/Time: 5/14/04

Project Manager Signature/ Date: 5/14/04

000093

SAMPLE LOGIN / DOT SURVEY

Client: Kent & Sullivan

Workorder No: 0405096 & 0405097

Project Manager: Debbie Fazio

Initials: AW

Date: 05/12/04

COOLER #: 22

External Micro R Meter Reading (μ R/hr): 260

Paragon Sample ID:	Client Sample ID:	Micro R Meter Reading (μ R/hr):
0405096-29-1	SOIL-07	< background
0405096-29-2	SOIL-07	< background
0405096-29-3	SOIL-07	< background
0405096-30-1	SOIL-08	45
0405096-30-2	SOIL-08	40
0405096-30-3	SOIL-08	40
0405096-31-1	SOIL-09	< background
0405096-31-2	SOIL-09	< background
0405096-31-3	SOIL-09	< background
0405096-32-1	SOIL-10	55
0405096-32-2	SOIL-10	50
0405096-32-3	SOIL-10	65
0405097-22-1	700-04	450
0405097-23-1	900-01	110
0405097-23-2	900-01	110
0405097-23-3	900-01	140

If applicable, was the client contacted? **YES / NO / NA** Client Rep. Name: Sue Kent Date/Time: 5/14/04

Project Manager Signature/ Date: 5/14/04

0405096
0405097

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0001

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

190

#924

2 seals

10°C

ARTIC 0-0410-3-1635

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0015

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

140

#898

2 seals

ARTIC 0-0410-3-1635

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0011

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

320

#887

2 seals

ARTIC 0-0410-3-1635

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0002

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

300

15°C

#919

2 seals

ARTIC 0-0410-3-1635

0405096
0405097

1-800-2ALASKA

Airbill Number
027 KTN 5436-6152 Box No. 0006

Destination
DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

320 12.0 2 seals

ARTIC 0-0410-3-1635

1-800-2ALASKA

Airbill Number
027 KTN 5436-6152 Box No. 0010

Destination
DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

260 14.0 2 seals

ARTIC 0-0410-3-1635

0405096
0405097

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0001

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS 190

#924 2 seals 10 oc

ARTIC 0-0410-3-1635

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0015

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS 140

#898 2 seals

ARTIC 0-0410-3-1635

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0011

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS 320 9 oc

#897 2 seals

ARTIC 0-0410-3-1635

1-800-2ALASKA

027 KTN 5436-6152 Box No. 0002

Destination DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS 300

15 oc

#919 2 seals

ARTIC 0-0410-3-1635

0405096
0405097

1-800-2ALASKA

Waybill Number
027 KTN 5436-6152 Box No. 0006

Destination
DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

320

12.2

#

Seals

ARTIC 0-0410-3-1635

1-800-2ALASKA

Waybill Number
027 KTN 5436-6152 Box No. 0010

Destination
DEN

Pieces	Total Weight	Date
17	865	10-MAY-04

14 RAIDOACTIVE COOLERS COOL
3 MT COOLERS

260

14.2

#

Seals

ARTIC 0-0410-3-1635

Sample Handling Instructions for Work Order Number: 0405096

Paragon Analytics **Printed By:** *cro--5/14/04 7:45:57 AM*

Paragon OrderNum: 0405096
Client Name: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:

Released: cro
Release Date: 5/14/04

Handling Code: **NONRAD NONDOE S**

Lab IDs:						
	0405096-1	0405096-2	0405096-3	0405096-8	0405096-10	0405096-13
	0405096-14	0405096-15	0405096-16			

1. The samples have been prescreened by the client or Paragon found to be nonradioactive
2. Standard non radioactive waste disposal procedures for these samples
3. These samples will not present any radioactive material handling concerns from these samples.
4. Labels these samples as NON-DOE NONRADIOACTIVE

Handling Code: **RAD-2**

RAD Level 2, Up to 1000 pCi/g

Lab IDs:						
	0405096-4	0405096-5	0405096-6	0405096-7	0405096-9	0405096-11
	0405096-12	0405096-17	0405096-18	0405096-19	0405096-20	0405096-21
	0405096-22	0405096-23	0405096-24	0405096-25	0405096-26	0405096-27
	0405096-28	0405096-29	0405096-30	0405096-31	0405096-32	

1. The samples have been prescreened by either the client or Paragon and they are radioactive.
2. The samples are labeled as radioactive material and will be treated as licensed material.
3. Weigh out all meterials and perform all chemical operations in hood.
4. Label all intermediate containers as radioactive with activity concentration and mass.
5. These samples may present external lab contamination hazards from alpha & beta/gamma radionuclides.
6. Applies to grinding operations.
   a. Evaluate samples for special grinding by using hot sample grinding puck.
   b. Check activity report and evaluate appropriate radionuclide spiking concentrations.
7. Refer to activity report and sample bottles for activity information.
8. Radioactive waste disposal procedures for these samples are as follows:
   a. Dispose of radioactive soils in LLRW Soils Waste.
   b. Dispose of aqueous waste in Aqueous LLRW.
   c. See Ed for instructions regarding Mixed Waste disposal.
9. Samples MAY NOT be subcontracted to any lab which does not have a radioactive materials license.

Sample Handling Instructions for Work Order Number: 0405096

Paragon Analytics

Printed By: *cro--5/14/04 7:45:58 AM*

Paragon OrderNum: 0405096
Client Name: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:

Released: cro
Release Date: 5/14/04

Potential Hazards:

LABID	MATRIX	HICODE	RAD	PCB	ASB	BIO	CORR	IGN	DET	PROD	CNS	H2O	OTHER	ALPHA	BETA
0405096-1	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-2	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-3	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-4	SOIL	RAD-2	RAD											N/A	N/A
0405096-5	SOIL	RAD-2	RAD											N/A	N/A
0405096-6	SOIL	RAD-2	RAD											N/A	N/A
0405096-7	SOIL	RAD-2	RAD											N/A	N/A
0405096-8	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-9	SOIL	RAD-2	RAD											N/A	N/A
0405096-10	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-11	SOIL	RAD-2	RAD											N/A	N/A
0405096-12	SOIL	RAD-2	RAD											N/A	N/A
0405096-13	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-14	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-15	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-16	SOIL	NONRAD NONDOE S	NONRAD											N/A	N/A
0405096-17	SOIL	RAD-2	RAD											N/A	N/A
0405096-18	SOIL	RAD-2	RAD											N/A	N/A
0405096-19	SOIL	RAD-2	RAD											N/A	N/A
0405096-20	SOIL	RAD-2	RAD											N/A	N/A
0405096-21	SOIL	RAD-2	RAD											N/A	N/A
0405096-22	SOIL	RAD-2	RAD											N/A	N/A
0405096-23	SOIL	RAD-2	RAD											N/A	N/A
0405096-24	SOIL	RAD-2	RAD											N/A	N/A
0405096-25	SOIL	RAD-2	RAD											N/A	N/A
0405096-26	SOIL	RAD-2	RAD											N/A	N/A
0405096-27	SOIL	RAD-2	RAD											N/A	N/A
0405096-28	SOIL	RAD-2	RAD											N/A	N/A
0405096-29	SOIL	RAD-2	RAD											N/A	N/A
0405096-30	SOIL	RAD-2	RAD											N/A	N/A

Sample Handling Instructions for Work Order Number: 0405096

Paragon Analytics

Printed By: *cro--5/14/04 7:45:58 AM*

Paragon OrderNum: 0405096
Client Name: Kent & Sullivan Inc.
Client Project Name: Ross Adams
Client Project Number:

Released: cro
Release Date: 5/14/04

0405096-31	SOIL	RAD-2	RAD	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	N/A	N/A
0405096-32	SOIL	RAD-2	RAD	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	N/A	N/A

Additional Comments:
Source material

Rad activity is expressed as pCi/matrix.

Potential Hazards (Definitions)

RAD	Radioactive.	**IGN**	May be ignitable.	**OTHER**	See Additional Comments.
PCB	May contain PCB's.	**DET**	May be explosive.	**ALPHA**	Alpha activity.
ASB	May contain Asbestos.	**PROD**	May be pure product.	**BETA**	Beta activity.
BIO	May present a biological hazard.	**CNS**	May contain reactive cyanides/sulfides.		
CORR	May be corrosive.	**H2O**	May be water reactive.		

Paragon Analytics

Sample Radioactivity Inventory Report

Radioactive Material License #847-02

Lab ID	Client ID	Mass	Mass Units	Alpha Activity Atomic#83-98 (Conc)	B/G Activity Atomic#3-82 (Conc)	H3 Activity	Units	Total Activity#83-98 (pCi)	Total Activity#3-82 (pCi)	H3 Activity (pCi)	Handling Code
0405096-1	KENT & SULLIVAN	1500	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-2	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-3	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-4	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-5	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-6	KENT & SULLIVAN	2272	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-7	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-8	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-9	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-10	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-11	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-12	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-13	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-14	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-15	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-16	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	CSS
0405096-17	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-18	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-19	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-20	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-21	KENT & SULLIVAN	750	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-22	KENT & SULLIVAN	1875	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-23	KENT & SULLIVAN	750	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-24	KENT & SULLIVAN	750	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-25	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-26	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S

Paragon Analytics

Sample Radioactivity Inventory Report

Radioactive Material License #847-02

Lab ID	Client ID	Mass	Mass Units	Alpha Activity Atomic#83-98 (Conc)	B/G Activity Atomic#3-82 (Conc)	H3 Activity	Units	Total Activity#83-98 (pCi)	Total Activity#3-82 (pCi)	H3 Activity (pCi)	Handling Code
0405096-27	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-28	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-29	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-30	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-31	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S
0405096-32	KENT & SULLIVAN	2250	grams	0	0	0	pCi/G	0	0	0	LLRW-S

Inventory Report Total Activity:

Alpha (pCi)	B/G (pCi)	H3 (pCi)
0	0	0

000103

[illegible] Laboratory [illegible]
[illegible], Fort Collins, Colorado
[illegible] Gross Alpha/Beta Analysis

[illegible]

Beta efficiency [illegible]
Beta [illegible]
Beta Background (cpm) [illegible]
Beta Attenuation [illegible]
Beta Attenuation [illegible]
Alpha to Beta [illegible]

[illegible]	[illegible]	[illegible]	Alpha Activity			Beta Activity			
			[illegible]	2σ	MDA	Gross CPM	pCi/L	2σ	MDA
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
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1E 5/14/04

Prescreen Worksheet

Analyst: Leah Balko
Samp Date S: 05/13/04
Prep Date C: 05/13/04
Sop used: 703Rev6

Am241- 616.2382.69
Sr90- 543.2613.11

Batch ID 0513ps.xls
Count Date:

CAR GRP	Pos Car No.	PAI W.O.#	Sample Mass (mg)	sample Aliquot (l) or (g)	Total.Sample Vol. or Mass (l) or (g)	no. of cont.	sample MTX	Gross PC (g)	Tare PC (g)	Filename/ Remarks
D	13	0513 MB	57.5	1	1	NA	NA	9.0542	8.9967	WTA0513A
D	14	0513 LCS	57.6	1	1	NA	NA	9.0881	9.0305	
E	15	0405095-1	2.4	0.01	1	1	WATER	9.0326	9.0302	WTA0513B
E	16	0405095-2	1.4	0.01	1	1	WATER	9.0329	9.0315	
E	17	0405095-3	2.2	0.01	1	1	WATER	8.9975	8.9953	
E	18	0405095-4	1.5	0.01	1	1	WATER	9.0094	9.0079	
E	19	0405095-5	3.9	0.01	1	1	WATER	9.0324	9.0285	
E	20	0405095-6	1.7	0.01	1	1	WATER	9.0225	9.0208	
E	21	0405095-7	0.4	0.01	1	1	WATER	9.0227	9.0223	
E	22	0405095-8	1.6	0.01	1	1	WATER	9.0279	9.0263	
E	23	0405095-9	1.2	0.01	1	1	WATER	9.0258	9.0246	
E	24	0405095-10	2.0	0.01	1	1	WATER	9.0111	9.0091	
E	25	0405095-11	1.2	0.01	1	1	WATER	8.9935	8.9923	
E	26	0405095-12	0.8	0.01	1	1	WATER	9.0391	9.0383	
F	27	0405096-1	108.9	0.1757	1	1	SOLID	9.1354	9.0265	WTA0513C
F	28	0405096-2	60.7	0.2757	1	1	SOLID	9.0468	8.9861	low mass- this is the best I could do
F	29	0405096-3	137.5	0.3201	1	1	SOLID	9.1301	8.9926	
F	30	0405096-4	119.7	0.1323	1	1	SOLID	9.1276	9.0079	
F	31	0405096-5	100.1	0.1185	1	1	SOLID	9.1142	9.0141	
F	32	0405096-7	55.7	0.1438	1	1	SOLID	9.0435	8.9878	low mass- this is the best I could do
F		0405096-8								sample is ALL rock (not even a grain of sand)
F	33	0405096-9	76.0	0.2889	1	1	SOLID	9.0678	8.9918	low mass- this is the best I could do
F	34	0405096-10	75.7	0.1793	1	1	SOLID	9.0649	8.9892	low mass- this is the best I could do
F	35	0405096-11	104.1	0.1312	1	1	SOLID	9.1479	9.0438	
F	36	0405096-12	129.1	0.1401	1	1	SOLID	9.1552	9.0261	
F	37	0405096-13	113.0	0.1286	1	1	SOLID	9.1512	9.0382	
F	38	0405096-14	107.6	0.1143	1	1	SOLID	9.1141	9.0065	
F	39	0405096-15	127.9	0.1349	1	1	SOLID	9.123	8.9951	
F	40	0405096-16	122.5	0.1783	1	1	SOLID	9.141	9.0185	
F	41	0405096-17	137.2	0.2201	1	1	SOLID	9.1423	9.0051	
F	42	0405096-18	116.9	0.1229	1	1	SOLID	9.145	9.0281	
F	43	0405096-19	140.1	0.1489	1	1	SOLID	9.1428	9.0027	
F	44	0405096-20	124.7	0.1234	1	1	SOLID	9.1439	9.0192	

Prescreen Worksheet

Analyst: Leah Balko
Samp Date S: 05/13/04
Prep Date C: 05/13/04
Sop used: 703Rev6

Am241- 616.2382.69
Sr90- 543.2613.11

Batch ID 0513ps2.xls
Count Date:

CAR GRP	Pos Car No.	PAI W.O.#	Sample Mass (mg)	sample Aliquot (l) or (g)	Total.Sample Vol. or Mass (l) or (g)	no. of cont.	sample MTX	Gross PC (g)	Tare PC (g)	Filename/ Remarks
F	45	0405096-21	112.4	0.1285	1	1	SOLID	9.127	9.0146	WTA0513C
F	46	0405096-22	121.8	0.1308	1	1	SOLID	9.1387	9.0169	
F	47	0405096-23	111.1	0.1321	1	1	SOLID	9.1343	9.0232	
F	48	0405096-24	123.2	0.1326	1	1	SOLID	9.1351	9.0119	
F	49	0405096-25	77.6	0.1667	1	1	SOLID	9.065	8.9874	
F	50	0405096-26	84.4	0.1601	1	1	SOLID	9.0878	9.0034	
F	51	0405096-27	102.5	0.1268	1	1	SOLID	9.1379	9.0354	
F	52	0405096-28	102.9	0.1272	1	1	SOLID	9.1107	9.0078	
F	53	0405096-29	114.7	0.1476	1	1	SOLID	9.137	9.0223	
F	54	0405096-30	113.2	0.2538	1	1	SOLID	9.1121	8.9989	
F	55	0405096-31	131.1	0.1679	1	1	SOLID	9.1238	8.9927	
F	56	0405096-32	112.6	0.2576	1	1	SOLID	9.1162	9.0036	
G	57	0405097-2	131.5	0.1692	1	1	SOLID	9.1619	9.0304	WTA0513D
G	58	0405097-3	137.3	0.1593	1	1	SOLID	9.1287	8.9914	
G	59	0405097-23	117.3	0.1306	1	1	SOLID	9.1063	8.989	
G	60	0405097-29	104.1	0.1483	1	1	SOLID	9.1054	9.0013	
G	61	0405097-30	101.5	0.1442	1	1	SOLID	9.1323	9.0308	
H	62	0405102-1	102.7	0.002	1	1	LIQUID	9.1445	9.0418	WTA0513E / reduced aliquot
I	63	0405107-1	8.9	0.01	1	1	WATER	9.0232	9.0143	WTA0513F
I	64	0405107-2	11.7	0.01	1	1	WATER	9.0229	9.0112	
I	65	0405107-3	4.3	0.01	1	1	WATER	9.0147	9.0104	
I	66	0405107-4	6.4	0.01	1	1	WATER	9.0217	9.0153	
I	67	0405107-5	4.8	0.01	1	1	WATER	8.9982	8.9934	
I	68	0405107-6	6.2	0.01	1	1	WATER	9.0154	9.0092	
I	69	0405107-7	7.9	0.01	1	1	WATER	9.0132	9.0053	
I	70	0405107-8	7.2	0.01	1	1	WATER	9.0213	9.0141	
I	71	0405107-9	13.6	0.01	1	1	WATER	8.9997	8.9861	
I	72	0405107-10	12.6	0.01	1	1	WATER	9.024	9.0114	
I	73	0405107-11	8.4	0.01	1	1	WATER	9.0089	9.0005	
I	74	0405107-12	8.0	0.01	1	1	WATER	8.9841	8.9761	
I	75	0405107-13	0.5	0.01	1	1	WATER	9.0137	9.0132	

000106

040833D01.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

****

Geo 13 / Solid

Sample ID: Prescreen 0405096-6

Sampling Start:	05/12/2004 12:00:00	Counting Start:	05/12/2004 14:31:11
Sampling Stop:	05/12/2004 12:00:00	Decay Time.	2.52E+000 Hrs
Buildup Time.	0.00E+000 Hrs	Live Time	300 Sec
Sample Size	1.00E+000 sample	Real Time	301 Sec
Collection Efficiency	1.0000	Spc. File	.040833D01.SPC

Detector #: 1 (Detector 1)

Energy(keV)= -1.01 + 0.501*Ch + 0.00E+00*Ch^2 + 0.00E+00*Ch^3 05/12/2004
FWHM(keV) = 1.38 + 0.009*En + 9.20E-04*En^2 + 0.00E+00*En^3 01/02/2004
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	76.00	153.79	77	44	33	155	2.68 a	Wide Pk
2	238.67	478.66	125	31	18	59	1.60 a	
3	242.04	485.41	32	20	14	41	1.09 b	
4	295.50	592.18	59	25	16	50	1.63 a	
5	351.91	704.83	132	28	13	31	1.87 a	
6	511.18	1022.91	31	21	15	33	2.69 a	
7	582.99	1166.32	38	16	9	16	1.60 a	
8	609.30	1218.86	111	26	12	27	2.07 a	
9	911.26	1821.91	28	21	15	32	3.38 a	
10	969.11	1937.45	28	17	11	19	2.68 a	
11	1120.83	2240.44	41	19	12	21	3.17 a	
12	1460.77	2919.34	259	34	9	11	3.56 a	
13	1764.31	3525.54	21	10	3	2	1.71 a	

040833D01.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:. . . . . DET010507.BKG (0417010-1 Weekly Bkg)

Bkg.File Detector #: 1

==========

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	76.00	77	44	33	76	44	33	
2	238.67	125	31	18	122	31	18	
3	242.04	32	20	14	31	20	14	
4	295.50	59	25	16	57	25	17	
5	351.91	132	28	13	128	28	13	
6	511.18	31	21	15	10	21	16	NET<CL
7	582.99	38	16	9	36	16	9	
8	609.30	111	26	12	105	26	13	
9	911.26	28	21	15	26	21	15	
10	969.11	28	17	11	26	17	11	
11	1120.83	41	19	12	40	19	12	
12	1460.77	259	34	9	253	34	10	
13	1764.31	21	10	3	20	10	3	

040833D01.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

****

Geo 13 / Solid

Sample ID: Prescreen 0405096-6

Sampling Start: 05/12/2004 12:00:00	Counting Start: 05/12/2004 14:31:11
Sampling Stop: 05/12/2004 12:00:00	Decay Time. . . . . 2.52e+000 Hrs
Buildup Time. . . . . 0.00e+000 Hrs	Live Time . . . . . 300 Sec
Sample Size . . . . . 1.00e+000 sample	Real Time . . . . . 301 Sec
Collection Efficiency 1.0000	Spectrum File 040833D01.SPC
Cr. Level Confidence Interval: 95 %	Det. Limit Confidence Interval: 95 %

Detector #: 1 (Detector 1)

Efficiency File: (D01)(Sh13).EFF (Geo 13 Eff Cal)

Eff.=1/[4.46E-03*En^-3.43E+00 + 5.75E+01*En^6.67E-01] 02/24/2004

Library File: . . . . . .FANP.LIB (FANP (Fiss. Act. and Nat. Products))

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	N E T	Concentration (pCi/sample)	MDA	Critical Level	Halflife (hrs)
Pb-212	238.63		5.77E+02 +- 1.48E+02	1.84E+02	8.58E+01	1.67E+04
Pb-214	Average:x		8.35E+02 +- 1.64E+02	. . . .	. . . .	1.40E+07
	295.22		6.85E+02 +- 3.04E+02	4.36E+02	2.02E+02	1.40E+07
	351.99		8.96E+02 +- 1.94E+02	2.04E+02	9.25E+01	1.40E+07
Tl-208	583.14		1.55E+02 +- 6.97E+01	8.96E+01	3.90E+01	1.27E+14
Bi-214	Average:x		8.99E+02 +- 2.01E+02	. . . .	. . . .	1.40E+07
	609.32		8.49E+02 +- 2.09E+02	2.34E+02	1.06E+02	1.40E+07
	1120.28		1.49E+03 +- 7.16E+02	9.97E+02	4.48E+02	1.40E+07
Ac-228	Average:x		6.21E+02 +- 3.23E+02	. . . .	. . . .	5.04E+04
	911.07		4.96E+02 +- 4.03E+02	6.33E+02	2.91E+02	5.04E+04
	968.90		8.47E+02 +- 5.41E+02	7.95E+02	3.54E+02	5.04E+04
K-40	1460.75		1.53E+04 +- 2.06E+03	1.38E+03	6.09E+02	1.12E+13
Am-241	59.54	N	1.93E+02 +- 4.73E+02	8.05E+02	3.75E+02	3.80E+06
Th-234	92.50	N	2.04E+03 +- 1.30E+03	2.02E+03	9.52E+02	3.92E+13
Eu-155	105.31	N	-1.94E+01 +- 2.51E+02	4.42E+02	2.08E+02	4.35E+04
Co-57	122.07	N	8.92E+01 +- 6.09E+01	9.52E+01	4.47E+01	6.48E+03
Ce-144	133.53	N	3.48E+02 +- 4.38E+02	7.20E+02	3.39E+02	6.82E+03
U-235	143.76	N	0.00E+00 +- 4.24E+02	7.40E+02	3.48E+02	6.17E+12
Ce-139	165.85	N	1.96E+01 +- 5.22E+01	8.90E+01	4.16E+01	3.30E+03
Th-227	236.00	N	-1.10E+03 +- 7.55E+02	1.44E+03R	6.96E+02	1.90E+05
Cr-51	320.07	N	4.61E+02 +- 4.34E+02	6.89E+02	3.11E+02	6.65E+02
I-131	364.48	N	1.97E+01 +- 5.57E+01	9.65E+01	4.38E+01	1.93E+02
Sb-125	427.95	N	6.88E+01 +- 1.46E+02	2.51E+02	1.12E+02	2.43E+04
Be-7	477.56	N	3.32E+02 +- 3.77E+02	6.07E+02	2.63E+02	1.28E+03
Sb-124	602.71	N	-5.54E+00 +- 5.96E+01	1.09E+02B	4.96E+01	1.44E+03

040833D01.SPC Analyzed by

MEASURED or MDA CONCENTRATIONS

Nuclide	ENERGY (keV)	NET	Concentration (pCi/sample)	MDA	Critical Level	Halflife (hrs)
Cs-134	604.66	N	-2.47E+02 +- 6.84E+02	1.14E+03P	5.65E+02	1.81E+04
Ru-106	621.84	N	1.76E+02 +- 5.04E+02	8.88E+02	3.92E+02	8.84E+03
Ag-110M	657.75	N	-9.73E+00 +- 5.79E+01	1.09E+02	4.88E+01	6.00E+03
Cs-137	661.62	N	4.08E+01 +- 5.97E+01	9.97E+01	4.36E+01	2.64E+05
Nb-94	702.50	N	-6.97E-01 +- 5.79E+01	1.07E+02	4.77E+01	1.78E+08
Bi-212	727.17	N	4.99E+02 +- 8.12E+02	1.37E+03	6.00E+02	1.67E+04
Nb-95	765.82	N	2.03E+01 +- 5.49E+01	9.67E+01	4.25E+01	1.54E+03
Co-58	810.75	N	-4.53E+00 +- 6.01E+01	1.12E+02	5.00E+01	1.70E+03
Mn-54	834.81	N	2.53E+01 +- 6.16E+01	1.07E+02	4.74E+01	7.49E+03
Sc-46	889.26	N	1.20E+00 +- 5.35E+01	1.01E+02	4.39E+01	2.01E+03
Pa-234m	1001.03	N	6.75E+03 +- 1.18E+04	2.01E+04	8.87E+03	3.92E+13
Eu-154	1004.80	N	5.77E+01 +- 4.02E+02	7.26E+02	3.24E+02	7.45E+04
Fe-59	1099.22	N	-6.52E+00 +- 1.13E+02	2.15E+02	9.41E+01	1.08E+03
Zn-65	1115.52	N	2.96E+02 +- 2.83E+02	4.56E+02P	2.13E+02	5.85E+03
Co-56	1238.28	N	1.99E+02 +- 1.16E+02	1.56E+02	6.59E+01	1.86E+03
Na-22	1274.54	N	-2.74E+01 +- 6.59E+01	1.33E+02	5.82E+01	2.28E+04
Co-60	1332.51	N	3.76E+01 +- 4.61E+01	7.35E+01	2.83E+01	4.62E+04
Eu-152	1408.08	N	3.56E+02 +- 3.41E+02	5.25E+02	2.21E+02	1.17E+05
Al-26	1808.65	N	1.16E+01 +- 5.14E+01	9.95E+01	3.93E+01	6.31E+09

MEASURED TOTAL: 3.05E+04 +- 2.09E+04 pCi/sample

UNKNOWN, SUM or ESCAPE PEAKS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	76.00	153.79	76	44	33	155	2.68	Unknown
3	242.04	485.41	31	20	14	41	1.09	Unknown
6	511.18	1022.91	10	21	16	33	2.69	Deleted*
13	1764.31	3525.54	20	10	3	2	1.71	Unknown

PARAGON ANALYTICS
Radiochemistry Data Package

Section 9

ADDITIONAL SUPPORTING DOCUMENTATION

9

Efficiency Calibrations

^{226}Ra by Rn Emanation Calibration Package for Detectors A and B

^{226}Ra by Rn Emanation Calibration Package Order Checklist

Rev. 09/22/03 AF (THIS SHEET FOR REFERENCE PURPOSES ONLY- NOT A CONTROLLED DOCUMENT)

- ☑ TITLE PAGE
  - ☑ VOLTAGE
    - ☑ PLATEAU PLOTS
    - ☑ QASS's
    - ☑ LOGBOOK PAGES
  - ☑ EFFICIENCY
    - ☑ QASS's
    - ☑ CALIBRATION RESULTS SHEET (A)
    - ☑ CALIBRATION SUMMARY SHEET (A)
    - ☑ BENCHSHEETS (A)
    - ☑ CALIBRATION RESULTS SHEET (B)
    - ☑ CALIBRATION SUMMARY SHEET (B)
    - ☑ BENCHSHEETS (B)
    - ☑ LOGBOOK PAGES
    - ☑ CALIBRATION SPIKE VERIFICATION PACKAGE
  - ☑ DAILY CHECKS
    - ☑ DAILY CHECK SUMMARY PAGES → LOGBOOK PAGES
    - ☑ DAILY CHECK CERTIFICATE
- ☑ ICV's
  - ☑ RADIOMETRIC RECOVERY SUMMARY PAGE
  - ☑ QASS's
  - ☑ BENCHSHEETS
  - ☑ LOGBOOK PAGES
  - ☑ DAILY CHECK SUMMARY PAGES
  - ☑ SPIKE VERIFICATION PACKAGE

^{226}Ra by Rn Emanation Calibration Package Review Checklist

Rev. 09/22/03 AF (THIS SHEET FOR REFERENCE PURPOSES ONLY- NOT A CONTROLLED DOCUMENT)

Is all appropriate documentation included?

- ☑ Any necessary QASS sheets
- ☑ ICV benchsheets and verification sheet
- ☑ Lucas Cell + PMT Calibration Control Summaries
- ☑ Printed and handwritten benchsheets for all detectors calibrated
- ☑ Log book page copies for all calibration dates
- ☑ Daily check sheets
- ☑ PMT Operating Voltage handwritten and printed benchsheets and plateau curve
- ☑ A Reagent prep log book pages for all standardized reagents used
- ☑ Standard prep log book pages for all standards used
- ☑ NIST Certificates for all standards used
- ☑ Verification information for all standards used

Is all documentation filled out properly?

- ☑ Current SOPs documented
- ☑ All benchsheets properly dated and initialed
- ☑ Handwritten benchsheets match printed benchsheets
- ☑ Log book sheets match handwritten benchsheets
- ☑ Efficiencies from Calibration Results page match Lucas Cell + PMT Calibration Control Summary, ISV calculation page, and detector calculation page

Quality Control

- ☑ ICV radiometric recovery is in control at 80-120%
- ☑ Cell backgrounds are less than 100 cts. per 30 min.
- ☑ There is at least a 4 hr. ingrowth period between deemanation and count start
- ☑ Efficiencies are within control
- ☑ Daily check gross counts are in control

^{226}Ra by Rn Emanation Calibration Package Order Checklist

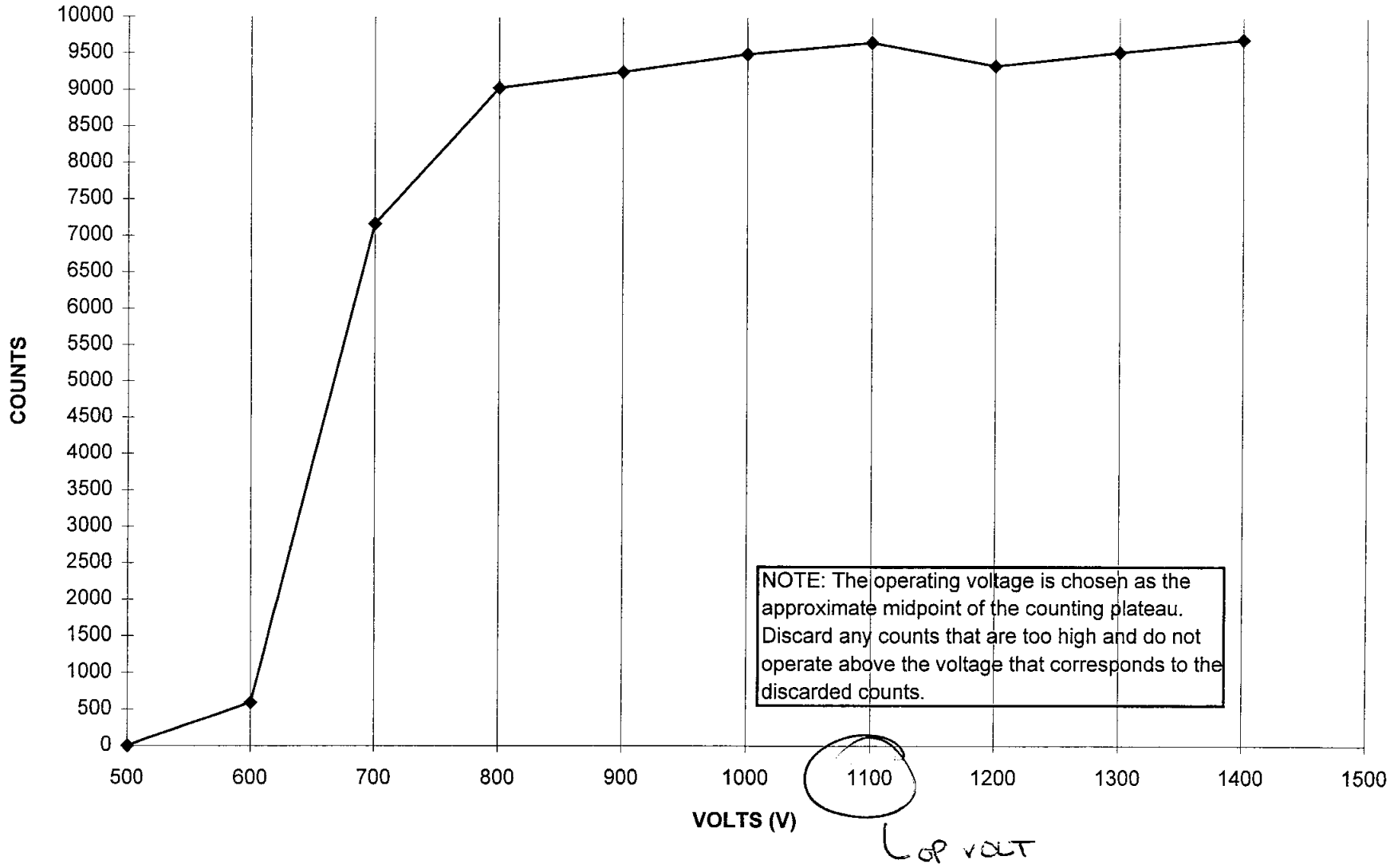
Rev. 09/22/03 AF (THIS SHEET FOR REFERENCE PURPOSES ONLY- NOT A CONTROLLED DOCUMENT)

- ❍ TITLE PAGE
  - ❍ VOLTAGE
    - ❑ PLATEAU PLOTS
    - ❑ QASS's
    - ❑ LOGBOOK PAGES
  - ❍ EFFICIENCY
    - ❑ QASS's
    - ❑ CALIBRATION RESULTS SHEET (A)
    - ❑ CALIBRATION SUMMARY SHEET (A)
    - ❑ BENCHSHEETS (A)
    - ❑ CALIBRATION RESULTS SHEET (B)
    - ❑ CALIBRATION SUMMARY SHEET (B)
    - ❑ BENCHSHEETS (B)
    - ❑ LOGBOOK PAGES
    - ❑ CALIBRATION SPIKE VERIFICATION PACKAGE
  - ❍ DAILY CHECKS
    - ❑ DAILY CHECK SUMMARY PAGES
    - ❑ DAILY CHECK CERTIFICATE → LOGBOOK PAGES
- ❍ ICV's
    - ❑ RADIOMETRIC RECOVERY SUMMARY PAGE
    - ❑ QASS's
    - ❑ BENCHSHEETS
    - ❑ LOGBOOK PAGES
    - ❑ DAILY CHECK SUMMARY PAGES
    - ❑ SPIKE VERIFICATION PACKAGE

Voltage Plateau Data

PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE							
^{230}Th SOURCE (18000 dpm) COUNTED FOR 1 MINUTE AT SPECIFIED OPERATING VOLATGES							
DATE:	6/21/04	ANALYST:	AF				
DETECTOR/SCALAR:		1A					
VOLTS	COUNTS						
500	0						
600	589						
700	7164						
800	9035						
900	9249						
1000	9498						
1100	9657		OP VOLT				
1200	9340						
1300	9526						
1400	9695						
1500	21426						
REVIEWED BY:							

OPERATING VOLTAGE FOR DETECTOR/SCALAR 1A



000119

PHOTOMULTIPLIER/SCALAR OPERATING VOLTAGE

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

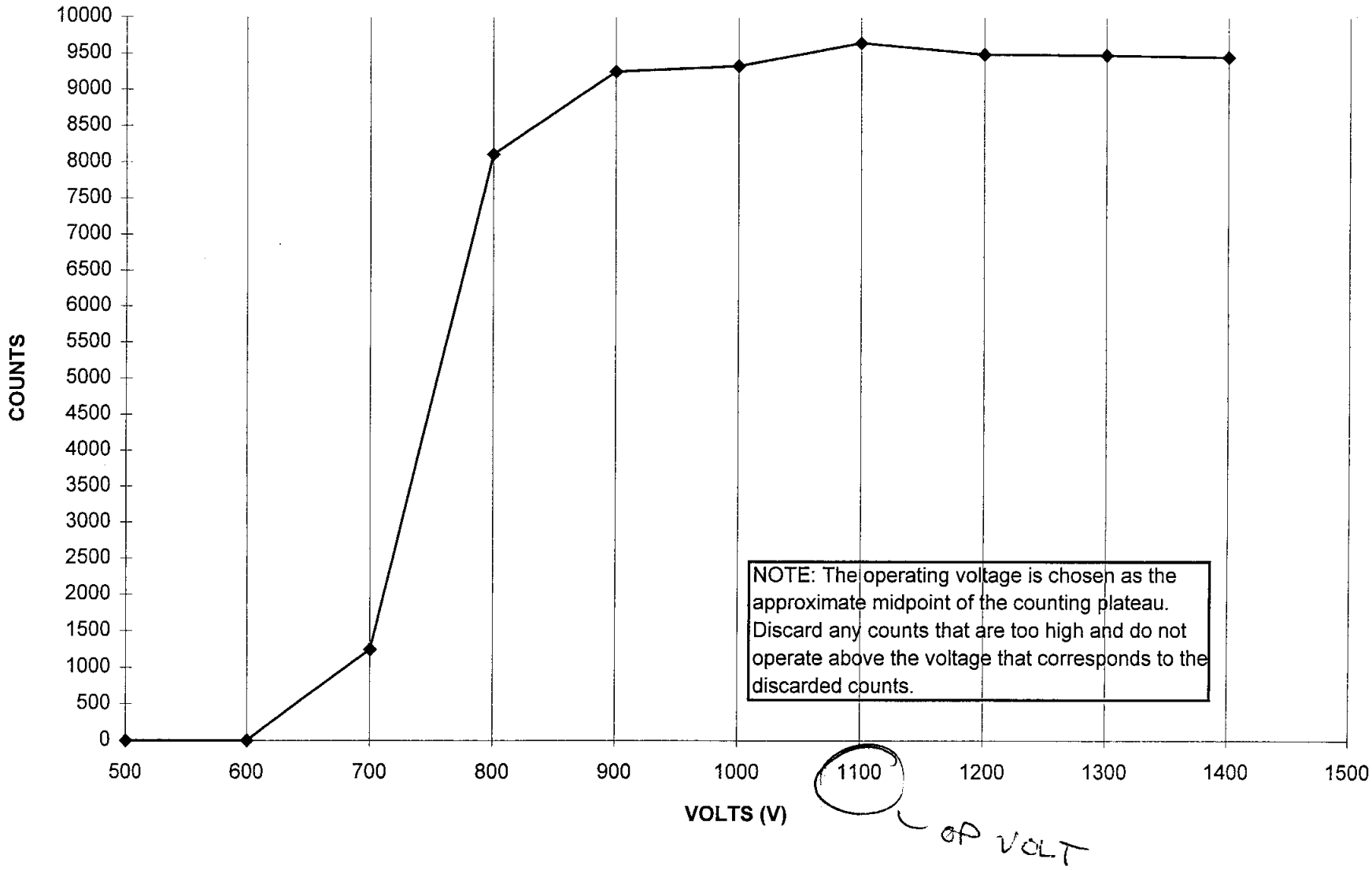
DATE: 6/21/04 ANALYST: AF

DETECTOR/SCALAR: 2B

VOLTS	COUNTS	
500	0	
600	0	
700	1241	
800	8109	
900	9254	
1000	9336	
1100	9652	← OP VOLT
1200	9497	
1300	9485	
1400	9457	
1500	13965	

REVIEWED BY:

OPERATING VOLTAGE FOR DETECTOR/SCALAR 2B



000121

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION

TEST 226Ra

METHOD 903.1

271033

SOP/REV (PREP) 783R5

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.

02/03/04

THE OPERATING VOLTAGE FOR SCALAR/DETECTOR COMBINATIONS WAS DETERMINED AS FOLLOWS:

1. ADJUST THE VOLTAGE OF THE SCALAR TO A LOW VOLTAGE (500V).
2. COUNT THE 18,000 dpm ^{230}Th SOURCE FOR 1 MINUTE AND RECORD THE COUNTS IN THE EMANATION MAINTENANCE LOG.
3. ADJUST THE VOLTAGE OF THE SCALAR BY 100V AND REPEAT STEP 2.
4. CONTINUE THIS PROCESS UNTIL THE GROSS COUNTS ARE CLEARLY OUT OF RANGE (>10,000, USUALLY ABOUT 1500V).
5. PLOT THE VOLTAGE AGAINST THE GROSS COUNTS ON A SCATTER PLOT.
6. REPEAT THE PROCESS DESCRIBED IN STEP 2 WITH NOTHING IN THE DETECTOR FOR OPERATING VOLTAGES ON THE PLATEAU TO DETERMINE DETECTOR BACKGROUND AT DIFFERENT OPERATING VOLTAGES. RECORD THE COUNTS IN THE EMANATION MAINTENANCE LOG.
7. CHOOSE AN OPERATING VOLTAGE ON THE PLATEAU THAT GIVES THE LOWEST POSSIBLE BACKGROUND COUNTS (PREFERABLY 0).

02/03/04

02/03/04

02/03/04

02/03/04

TECHNICIAN/ANALYST _____ DATE 02/03/04

DEPARTMENT MANAGER _____ DATE 2/3/04

VOLTAGE PLATEAUS FOR COUNTERS 1A & 2B.
Th - SOURCE COUNTED FOR 1 MIN. AT EACH VOLTAGE.

VOLT. (KV)	1A	2B
0.5	Ø	Ø
0.6	589	Ø
0.7	7164	1241
0.8	9035	8109
0.9	9249	9254
1.0	9498	9336
1.1	9657	9652
1.2	9340	9497
1.3	9526	9485
1.4	9695	9457
1.5	21426	13965

BACKGROUND COUNTS (NO SOURCE COUNTED) AT PLATEAU ENERGIES FOR COUNTERS 1A & 2B, 1 MIN COUNTS

VOLT (KV)	1A					2B				
	1	2	3	4	5	1	2	3	4	5
0.9	Ø	Ø	~~3~~ Ø 06/01/19/04	Ø	Ø	Ø	Ø	Ø	Ø	Ø
1.0	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
1.1	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
1.2	3	2	4	1	2	Ø	Ø	Ø	Ø	Ø
1.3	15	14	13	11	15	5	6	6	6	4

Continued on Page

Read and Understood By

Signed [signature] Date 6/19/04

Signed Nicholas Tsoulfanidis Date 6/25/04

Efficiency Data

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION

TEST ^{226}Ra

271011

METHOD 903.1

SOP/REV (PREP) 783 R5

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.

01/19/04

CALIBRATION SOURCES WERE PREPARED IN THE FOLLOWING MANNER:

1. 23 mL OF EDTA WAS ADDED TO EACH VOA VIAL.
2. EACH VIAL WAS SPIKED WITH 2 mL OF THE CALIBRATION SOURCE (460.1572.47)
3. THE VIALS WERE PURGED WITH He AND ALLOWED TO INGROW FOR AT LEAST 7 DAYS.

01/19/04

01/19/04

INDEPENDENT CALIBRATION VERIFICATION (ICV) SOURCES WERE PREPARED IN THE MANNER STATED ABOVE, USING THE ^{226}Ra SPIKING SOURCE TO SPIKE THE VIALS.

01/19/04

01/19/04

TECHNICIAN/ANALYST _____ DATE 01/19/04

DEPARTMENT MANAGER _____ DATE 1/19/04

FORM 302r5.FRM (04/30/01)

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION
TEST ^{226}Ra
METHOD 903.1
SOP/REV (PREP) 783 R5
SOP/REV (ANAL) —

268304

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.

11/12/03

BACKGROUND COUNTS FOR SOME CELL-DETECTOR COMBINATIONS WERE COUNTED FOR LESS THAN THE SAMPLE COUNT TIME AND EXTRAPOLATED TO THE LONGER COUNT TIME (SEE CALCULATION BELOW). SINCE >10000 COUNTS ARE OBTAINED FOR EACH SAMPLE, THE ERROR ASSOCIATED WITH CORRECTING THE BACKGROUND COUNTS TO THE SAMPLE COUNT TIME IS NOT SIGNIFICANT. THE CORRECTED DATA IS THEREFORE SUBMITTED WITHOUT QUALIFICATION.

11/12/03

11/12/03

BACKGROUND COUNT CORRECTION:

$$\frac{\text{BKG COUNTS}}{\text{BKG COUNT TIME}} = \frac{\text{CORRECTED BKG}}{\text{SAMPLE COUNT TIME}}$$

11/12/03

11/12/03

TECHNICIAN/ANALYST _____ DATE 11/12/03

DEPARTMENT MANAGER _____ DATE 11/12/03

FORM 302r5.FRM (04/30/01)

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

Calibration results

Analyst:	AF					
Prep. Date S:	6/10/04		Count Date:	6/22/04-6/24/04		
Prep. Date C:	6/10/04					
SOP Used:	783R5					
	S	Flask	Counter	Scaler	Ra-226	
W.O.#	ID	No.	No.	No.	Standard (dpm)	Efficiency
418009	S1	1	1	A	239	2.2394
418009	S2	2	1	A	239	2.6756
418009	S3	3	1	A	239	2.6358
418009	S4	4	1	A	239	2.5025
418009	S5	6	1	A	239	2.5248
418009	S7	8	1	A	239	2.1225
418009	S14	9	1	A	239	2.5149
418009	S9	10	1	A	239	2.1198
418009	S10	12	1	A	239	2.2961
418009	S11	13	1	A	239	2.2478
418009	S12	14	1	A	239	2.4569

000127

Lucas Cell + PMT Calibration Control Summary

r:\inst\alphscnt\cell_cal.xls

*Control limits established 01/14/04-01/21/04

Det+Flask ID																						
Date	A1		A2		A3		A4		A6		A8		A9		A10		A12		A13		A14	
Initial calibration	2.3585	1/14/04	2.5599	1/14/04	2.5818	1/14/04	2.5560	1/14/04	2.4979	1/15/04	2.1919	1/15/04	2.4318	1/15/04	2.1231	1/21/04	2.4188	1/16/04	2.4638	1/16/04	2.5206	1/16/04
UCL	2.5943		2.8159		2.8399		2.8116		2.7477		2.4111		2.6750		2.3354		2.6607		2.7102		2.7726	
LCL	2.1226		2.3039		2.3236		2.3004		2.2481		1.9727		2.1886		1.9108		2.1769		2.2174		2.2685	
6/21/04-6/24/04	2.2394	OK	2.6756	OK	2.6358	OK	2.5025	OK	2.5248	OK	2.1225	OK	2.5149	OK	2.1198	OK	2.2961	OK	2.2478	OK	2.4569	OK

Reviewed By 6/28/04 Date

0001128

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

Analyst: AF
Prep. Date S: 6/10/04
Prep. Date C: 6/10/04
SOP Used: 783R5

		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.)	#	
04-18-009	S1	1	6/10/04	11:15	1	1	A	18	30	6/21/04	11:24	6/21/04	15:44	25	11215	
04-18-009	S2	1	6/10/04	11:15	2	1	A	17	23	6/21/04	11:24	6/21/04	16:13	20	10678	
04-18-009	S3	1	6/10/04	11:15	3	1	A	19	25	6/21/04	12:13	6/21/04	17:15	20	10515	
04-18-009	S4	1	6/10/04	11:15	4	1	A	22	37	6/21/04	12:13	6/21/04	18:01	25	12410	
04-18-009	S5	1	6/10/04	11:15	6	1	A	17	23	6/22/04	10:46	6/22/04	14:50	20	10392	
04-18-009	S7	1	6/10/04	11:15	8	1	A	14	23	6/22/04	11:47	6/22/04	17:24	25	10800	
04-18-009	S9	1	6/10/04	11:15	10	1	A	22	37	6/23/04	10:00	6/23/04	16:10	25	10966	
04-18-009	S10	1	6/10/04	11:15	12	1	A	21	35	6/23/04	10:00	6/23/04	17:15	25	11777	
04-18-009	S11	1	6/10/04	11:15	13	1	A	25	42	6/23/04	12:27	6/23/04	17:53	25	11718	
04-18-009	S12	1	6/10/04	11:15	14	1	A	23	38	6/23/04	12:27	6/23/04	18:38	25	12729	
04-18-009	S14	1	6/10/04	11:15	9	1	A	42	56	6/24/04	9:29	6/24/04	14:24	20	10711	

SEE QASS#

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47	Ra 226	2.0	RS011

Spiked by: AF 6/10/04
Spike Witness: NT 6/10/04
Reviewed by: 6/25/04

000123

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

Analyst: AF
Prep. Date S: 6/10/04
Prep. Date C:
SOP Used: 783R5

W.O.#	S ID	S V (L)	Purge (end) Date D1	Purge (end) Time T1	Flask No.	Counter No.	Scaler No.	CBKG #	CBKG (CORR.)	Deeman. (end) Date D2	Deeman. (end) Time T2	Count Start Date D3	Count Start Time T3	Count Duration (min.)	COUNT #	REMARKS
04-18-009	S1	1	6/10/04 to 6/18/04	11:15	1	1	A	18	0	6/21/04	11:24	6/21/04	15:44	25	11215	
04-18-009	S2	1			2	1	A	17	0				16:13	20	10678	REDO
04-18-009	S3	1			3	1	A	19	0		12:13		17:15	20	10515	
04-18-009	S4	1			4	1	A	22	0				18:01	25	12410	
04-18-009	S5	1			6	1	A	17	0	6/22/04	10:46	6/22/04	14:50	20	10392	
04-18-009	S6	1			7	1	A	10	0				15:37	25	11929	
04-18-009	S7	1			8	1	A	14	0		11:47		17:24	25	10800	
04-18-009	S8	1			9	1	A	23	0				18:01	20	10803	REDO
04-18-009	S9	1			10	1	A	22	0	6/23/04	10:00	6/23/04	16:10	25	10966	REDO
04-18-009	S10	1			12	1	A	21	0				17:15	25	11777	
04-18-009	S11	1			13	1	A	25	0		12:27		17:53	25	11718	
04-18-009	S12	1			14	1	A	23	0				18:38	25	12729	
04-18-009	S13	1			2	1	A	49	0	6/24/04	09:29	6/24/04	13:49	20	11272	
04-18-009	S14	1			9	1	A	42	0				14:24	20	10711	
04-18-009	S15	1			10	1	A	57	0		10:23		15:21	25	11801	
04-18-009	S16	1				1	A		0							
04-18-009	S17	1				1	A		0							
04-18-009	S18	1				1	A		0							
04-18-009	S19	1				1	A		0							
04-18-009	S20	1				1	A		0							
04-18-009	S21	1				1	A		0							
04-18-009	S22	1				1	A		0							
04-18-009	S23	1				1	A		0							
04-18-009	S24	1				1	A		0							
04-18-009	S25	1				1	A		0							
04-18-009	S26	1				1	A		0							
04-18-009	S27	1				1	A		0							
04-18-009	S28	1				1	A		0							
04-18-009	S29	1				1	A		0							
04-18-009	S30	1				1	A		0							

SEE QASS#

Std./Ba Carrier ID	Std./ Carrier Type	Spike Vol. (ml)	pipet No.
460-1572-47	Ra 226	2.0	RS011

3/21/05

Spiked by: 6/10/04
Spike Witness: NT 6/10/04
Reviewed by:

6/10/04.....10:35 AM

R/BENCH-SH/REMCALIB.XLA

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

Calibration results

Analyst:	AF					
Prep. Date S:	6/10/04		Count Date:	6/21/04-6/24/04		
Prep. Date C:	6/10/04					
SOP Used:	783R5					
	S	Flask	Counter	Scaler	Ra-226	
W.O.#	ID	No.	No.	No.	Standard (dpm)	Efficiency
418009	S1	1	2	B	239	2.0964
418009	S2	2	2	B	239	2.6656
418009	S3	3	2	B	239	2.4895
418009	S4	4	2	B	239	2.4692
418009	S5	6	2	B	239	2.3713
418009	S7	8	2	B	239	2.0138
418009	S14	9	2	B	239	2.4121
418009	S9	10	2	B	239	2.0996
418009	S10	12	2	B	239	2.2417
418009	S11	13	2	B	239	2.1379
418009	S12	14	2	B	239	2.3970

000131

Lucas Cell + PMT Calibration Control Summary

r:\inst\alphscnt\cell_cal.xls

*Control limits established 01/14/04-01/21/04

Det+Flask ID																						
Date	B1		B2		B3		B4		B6		B8		B9		B10		B12		B13		B14	
Initial calibration	2.1987	1/14/04	2.5630	1/14/04	2.5722	1/14/04	2.5444	1/14/04	2.3337	1/15/04	2.2242	1/15/04	2.3107	1/15/04	2.0244	1/21/04	2.3118	1/16/04	2.3603	1/16/04	2.4950	1/16/04
UCL	2.4186		2.8193		2.8294		2.7989		2.5670		2.4467		2.5417		2.2269		2.5430		2.5963		2.7445	
LCL	1.9789		2.3067		2.3150		2.2900		2.1003		2.0018		2.0796		1.8220		2.0806		2.1243		2.2455	
6/21/04-6/24/04	2.0964	OK	2.6656	OK	2.4895	OK	2.4692	OK	2.3713	OK	2.0138	OK	2.4121	OK	2.0996	OK	2.2417	OK	2.1379	OK	2.3970	OK

Reviewed By: [signature] Date: 6/25/04

000132

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

Analyst: AF
Prep. Date S: 6/10/04
Prep. Date C: 6/10/04
SOP Used: 783R5

		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.)	#	
04-18-009	S1	1	6/10/04	11:15	1	2	B	19	32	6/21/04	11:24	6/21/04	16:13	25	10464	
04-18-009	S2	1	6/10/04	11:15	2	2	B	8	11	6/21/04	11:24	6/21/04	15:44	20	10665	
04-18-009	S3	1	6/10/04	11:15	3	2	B	8	13	6/21/04	12:13	6/21/04	18:01	25	12322	
04-18-009	S4	1	6/10/04	11:15	4	2	B	5	12	6/21/04	12:13	6/21/04	17:15	35	17192	
04-18-009	S5	1	6/10/04	11:15	6	2	B	11	18	6/22/04	10:46	6/22/04	15:37	25	12116	
04-18-009	S7	1	6/10/04	11:15	8	2	B	12	20	6/22/04	11:47	6/22/04	18:01	25	10197	
04-18-009	S9	1	6/10/04	11:15	10	2	B	15	25	6/23/04	10:00	6/23/04	17:15	25	10762	
04-18-009	S10	1	6/10/04	11:15	12	2	B	9	15	6/23/04	10:00	6/23/04	16:10	25	11573	
04-18-009	S11	1	6/10/04	11:15	13	2	B	11	18	6/23/04	12:27	6/23/04	18:38	25	11061	
04-18-009	S12	1	6/10/04	11:15	14	2	B	13	22	6/23/04	12:27	6/23/04	17:53	25	12473	
04-18-009	S14	1	6/10/04	11:15	9	2	B	34	45	6/24/04	9:29	6/24/04	13:49	20	10310	

SEE QASS#

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47	Ra 226	2.0	RS011

Spiked by: AF 6/10/04
Spike Witness: NT 6/10/04
Reviewed by: [illegible] 6/28/04

000133

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

Analyst: AF
Prep. Date S: 6/10/04
Prep. Date C:
SOP Used: 783R5

W.O.#	S ID	S V (L)	Purge (end) Date D1	Purge (end) Time T1	Flask No.	Counter No.	Scaler No.	CBKG #	CBKG (CORR.)	Deeman. (end) Date D2	Deeman. (end) Time T2	Count Start Date D3	Count Start Time T3	Count Duration (min.)	COUNT #	REMARKS
04-18-009	S1	1	6/10/04	16:15	1	2	B	19	0	6/21/04	11:24	6/21/04	16:13	25	10464	
04-18-009	S2	1			2	2	B	8	0				15:44	20	10665	REDO
04-18-009	S3	1			3	2	B	8	0		12:13		18:01	25	12322	
04-18-009	S4	1			4	2	B	5	0				17:15	35	17192	
04-18-009	S5	1			6	2	B	11	0	6/22/04	10:46	6/22/04	15:37	25	12116	
04-18-009	S6	1			7	2	B	8	0				14:50	25	10786	
04-18-009	S7	1			8	2	B	12	0		11:47		18:01	25	10197	
04-18-009	S8	1			9	2	B	7	0				17:24	20	18308	REDO
04-18-009	S9	1			10	2	B	15	0	6/23/04	10:00	6/23/04	17:15	25	10762	REDO
04-18-009	S10	1			12	2	B	9	0				16:10	25	11573	
04-18-009	S11	1			13	2	B	11	0		12:27		18:38	25	~~12729~~	11061 6/23/04
04-18-009	S12	1			14	2	B	13	0				17:53	25	12473	
04-18-009	S13	1			2	2	B	52	0	6/24/04	09:29	6/24/04	14:24	20	10766	
04-18-009	S14	1			9	2	B	34	0				13:49	20	10310	
04-18-009	S15	1			10	2	B	34	0		10:23		16:12	25	11027	
04-18-009	S16	1				2	B		0							
04-18-009	S17	1				2	B		0							
04-18-009	S18	1				2	B		0							
04-18-009	S19	1				2	B		0							
04-18-009	S20	1				2	B		0							
04-18-009	S21	1				2	B		0							
04-18-009	S22	1				2	B		0							
04-18-009	S23	1				2	B		0							
04-18-009	S24	1				2	B		0							
04-18-009	S25	1				2	B		0							
04-18-009	S26	1				2	B		0							
04-18-009	S27	1				2	B		0							
04-18-009	S28	1				2	B		0							
04-18-009	S29	1				2	B		0							
04-18-009	S30	1				2	B		0							

SEE QASS#

Std./Ba Carrier ID	Std./ Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47 3/2/05	Ra 226	2.0	RS011

Spiked by: 6/10/04
Spike Witness: NT 6/10/04
Reviewed by:

6/10/04.....10:35 AM

R/BENCH-SH/REMCALIB.XLB

Logbook No./Page 248268

Paragon Analytics, Inc.

Sample 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.
CALIB. SOURCE	2B	NA							6/17/04	08:29	9449	1	
	6C									08:30	9409		
	4D									08:31	9295		
0405175.1	Q6/17/04 6C	29	18	6/17/04	08:34	Ø	15			14:31	6	15	
.1 DUP	4D	30				5					10		
.2	6C	31			09:21	3				15:06	7		
RE040613.1.MB	4D	20	19			3					4		
.LCS	6C	21			10:30	3				15:33	1140		
CALIB. SOURCE	1A	NA								17:21	9454		
	2B									17:22	9335		
	6C									17:23	9644		
	4D									17:24	9439		
	1A								6/21/04	09:27	9429		
	2B									09:28	9333		
	6C									09:29	9460		
	4D									09:30	9375		
0418009.S1	1A	1	NA	6/21/04	09:29	18	15			15:44	11215	25	
.S2	2B	2				8					10665	20	
.S2	1A	2			09:46	17				16:13	10678	20	
.S1	2B	1				19					10464	25	
.S3	1A	3			10:47	19				17:15	10515	20	
.S4	2B	4				5					17192	35	
.S4	1A	4			11:13	22				18:01	12410	25	

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 6/24/04

000135

Paragon Analytics, Inc.

Logbook No./Page 248269

Sample 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.
0418009·S3	2B	3	NA	6/21/04	11:13	8	15		6/21/04	18:01	12322	25	
CALIB. SOURCE	1A	NA							6/22/04	08:26	9496	1	
	2B									08:27	9475		
	6C									08:28	9460		
	4D									08:29	9421		
0418009·S5	1A	6	NA	6/22/04	08:29	17	15			14:50	10392	20	
·S6	2B	7				8					10786	25	
·S6	1A	7			09:13	10				15:31 ~~15:36~~	11929	25	
·S5	2B	6				11					12116	25	
·S7	1A	8			09:35	14				17:24	10800	25	
·S8	2B	9				7					10308	20	
·S8	1A	9			10:00	23				18:01	10863	20	
·S7	2B	8				12					10197	25	
CALIB. SOURCE	1A	NA							6/23/04	08:29	9571	1	
	2B									08:30	9339		
	6C									08:31	9292		
	4D									08:32	9490		
0418009·S9	1A	10	NA	6/23/04	08:39	22	15			16:10	10966	25	
·S10	2B	12				9					11573	25	
·S10	~~6C~~ 1A	12			08:59	21				17:15	11777	25	
·S9	~~4D~~ 2B	10				15					10762	25	
·S11	1A	13			09:27	25				17:53	11718	25	
·S12	2B	14				13					12473	25	

Comments:

Reviewed by/date: 6/24/04

Form 795r2.xls (9/23/2002)

000135

Logbook No./Page 248270

Paragon Analytics, Inc.

Sample 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.
0418009.S12	1A	14	NA	6/23/04	09:51	23	15		6/23/04	18:38	12729	25	
↓ .S11	2B	13	↓	↓	↓	11	↓		↓	↓	11061	25	
CALIB SOURCE	1A	NA							6/24/04	07:59	9468	1	
↓	2B	↓								08:00	9324	↓	↓
	6C									08:01	9539		
	4D	↓								08:02	9640		
0418009.S13	1A	2	NA	6/24/04	08:03	49	15			13:49	11272	20	
↓ .S14	2B	9	↓		↓	34	↓			↓	10310	20	
.S14	1A	9			08:21	42				14:24	10711	20	
.S13	2B	2			↓	52				↓	10766	20	
.S15	1A	10			08:43	57				15:21	11801	25	
↓ .S15	2B	10			09:22	34				16:12	11027	25	
0418009.ICV1	1A	1	1		10:07	39				16:54	6304	15	
↓ .ICV2	2B	3	↓	↓	↓	49	↓			↓	6836	↓	
CALIB. SOURCE	1A	NA								18:34	9452	1	
↓	2B	↓								18:35	9612	↓	↓
	6C									18:36	9473		
	4D	↓							↓	18:37	9472	↓	↓

6/24/04

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 6/24/04

000137

PROJECT Ra 226 working standard

Continued From Page

JMM 1-28-99 ~~461~~ 460 1572.47

Make primary standard ~~461~~ 460 1572.45 JMM 1-28-99 and dilute

using 0.5 N HCl JMM 1-28-99

Balance 12 used

VOA initial: 65.8813 g
VOA final: 48.5167 g
amt transferred: 17.3646 g (Ra 226 primary standard)

bottle: ~~71.008~~ JMM 1-28-99 g Balance 12 used
55.7098 g (w/ Ra 226 primary standard)
Ra 226 1° std: 17.3646 g
38.3452 g (wt of empty bottle)

density of 0.5 N HCl Balance 12 used

empty vol. flask: 36.5852 g B
50 mL final: 86.7189 g
50.1337 g

density = 1.00278 g/mL

Balance 21 used

final bottle: 516.29 g − 38.3452 g (empty bottle) = 477.9448 g solution

activity = 17.3646 g · 1486 pCi/g = 25,803.7956 pCi

$$\frac{25{,}803.7956 \text{ pCi}}{\cancel{516.29}\ 477.9448 \text{ g}} = 53.99 \text{ pCi/g} \times 1.0027 \text{ g/mL} = 54.136 \text{ pCi/mL}$$

JMM 1-28-99

Stnd ID: 460.1572.47

Description: Ra-226 Working Solution
Activity: 54.136 pCi/mL
Uncertainty: 2.977 pCi/mL
Ref. Date: 1/1/93
Ref Time: na
Prep Date 6/8/99 Prep by: JMM
Expiration 6/7/04
Matrix/Comp. 0.5 N HCl
Half Life (y): 1.60E+03

DCB 12/3/99

Continued on Page

Read and Understood By

J. Mansell 6/8/99 Signed Date

Daniel C. Burns 12/3/99 Signed Date

1/28/98 Open ampule sol#2557-4 (RSO# 460), transfer to 40 ml VOA vial + dilute w/ 0.5 M HCL.

Diluent = 0.5 N HCl

Balance 12 used

VOA start: 26.5345 g (empty)
VOA final: 65.8813 g (final, Ra 226 + 0.5 HCl)

Δ transferred: 39.3468 g

Balance 12 used

initial ampule + beaker: 38.0054 g
empty ampule + beaker: 33.0913 g
4.9141 g mass Ra-226 added to VOA

11,900 pCi/g
× 4.9141
58,477.79 pCi
÷ 39.35
1486 pCi/g final activity conc.
as of 1/93
$t_{1/2}$ = 1600 y
total unc = ± 5.5%

Standard verification balance 21 GEOMERY 10
former pitare: 61.03 g
total wt: 181.33 g
181.33 − 61.03 g =
120.30 g solution

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
[signature]	1/28/99	[signature]	2/3/99

Parogan ID 460
Recd 8-25-97

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide: Radium-226 Half-life: 1600 years

Nominal activity: 60 nano curies

Nominal volume: 5 ml in ampoule/bottle number 2557-4

Measurement Activity of principal radionuclide

Activity per gram of this solution

11.9 nano curies of Radium-226

at 0400 hours PST on January 1993

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

curies Per gram

of the daughter nuclide

Total mass of this solution

Approximately 5.0 grams

Method of measurement

This standard was prepared by gravimetric dilution of NBS Standard Reference Material 4964-B. The specific activity of the dilution was determined by gamma spectrometry by comparing the sum of the activities of the 242, 352 and 609 KeV gamma ray emissions to those of several NBS SRM 4957 Radium-226 sources.

Useful Life

This radionuclide has decayed through half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after Indefinite

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1)	less than equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than ± 0.6 %

(The 99.7% confidence limits are given by t(sm) where t is obtained from the student t factor for the degree of freedom (n-1)).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error ($+\delta - \delta'$). These have been estimated not to exceed

+ 3.7 % or - 3.7 %

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error [t(sm)] at the 99.7% confidence limits and the worst case estimate of the systematic errors ($+\delta, -\delta'$)
The overall uncertainty is therefore calculated on the basis of + [t(sm) $+\delta$], - [t(sm) $+\delta'$]
and is + 5.5 %, - 5.5 % of the quoted radioactive concentration.

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

Radium-226 is a member of the Uranium-238 decay chain. Radium-226 decays 100 percent by alpha emission to Radon-222.

Chemical Composition of Solution

Carrier content per gram of solution: 0.8 micrograms Ba

Other components: 0.5M HCl

Preservative:

Remarks

The measured value and the expected value using the gravimetric factors and the NBS calibration of SRM-4964B differed by 1.6 percent. The average of the two values was used for this standard.

Date Certificate Prepared January 21, 1993

Approval Signature Paul B. Hahn

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide	Radium-226
Source identification	2557-4, prepared by EMSL
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.0 grams
Source composition	Radium-226 plus 0.8 μg of non-radioactive barium per gram of 0.5 $mol \cdot L^{-1}$ HCl
Reference time	0700 EST January 1, 1993

	NIST DATA	EMSL DATA
Radioactivity concentration	447.5 $Bq \cdot g^{-1}$	440.3 $Bq \cdot g^{-1}$
Expanded uncertainty	2.5 percent (1)*	±5.5 percent (2)
Photon-emitting impurities (Activities at reference time)	None observed (3)	None reported
Measuring instrument	NIST pressurized "4π"γ ionization chamber A calibrated with SRM 4955	Dilution of SRM 4964-B verified using germanium spectrometer system
Half life	1600 ± 7 years (4)	
Difference from NIST		-1.61 percent (5)

For the Director,

J.M. Robin Hutchinson, Group Leader
Radioactivity Group
Physics Laboratory

Gaithersburg, MD 20899
September 1994

*Notes on next page

(over)

NOTES

(1) The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1297* (1993)].

(2) The combined standard uncertainty, u_c = 1.24 percent, is the quadratic combination of the standard deviation (or standard deviation of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a)	100 ionization chamber measurements on each of 2 samples	0.31 percent
b)	activity of SRM 4955-55	1.21 percent
c)	gravimetric	0.05 percent
d)	half-life propagation (Δt = 25 y)	0.005 percent

The expanded uncertainty, U = 2.5 percent, is obtained by multiplying u_c by a coverage factor of k = 2 and is assumed to provide an uncertainty interval of approximately 95 percent confidence.

(3) Overall uncertainty reported by EMSL.

(4) The limits of detection are:

$$12.6\ \gamma\ s^{-1}\ g^{-1} \text{ between 40 and 348 keV,}$$
$$4.75\ \gamma\ s^{-1}\ g^{-1} \text{ between 356 and 605 keV, and}$$
$$1.58\ \gamma\ s^{-1}\ g^{-1} \text{ between 613 and 1900 keV,}$$

provided that impurity photons are separated in energy by four keV or more from the principle gamma-ray emissions of radium-226 and its daughters.

(5) Evaluated Nuclear Structure Data File (1990).

(6) This result demonstrates the traceability of EMSL to NIST, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NIST interagency agreement of April 1976, as amended.

For further information, please contact Jeffrey T. Cessna at 301-975-5539.

Source identification 2557-4

Code #: 460.15.72.47 Name of Standard: Ra 226 Working Std.

Date: 12/1/99 Analyst: JASON MODEST

Aliquot for verification: Two 64.6 g Aliquots placed in GED 11 γ container

Work up: See Attached QASS

Expected activity and uncertainty: 53.99 pCi/g

Results of Counting and counting uncertainty: ≃ 57.5 ± 11.75

= 106.5% of expected

Radiochemistry Technical Manager: [signature] Date: 12/3/99

Radiochemistry QA Manager: Date:

ATI FM 718FC
(2/27/95

Gamma Spectroscopy Analysis Benchsheet

Spreadsheet Unprotected: NA

Batch ID: 23010gsw.xls
Analyst: AV
Prep. Date: 11-30-99
SOP: 739 R3

Analytical Balance No.: XXXX
Top Load Balance No.: 22

QASS/NCR: Y / N ID # NA
Pretreatment Y / N Batch: NA

	Work Order Number		Client Sample ID	Collection Date	Aliquot Size	Aliquot Units g	Aliquot Basis w	% Moist.	Report Size	Report Units g	Report Basis w	Remarks	Det. No.	Geo. No.	Count Dur	Count Date
1	99-23-010	1	STD.VER	11-30-99	64.63	g	D	N/A	64.6	g	D		1	11	30min	~~11~~ 12/1/99
2	99-23-010	2	STD VER	see WO	64.64	g	D	N/A	64.6	g	D	SAME STD1(DUP)	3	11	30min	12/1/99
3		D1	↓						64.6	g	D		3	11	30min	12/1/99
4		D2	↓						64.6	g	D		1	11	30min	12/1/99
5																
6																
7																
8																
9																
10																
11																
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16																
17																
18																
19																
20																
21																
22																
23																
24																

Relinquished by: AV
date: 11-30-99

Received by: [signature]
date: 11/30/99

Reviewed by:
Date:

000145

11/30/99.....3:15 PM

R/BENCH-SH/23010GSW.XLS

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH 99-23-010-1, 2
TEST γ
METHOD prep. std. var.
SOP NA (VERBAL INSTRUCTION FROM DCB)

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.

99-23-010-01 and -02 are the same std. of Ra-226 (# 460.1572.47) As per DCB, Geo-11 std geometry was used to make this standard.

AV

TECHNICIAN/ANALYST AV DATE 11/30/99

RESOURCE MANAGER A.M. Wagner DATE 11/30/99.

171621

FORM 302FC3.FRM (10-30-98)

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Std. verification Total Radium
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-01
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:48
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.3	BDL	U
Na-22	< 0.19	BDL	U
K-40	< 2.0	BDL	U
Sc-46	< 0.24	BDL	U
Cr-51	< 1.2	BDL	U
Mn-54	< 0.18	BDL	U
Co-56	< 0.32	BDL	U
Co-57	< 0.10	BDL	U
Co-58	< 0.18	BDL	U
Fe-59	< 0.31	BDL	U
Co-60	< 0.25	BDL	U
Zn-65	< 0.64	BDL	U
Sr-85	< 0.23	BDL	U
Nb-95	< 0.28	BDL	U
Ru-106	< 1.3	BDL	U
Ag-110m	< 0.14	BDL	U
Sb-124	< 0.20	BDL	U
Sb-125	< 0.41	BDL	U
I-131	< 0.18	BDL	U
Cs-134	< 0.24	BDL	U
Cs-137	< 0.18	BDL	U
Ce-139	< 0.12	BDL	U
Ce-144	< 0.77	BDL	U
Eu-152	< 1.1	BDL	U
Eu-154	< 0.53	BDL	U
Eu-155	< 0.47	BDL	U
Tl-208	< 0.18	BDL	U
Bi-212	< 2.0	BDL	U
Pb-212	< 0.24	BDL	U
Bi-214	6.3 ± 1.2	18.9	
Pb-214	7.0 ± 1.3	18.0	
Ra-226	57 ± 11	18.8	

Data stored in file 10007826.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Std. verification Total Radium
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-01
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:48
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 0.88	BDL	U
Ac-228	< 0.63	BDL	U
Pa-234m	< 31	BDL	U
Th-234	< 2.2	BDL	U
U-235	< 0.85	BDL	U
Am-241	< 0.74	BDL	U

Data stored in file 10007826.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra 226 Std. Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D1
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 09:25
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.9	BDL	U
Na-22	< 0.33	BDL	U
K-40	< 2.9	BDL	U
Sc-46	< 0.17	BDL	U
Cr-51	< 1.3	BDL	U
Mn-54	< 0.24	BDL	U
Co-56	< 0.57	BDL	U
Co-57	< 0.11	BDL	U
Co-58	< 0.20	BDL	U
Fe-59	< 0.57	BDL	U
Co-60	< 0.41	BDL	U
Zn-65	< 0.44	BDL	U
Sr-85	< 0.31	BDL	U
Nb-95	< 0.28	BDL	U
Ru-106	< 2.1	BDL	U
Ag-110m	< 0.26	BDL	U
Sb-124	< 0.24	BDL	U
Sb-125	< 0.57	BDL	U
I-131	< 0.18	BDL	U
Cs-134	< 0.26	BDL	U
Cs-137	< 0.30	BDL	U
Ce-139	< 0.12	BDL	U
Ce-144	< 1.0	BDL	U
Eu-152	< 2.3	BDL	U
Eu-154	< 0.92	BDL	U
Eu-155	< 0.63	BDL	U
Tl-208	< 0.27	BDL	U
Bi-212	< 3.0	BDL	U
Pb-212	< 0.32	BDL	U
Bi-214	5.5 ± 1.2	22.5	
Pb-214	5.6 ± 1.1	20.1	
Ra-226	62 ± 12	20.1	

Data stored in file 10007832.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra 226 Std. Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D1
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 09:25
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 1.2	BDL	U
Ac-228	< 0.94	BDL	U
Pa-234m	< 48	BDL	U
Th-234	< 2.7	BDL	U
U-235	< 0.89	BDL	U
Am-241	< 1.1	BDL	U

Data stored in file 10007832.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Remarks: Sample 99-23-010-D1 is a duplicate of 99-23-010-01.

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Standard Verification Ra226.
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-02
Sample Matrix: LIQUID
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:51
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.4	BDL	U
Na-22	< 0.33	BDL	U
K-40	< 3.8	BDL	U
Sc-46	< 0.24	BDL	U
Cr-51	< 1.5	BDL	U
Mn-54	< 0.27	BDL	U
Co-56	< 0.37	BDL	U
Co-57	< 0.12	BDL	U
Co-58	< 0.31	BDL	U
Fe-59	< 0.52	BDL	U
Co-60	< 0.43	BDL	U
Zn-65	< 0.85	BDL	U
Sr-85	< 0.33	BDL	U
Nb-95	< 0.37	BDL	U
Ru-106	< 2.3	BDL	U
Ag-110m	< 0.18	BDL	U
Sb-124	< 0.29	BDL	U
Sb-125	< 0.53	BDL	U
I-131	< 0.21	BDL	U
Cs-134	< 0.26	BDL	U
Cs-137	< 0.26	BDL	U
Ce-139	< 0.14	BDL	U
Ce-144	< 0.89	BDL	U
Eu-152	< 2.1	BDL	U
Eu-154	< 0.92	BDL	U
Eu-155	< 0.63	BDL	U
Tl-208	< 0.28	BDL	U
Bi-212	< 2.8	BDL	U
Pb-212	< 0.29	BDL	U
Bi-214	6.5 ± 1.4	21.0	
Pb-214	6.7 ± 1.3	19.4	
Ra-226	57 ± 12	20.4	

Data stored in file 10007827.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Standard Verification Ra226.
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-02
Sample Matrix: LIQUID
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:51
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 1.4	BDL	U
Ac-228	< 1.1	BDL	U
Pa-234m	< 57	BDL	U
Th-234	< 2.6	BDL	U
U-235	< 1.0	BDL	U
Am-241	< 1.1	BDL	U

Data stored in file 10007827.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ).
See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra226 Std.Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D2
Sample Matrix:
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 09:23
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.3	BDL	U
Na-22	< 0.20	BDL	U
K-40	< 2.9	BDL	U
Sc-46	< 0.19	BDL	U
Cr-51	< 1.2	BDL	U
Mn-54	< 0.17	BDL	U
Co-56	< 0.32	BDL	U
Co-57	< 0.092	BDL	U
Co-58	< 0.16	BDL	U
Fe-59	< 0.43	BDL	U
Co-60	< 0.21	BDL	U
Zn-65	< 0.61	BDL	U
Sr-85	< 0.24	BDL	U
Nb-95	< 0.26	BDL	U
Ru-106	< 1.7	BDL	U
Ag-110m	< 0.15	BDL	U
Sb-124	< 0.23	BDL	U
Sb-125	< 0.49	BDL	U
I-131	< 0.17	BDL	U
Cs-134	< 0.24	BDL	U
Cs-137	< 0.21	BDL	U
Ce-139	< 0.11	BDL	U
Ce-144	< 0.84	BDL	U
Eu-152	< 1.3	BDL	U
Eu-154	< 0.56	BDL	U
Eu-155	< 0.48	BDL	U
Tl-208	< 0.22	BDL	U
Bi-212	< 2.3	BDL	U
Pb-212	< 0.25	BDL	U
Bi-214	7.4 ± 1.4	18.5	
Pb-214	7.0 ± 1.3	18.0	
Ra-226	54 ± 10	19.2	

Data stored in file 10007831.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra226 Std.Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D2
Sample Matrix:
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 09:23
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 0.84	BDL	U
Ac-228	< 0.60	BDL	U
Pa-234m	< 37	BDL	U
Th-234	< 2.6	BDL	U
U-235	< 0.82	BDL	U
Am-241	< 0.73	BDL	U

Data stored in file 10007831.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ).
See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Remarks: Sample 99-23-010-D2 is a duplicate of 99-23-010-02.

```
==========================================================================
)R_C        Paragon Analytics, Inc.        Fort Collins, CO        Version 6.2
==========================================================================

ample ID :   99-23-010-02 B:STD.ACT.VERIFIC.

--------------------------------------------------------------------------
ample Size . . . .  1.00e+000 Sample | Spectrum File . . . . . . . . GDR03.SPC
ampling Start. . . . .11-30-99 12:00 | Counting Start. . . . .  12-01-99 08:51
ampling Stop . . . . .11-30-99 12:00 | Live Time . . . . . . . . .    1800 Sec
urrent Date. . . . . .12-01-99 08:16 | Real Time . . . . . . . . .    1806 Sec
--------------------------------------------------------------------------
                              Detector #:  3
nergy(keV)= -0.52 +  0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

WHM(keV)  =  0.80 +  0.011*En + 6.71e-004*En^2 + 0.00e+000*En^3 11-08-99 11:57
                Where En = Sqrt(Energy in keV)
--------------------------------------------------------------------------
ensitivity . . . . . . . . . . . 0.20 | Search Start / End. . . . .   30 / 4000
igma Multiplier. . . . . . . . . 2.00 |
--------------------------------------------------------------------------
```

PEAK SEARCH RESULTS

K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.77	150.34	46	38	33	129	1.05	a
2	77.17	155.13	116	39	28	115	0.96	b
3	86.89	174.53	22	36	32	125	0.48	NET < CL
4	186.13	372.68	443	52	27	89	1.16	
5	238.37	477.00	14	17	13	31	0.66	a
6	241.98	484.20	126	31	19	47	1.15	b
7	295.18	590.44	203	37	22	52	1.33	
8	351.81	703.50	357	43	19	40	1.23	
9	379.29	758.37	18	17	14	22	1.28	
10	486.19	971.82	10	16	14	18	0.85	NET < CL
11	511.04	1021.44	39	21	16	27	2.52	
12	609.27	1217.58	272	37	15	21	1.61	
13	768.42	1535.36	28	17	13	16	1.36	
14	934.00	1865.98	13	14	11	13	1.06	
15	989.85	1977.50	5	13	11	11	1.11	NET < CL
16	1120.22	2237.82	46	18	11	9	1.74	
17	1238.12	2473.24	22	11	6	4	1.88	
18	1315.24	2627.22	5	9	7	4	0.60	NET < CL
19	1400.32	2797.10	10	6	0	0	2.35	
20	1408.58	2813.61	19	9	0	0	2.23	
21	1764.67	3524.62	39	14	5	2	2.06	

)R/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

ample ID : 99-23-010-02 B:STD.ACT.VERIFIC.

kg File: . . . . . DET03.bkg | Counting Start. 12-01-99 08:51
). : 99-23-006-03 B:11/29/99 WK.BKG | Current Date 12-01-99 08:16

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
4	186.13	1.16	443	52	431	52	
5	238.37	0.66	14	17	11	18	NET < CL
8	351.81	1.23	357	43	347	43	
11	511.04	2.52	39	21	-7	22	NET < CL
12	609.27	1.61	272	37	265	37	
21	1764.67	2.06	39	14	37	14	

DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

ample ID: 99-23-010-02 B:STD.ACT.VERIFIC.

ample Size . . . . 1.00e+000 Sample	Spectrum File GDR03.SPC
ampling Start. 11-30-99 12:00	Counting Start. 12-01-99 08:51
ampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
urrent Date. 12-01-99 08:16	Decay Time. . . . . 2.09e+001 Hrs

fficiency File. DET0311.EFF	Library File. FANPR6.LIB
D. GEO11 534	IDFiss. Act. and Nat. Library RTS 02/17

iff.= 1/[2.28e-003*En^-3.58e+000 + 7.58e+001*En^8.58e-001] 08-25-99 14:19

amma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
ibrary Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	8.24e+003 +-9.94e+002	1.40e+007	1 of 1
Pb-214	Average:	9.58e+002 +-9.87e+001	1.40e+007	2 of 2
	295.21	9.45e+002 +-1.72e+002		
	351.92	9.64e+002 +-1.21e+002		
Bi-214	Average:	9.31e+002 +-1.22e+002	1.40e+007	2 of 2
	609.31	9.46e+002 +-1.31e+002		
	1120.29	8.42e+002 +-3.23e+002		
Am-241	59.54	< 1.60e+002	3.79e+006	MDA
Eu-155	86.55	< 9.01e+001	4.34e+004	MDA
Th-234	92.60	< 3.67e+002	3.91e+013	MDA
Co-57	122.06	< 1.76e+001	6.50e+003	MDA
Ce-144	133.54	< 1.27e+002	6.82e+003	MDA
U-235	143.76	< 1.46e+002	6.17e+012	MDA
Ce-139	165.85	< 2.01e+001	3.30e+003	MDA
Th-227	236.00	< 1.97e+002	1.91e+005	MDA
Pb-212	238.63	< 4.10e+001	1.67e+004	MDA
Cr-51	320.08	< 2.16e+002	6.65e+002	MDA
I-131	364.48	< 3.07e+001	1.93e+002	MDA
Sb-125	427.89	< 7.59e+001	2.43e+004	MDA
Be-7	477.59	< 1.95e+002	1.28e+003	MDA
Sr-85	513.99	< 4.77e+001	1.56e+003	MDA
Tl-208	583.14	< 4.03e+001	1.67e+004	MDA
Sb-124	602.71	< 4.14e+001	1.44e+003	MDA
Cs-134	604.70	< 3.78e+001	1.81e+004	MDA
Ru-106	621.84	< 3.35e+002	8.84e+003	MDA
Ag-110m	657.75	< 2.64e+001	6.00e+003	MDA
Cs-137	661.65	< 3.78e+001	2.64e+005	MDA
Bi-212	727.17	< 4.04e+002	1.67e+004	MDA
Nb-95	765.79	< 5.37e+001	1.54e+003	MDA
Co-58	810.76	< 4.44e+001	1.70e+003	MDA
Mn-54	834.83	< 3.92e+001	7.50e+003	MDA

:-46	889.25	< 3.42e+001	2.01e+003	MDA
:-228	911.07	< 1.52e+002	5.04e+004	MDA
ı-234m	1001.03	< 8.11e+003	3.91e+013	MDA
:-59	1099.22	< 7.43e+001	1.07e+003	MDA
ı-65	1115.52	< 1.22e+002	5.87e+003	MDA
ɔ-60	1173.22	< 6.18e+001	4.62e+004	MDA
ɔ-56	1238.25	< 5.24e+001	1.89e+003	MDA
ı-154	1274.45	< 1.32e+002	7.71e+004	MDA
ı-22	1274.54	< 4.71e+001	2.28e+004	MDA
ı-152	1407.95	< 3.00e+002	1.19e+005	MDA
-40	1460.81	< 5.44e+002	1.12e+013	MDA

ɔTAL: 1.01e+004 DPM/Sample

UNKNOWN PEAKS

nergy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.77	150.34	46	38	33	129	1.05	8.293e-001
77.17	155.13	116	39	28	115	0.96	1.943e+000
241.98	484.20	126	31	19	47	1.15	1.594e+000
379.29	758.37	18	17	14	22	1.28	3.250e-001
768.42	1535.36	28	17	13	16	1.36	9.405e-001
934.00	1865.98	13	14	11	13	1.06	5.188e-001
238.12	2473.24	22	11	6	4	1.88	1.111e+000
400.32	2797.10	10	6	0	0	2.35	5.621e-001
408.58	2813.61	19	9	0	0	2.23	1.073e+000
764.67	3524.63	37	14	5	2	2.06	2.534e+000

DR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

ample ID : 99-23-010-01 B:TOTAL RA.STD.ACT.VER

ample Size	1.00e+000 Sample	Spectrum File	GDR01.SPC
ampling Start.	.11-30-99 12:00	Counting Start.	12-01-99 08:48
ampling Stop	.11-30-99 12:00	Live Time	1800 Sec
urrent Date.	.12-01-99 08:12	Real Time	1806 Sec

Detector #: 1

nergy(keV)= -1.41 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

WHM(keV) = 1.15 + -0.013*En + 1.64e-003*En^2 +-1.10e-005*En^3 11-08-99 09:40
Where En = Sqrt(Energy in keV)

ensitivity	0.20	Search Start / End.	60 / 4000
igma Multiplier.	2.00		

PEAK SEARCH RESULTS

'K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.76	152.07	105	55	48	229	1.21	a
2	77.01	156.57	216	53	39	210	1.15	b
3	83.49	169.50	18	36	30	142	0.59	a NET < CL
4	87.06	176.62	62	46	38	202	1.08	b
5	186.06	374.27	823	70	36	147	1.31	
6	241.80	485.55	191	46	33	128	1.00	
7	295.10	591.96	411	53	33	106	1.18	
8	323.10	647.86	6	31	28	82	0.32	NET < CL
9	351.73	705.01	788	64	28	81	1.33	
10	511.16	1023.30	117	37	29	76	2.14	
11	609.22	1219.07	580	56	26	70	1.87	
12	768.45	1536.95	69	28	22	41	1.42	
13	934.04	1867.54	36	22	18	26	2.36	
14	1104.88	2208.60	21	16	13	14	3.31	
15	1120.22	2239.23	144	33	22	37	2.16	
16	1237.99	2474.35	68	21	13	14	1.88	
17	1377.52	2752.90	32	23	20	27	2.86	
18	1401.33	2800.45	21	19	16	20	13.60	
19	1460.96	2919.48	48	23	18	25	1.49	
20	1729.26	3455.12	37	21	16	20	3.07	
21	1764.14	3524.74	154	28	14	11	3.09	
22	1847.60	3691.38	24	15	11	8	2.50	

DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

ample ID : 99-23-010-01 B:TOTAL RA.STD.ACT.VER

kg File: . . . . . det01.bkg | Counting Start. 12-01-99 08:48
D.: 99-23-006-01 B:11/29/99 WK. BK | Current Date 12-01-99 08:12

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
5	186.06	1.31	823	70	789	70	
7	295.10	1.18	411	53	402	54	
9	351.73	1.33	788	64	767	64	
10	511.16	2.14	117	37	-20	39	NET < CL
11	609.22	1.87	580	56	562	57	
17	1377.52	2.86	32	23	29	23	
19	1460.96	1.49	48	23	0	24	NET < CL
21	1764.14	3.09	154	28	147	29	

DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

ample ID: 99-23-010-01 B:TOTAL RA.STD.ACT.VER

ample Size . . . . 1.00e+000 Sample	Spectrum File GDR01.SPC
ampling Start. 11-30-99 12:00	Counting Start. 12-01-99 08:48
ampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
urrent Date. 12-01-99 08:12	Decay Time. . . . . 2.08e+001 Hrs
fficiency File. DET0111.EFF	Library File. FANPR6.LIB
D. . . . . Geo11 #534	IDFiss. Act. and Nat. Library RTS 02/17

ff.= 1/[2.85e-003*En^-3.16e+000 + 3.06e+001*En^6.85e-001] 08-30-99 08:13

amma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
ibrary Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

uclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
a-226	186.21	8.23e+003 +-7.35e+002	1.40e+007	1 of 1
b-214	Average:	1.00e+003 +-7.15e+001	1.40e+007	2 of 2
	295.21	9.35e+002 +-1.26e+002		
	351.92	1.03e+003 +-8.69e+001		
i-214	Average:	9.04e+002 +-8.33e+001	1.40e+007	2 of 2
	609.31	8.83e+002 +-8.89e+001		
	1120.29	1.05e+003 +-2.39e+002		
m-241	59.54	< 1.06e+002	3.79e+006	MDA
u-155	86.55	< 6.79e+001	4.34e+004	MDA
h-234	92.60	< 3.22e+002	3.91e+013	MDA
o-57	122.06	< 1.48e+001	6.50e+003	MDA
e-144	133.54	< 1.11e+002	6.82e+003	MDA
J-235	143.76	< 1.21e+002	6.17e+012	MDA
e-139	165.85	< 1.69e+001	3.30e+003	MDA
Th-227	236.00	< 1.26e+002	1.91e+005	MDA
b-212	238.63	< 3.42e+001	1.67e+004	MDA
r-51	320.08	< 1.76e+002	6.65e+002	MDA
I-131	364.48	< 2.52e+001	1.93e+002	MDA
b-125	427.89	< 5.90e+001	2.43e+004	MDA
e-7	477.59	< 1.83e+002	1.28e+003	MDA
r-85	513.99	< 3.32e+001	1.56e+003	MDA
l-208	583.14	< 2.59e+001	1.67e+004	MDA
b-124	602.71	< 2.92e+001	1.44e+003	MDA
s-134	604.70	< 3.50e+001	1.81e+004	MDA
Ru-106	621.84	< 1.84e+002	8.84e+003	MDA
Ag-110m	657.75	< 1.99e+001	6.00e+003	MDA
Cs-137	661.65	< 2.65e+001	2.64e+005	MDA
Bi-212	727.17	< 2.93e+002	1.67e+004	MDA
Nb-95	765.79	< 4.06e+001	1.54e+003	MDA
Co-58	810.76	< 2.63e+001	1.70e+003	MDA
Mn-54	834.83	< 2.56e+001	7.50e+003	MDA

:-46	889.25	< 3.37e+001	2.01e+003	MDA
:-228	911.07	< 8.97e+001	5.04e+004	MDA
ı-234m	1001.03	< 4.47e+003	3.91e+013	MDA
:-59	1099.22	< 4.39e+001	1.07e+003	MDA
ı-65	1115.52	< 9.17e+001	5.87e+003	MDA
›-60	1173.22	< 3.59e+001	4.62e+004	MDA
›-56	1238.25	< 4.60e+001	1.89e+003	MDA
ı-154	1274.45	< 7.62e+001	7.71e+004	MDA
ı-22	1274.54	< 2.71e+001	2.28e+004	MDA
ı-152	1407.95	< 1.62e+002	1.19e+005	MDA
-40	1460.81	< 2.87e+002	1.12e+013	MDA

)TAL: 1.01e+004 DPM/Sample

UNKNOWN PEAKS

nergy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.76	152.07	105	55	48	229	1.21	9.091e-001
77.01	156.57	216	53	39	210	1.15	1.769e+000
87.06	176.62	62	46	38	202	1.08	4.184e-001
241.80	485.55	191	46	33	128	1.00	1.258e+000
768.45	1536.94	69	28	22	41	1.42	9.780e-001
934.04	1867.54	36	22	18	26	2.36	5.823e-001
104.88	2208.60	21	16	13	14	3.31	3.818e-001
237.99	2474.35	68	21	13	14	1.88	1.339e+000
377.52	2752.90	29	23	20	27	2.86	6.213e-001
401.33	2800.45	21	19	16	20	13.60	4.485e-001
729.26	3455.12	37	21	16	20	3.07	9.158e-001
764.14	3524.74	147	29	14	11	3.09	3.688e+000
847.60	3691.38	24	15	11	8	2.50	6.216e-001

DR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

ample ID : 99-23-010-D1 B:RA226 STD.VER.

ample Size	1.00e+000 Sample	Spectrum File	GDR03.SPC
ampling Start.	.11-30-99 12:00	Counting Start.	12-01-99 09:25
ampling Stop	.11-30-99 12:00	Live Time	1800 Sec
urrent Date.	.12-01-99 08:50	Real Time	1806 Sec

Detector #: 3

nergy(keV)= -0.52 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

WHM(keV) = 0.80 + 0.011*En + 6.71e-004*En^2 + 0.00e+000*En^3 11-08-99 11:57
Where En = Sqrt(Energy in keV)

ensitivity	0.20	Search Start / End.	30 / 4000
igma Multiplier.	2.00		

PEAK SEARCH RESULTS

K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.80	150.39	60	36	30	106	0.90	a
2	77.13	155.05	87	36	26	108	0.94	b
3	87.25	175.25	28	28	23	81	0.66	
4	186.21	372.85	476	53	27	82	1.07	
5	238.61	477.48	25	27	24	50	1.38	a
6	241.89	484.03	96	30	21	48	1.49	b
7	295.12	590.32	181	36	22	55	1.19	
8	351.86	703.60	294	39	17	36	1.29	
9	511.43	1022.24	34	25	21	39	3.20	
10	609.22	1217.48	231	35	17	29	1.37	
11	768.67	1535.86	18	17	14	17	1.93	
12	933.79	1865.57	18	13	9	8	2.70	
13	1120.23	2237.84	40	21	16	22	2.28	
14	1238.02	2473.03	25	16	12	12	3.72	
15	1378.11	2752.76	11	11	9	6	2.05	
16	1450.72	2897.75	4	8	7	4	1.03	NET < CL
17	1461.53	2919.32	8	11	9	7	1.12	NET < CL
18	1764.42	3524.11	55	16	6	3	2.90	

DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

ample ID : 99-23-010-D1 B:RA226 STD.VER.

kg File: . . . . . DET03.bkg | Counting Start. 12-01-99 09:25
D.: 99-23-006-03 B:11/29/99 WK.BKG | Current Date 12-01-99 08:50

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
4	186.21	1.07	476	53	464	53	
5	238.61	1.38	25	27	19	27	NET < CL
8	351.86	1.29	294	39	284	40	
9	511.43	3.20	34	25	-12	26	NET < CL
10	609.22	1.37	231	35	224	36	
17	1461.53	1.12	8	11	0	12	NET < CL
18	1764.42	2.90	55	16	53	16	

DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

ample ID: 99-23-010-D1 B:RA226 STD.VER.

ample Size . . . . 1.00e+000 Sample	Spectrum File GDR03.SPC
ampling Start. 11-30-99 12:00	Counting Start. 12-01-99 09:25
ampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
urrent Date. 12-01-99 08:50	Decay Time. . . . . 2.14e+001 Hrs
fficiency File. DET0311.EFF	Library File. FANPR6.LIB
D. GEO11 534	IDFiss. Act. and Nat. Library RTS 02/17

ff.= 1/[2.28e-003*En^-3.58e+000 + 7.58e+001*En^8.58e-001] 08-25-99 14:19

amma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
ibrary Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	8.89e+003 +-1.02e+003	1.40e+007	1 of 1
Pb-214	Average:	8.05e+002 +-9.20e+001	1.40e+007	2 of 2
	295.21	8.40e+002 +-1.68e+002		
	351.92	7.89e+002 +-1.10e+002		
Bi-214	Average:	7.92e+002 +-1.21e+002	1.40e+007	2 of 2
	609.31	7.98e+002 +-1.28e+002		
	1120.29	7.44e+002 +-3.85e+002		
Am-241	59.54	< 1.62e+002	3.79e+006	MDA
Eu-155	86.55	< 9.01e+001	4.34e+004	MDA
Th-234	92.60	< 3.82e+002	3.91e+013	MDA
Co-57	122.06	< 1.62e+001	6.50e+003	MDA
Ce-144	133.54	< 1.44e+002	6.82e+003	MDA
U-235	143.76	< 1.28e+002	6.17e+012	MDA
Ce-139	165.85	< 1.73e+001	3.30e+003	MDA
Th-227	236.00	< 1.66e+002	1.91e+005	MDA
Pb-212	238.63	< 4.59e+001	1.67e+004	MDA
Cr-51	320.08	< 1.90e+002	6.65e+002	MDA
I-131	364.48	< 2.58e+001	1.93e+002	MDA
Sb-125	427.89	< 8.17e+001	2.43e+004	MDA
Be-7	477.59	< 2.67e+002	1.28e+003	MDA
Sr-85	513.99	< 4.39e+001	1.56e+003	MDA
Tl-208	583.14	< 3.92e+001	1.67e+004	MDA
Sb-124	602.71	< 3.40e+001	1.44e+003	MDA
Cs-134	604.70	< 3.68e+001	1.81e+004	MDA
Ru-106	621.84	< 2.99e+002	8.84e+003	MDA
Ag-110m	657.75	< 3.77e+001	6.00e+003	MDA
Cs-137	661.65	< 4.32e+001	2.64e+005	MDA
Bi-212	727.17	< 4.24e+002	1.67e+004	MDA
Nb-95	765.79	< 3.96e+001	1.54e+003	MDA
Co-58	810.76	< 2.91e+001	1.70e+003	MDA
Mn-54	834.83	< 3.47e+001	7.50e+003	MDA

:-46	889.25	< 2.39e+001	2.01e+003	MDA
:-228	911.07	< 1.35e+002	5.04e+004	MDA
a-234m	1001.03	< 6.84e+003	3.91e+013	MDA
e-59	1099.22	< 8.15e+001	1.07e+003	MDA
1-65	1115.52	< 6.29e+001	5.87e+003	MDA
)-60	1173.22	< 5.87e+001	4.62e+004	MDA
)-56	1238.25	< 8.18e+001	1.89e+003	MDA
1-154	1274.45	< 1.32e+002	7.71e+004	MDA
a-22	1274.54	< 4.71e+001	2.28e+004	MDA
1-152	1407.95	< 3.24e+002	1.19e+005	MDA
-40	1460.81	< 4.11e+002	1.12e+013	MDA

OTAL: 1.05e+004 DPM/Sample

UNKNOWN PEAKS

nergy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.80	150.39	60	36	30	106	0.90	1.082e+000
77.13	155.05	87	36	26	108	0.94	1.454e+000
87.25	175.25	28	28	23	81	0.66	3.567e-001
241.89	484.03	96	30	21	48	1.49	1.221e+000
768.67	1535.86	18	17	14	17	1.93	5.990e-001
933.79	1865.57	18	13	9	8	2.70	7.299e-001
238.02	2473.03	25	16	12	12	3.72	1.258e+000
378.11	2752.76	11	11	9	6	2.05	5.958e-001
764.42	3524.11	53	16	6	3	2.90	3.598e+000

DR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

ample ID : 99-23-010-D2 B:RA226 STD.VER.

ample Size	1.00e+000 Sample	Spectrum File	GDR01.SPC
ampling Start. . . .	.11-30-99 12:00	Counting Start.	12-01-99 09:23
ampling Stop	.11-30-99 12:00	Live Time	1800 Sec
urrent Date.	.12-01-99 08:48	Real Time	1806 Sec

Detector #: 1

nergy(keV) = -1.41 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

WHM(keV) = 1.15 + -0.013*En + 1.64e-003*En^2 +-1.10e-005*En^3 11-08-99 09:40
Where En = Sqrt(Energy in keV)

ensitivity	0.20	Search Start / End.	60 / 4000
igma Multiplier.	2.00		

PEAK SEARCH RESULTS

K. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.67	151.90	125	47	36	177	0.93	a
2	77.02	156.59	232	51	36	192	0.98	b
3	87.10	176.71	-3	49	43	256	0.04	NET < CL
4	186.02	374.18	771	72	42	198	1.17	
5	241.96	485.86	165	46	35	133	1.20	
6	295.15	592.05	470	56	34	116	1.22	
7	351.71	704.97	749	64	32	101	1.53	
8	510.77	1022.52	184	37	24	48	2.53	
9	609.16	1218.94	655	60	29	85	1.77	
10	768.69	1537.43	84	28	20	33	1.83	
11	934.35	1868.16	22	23	20	36	2.63	
12	1120.25	2239.29	194	33	16	21	2.42	
13	1238.21	2474.79	57	25	20	30	1.92	
14	1377.87	2753.60	28	23	20	30	1.51	
15	1461.34	2920.24	61	27	22	30	2.54	
16	1510.06	3017.51	19	18	15	16	3.00	
17	1729.27	3455.13	43	18	12	11	3.83	
18	1764.40	3525.27	133	29	17	18	2.41	

DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

ample ID : 99-23-010-D2 B:RA226 STD.VER.

kg File: . . . . . det01.bkg | Counting Start. 12-01-99 09:23
D.: 99-23-006-01 B:11/29/99 WK. BK | Current Date 12-01-99 08:48

K#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
4	186.02	1.17	771	72	737	73	
6	295.15	1.22	470	56	461	57	
7	351.71	1.53	749	64	728	65	
8	510.77	2.53	184	37	47	39	
9	609.16	1.77	655	60	637	61	
14	1377.87	1.51	28	23	25	23	
15	1461.34	2.54	61	27	13	27	NET < CL
18	1764.40	2.41	133	29	126	29	

DR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

ample ID: 99-23-010-D2 B:RA226 STD.VER.

ample Size . . . . 1.00e+000 Sample	Spectrum File GDR01.SPC
ampling Start. 11-30-99 12:00	Counting Start. 12-01-99 09:23
ampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
urrent Date. 12-01-99 08:48	Decay Time. . . . . 2.14e+001 Hrs
fficiency File. DET0111.EFF	Library File. FANPR6.LIB
D. . . . . Geo11 #534	IDFiss. Act. and Nat. Library RTS 02/17

ff.= 1/[2.85e-003*En^-3.16e+000 + 3.06e+001*En^6.85e-001] 08-30-99 08:13

amma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
ibrary Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	7.68e+003 +-7.60e+002	1.40e+007	1 of 1
Pb-214	Average:	1.01e+003 +-7.32e+001	1.40e+007	2 of 2
	295.21	1.07e+003 +-1.33e+002		
	351.92	9.82e+002 +-8.76e+001		
Bi-214	Average:	1.06e+003 +-8.85e+001	1.40e+007	2 of 2
	609.31	1.00e+003 +-9.53e+001		
	1120.29	1.42e+003 +-2.38e+002		
Am-241	59.54	< 1.05e+002	3.79e+006	MDA
Eu-155	86.55	< 6.95e+001	4.34e+004	MDA
Th-234	92.60	< 3.67e+002	3.91e+013	MDA
Co-57	122.06	< 1.32e+001	6.50e+003	MDA
Ce-144	133.54	< 1.21e+002	6.82e+003	MDA
U-235	143.76	< 1.17e+002	6.17e+012	MDA
Ce-139	165.85	< 1.64e+001	3.30e+003	MDA
Th-227	236.00	< 1.20e+002	1.91e+005	MDA
Pb-212	238.63	< 3.64e+001	1.67e+004	MDA
Cr-51	320.08	< 1.76e+002	6.65e+002	MDA
I-131	364.48	< 2.46e+001	1.93e+002	MDA
Sb-125	427.89	< 7.01e+001	2.43e+004	MDA
Be-7	477.59	< 1.86e+002	1.28e+003	MDA
Sr-85	513.99	< 3.47e+001	1.56e+003	MDA
Tl-208	583.14	< 3.14e+001	1.67e+004	MDA
Sb-124	602.71	< 3.26e+001	1.44e+003	MDA
Cs-134	604.70	< 3.47e+001	1.81e+004	MDA
Ru-106	621.84	< 2.37e+002	8.84e+003	MDA
Ag-110m	657.75	< 2.20e+001	6.00e+003	MDA
Cs-137	661.65	< 3.06e+001	2.64e+005	MDA
Bi-212	727.17	< 3.30e+002	1.67e+004	MDA
Nb-95	765.79	< 3.70e+001	1.54e+003	MDA
Co-58	810.76	< 2.31e+001	1.70e+003	MDA
Mn-54	834.83	< 2.49e+001	7.50e+003	MDA

:-46	889.25	< 2.76e+001	2.01e+003	MDA
:-228	911.07	< 8.67e+001	5.04e+004	MDA
ı-234m	1001.03	< 5.26e+003	3.91e+013	MDA
ɜ-59	1099.22	< 6.15e+001	1.07e+003	MDA
ı-65	1115.52	< 8.76e+001	5.87e+003	MDA
ɔ-60	1173.22	< 3.06e+001	4.62e+004	MDA
ɔ-56	1238.25	< 4.60e+001	1.89e+003	MDA
ı-154	1274.45	< 8.03e+001	7.71e+004	MDA
ɜ-22	1274.54	< 2.85e+001	2.28e+004	MDA
ı-152	1407.95	< 1.91e+002	1.19e+005	MDA
-40	1460.81	< 4.17e+002	1.12e+013	MDA

ɔTAL: 9.75e+003 DPM/Sample

UNKNOWN PEAKS

nergy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.67	151.90	125	47	36	177	0.93	1.086e+000
77.02	156.59	232	51	36	192	0.98	1.898e+000
241.96	485.86	165	46	35	133	1.20	1.083e+000
510.77	1022.52	47	39	24	48	2.53	5.089e-001
768.69	1537.43	84	28	20	33	1.83	1.198e+000
934.35	1868.16	22	23	20	36	2.63	3.573e-001
238.21	2474.79	57	25	20	30	1.92	1.116e+000
377.87	2753.60	25	23	20	30	1.51	5.226e-001
510.06	3017.51	19	18	15	16	3.00	4.286e-001
729.27	3455.13	43	18	12	11	3.83	1.073e+000
764.40	3525.27	126	29	17	18	2.41	3.162e+000

Radiochemistry Solution Report

Solution Id: 460.1572.47 Name: Ra-226 Intermediate Standard Type: IS
Lot: Vendor Name:

Final Vol:	476.6578	Dept:	RD	Prep By	DCB	on	6/ 8/99	Reviewed By	sed on 1/14/04
Units:	mL	Location:		Opened By		on		Verified By	DCB on 12/ 3/99
Matrix:	LIQUID	ExpireDate:	6/ 7/04	Received By		on		Deactivated By	on

Comment:

Component Name	Component ID	Volume Added	Units
Ra-226 Intermediate Standard	460.1572.45	17.3646	g

CompName	Calibrated Primary Act/Conc	Calibration Date	Reference Date	1/2 Life (Yrs)	Final Act/Conc	Summed Conc	Units
Ra-226	11900	1/1/93	1/14/04	1600	53.8844821813323		pCi/ml

Associated Parent IDs

460 460.1572.45

Parent Solutions Sub Report

Solution Id: 460 Name: Ra-226 Primary Standard Type: PS

Final Vol: 5 Units: g Matrix: LIQUID

CompName	Calibration Date	Reference Date	Decay Corrected Act/Conc	Units
Ra-226	1/1/93	1/14/04	11843.2531719227	pCi/g

Solution Id: 460.1572.45 Name: Ra-226 Intermediate Standard Type: IS

Final Vol: 39.3468 Units: g Matrix: LIQUID

CompName	Calibration Date	Reference Date	Decay Corrected Act/Conc	Units
Ra-226	1/1/93	1/14/04	1479.12737571274	pCi/g

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

Date Printed: Wednesday, January 14, 2004

Paragon Analytics Inc.

Standards DB Version: 1.074

Code #: 460.15.72.47 Name of Standard: Ra 226 Working Std.

Date: 12/1/99 Analyst: JASON MODEST

Aliquot for verification: Two 64.6 g Aliquots placed in GEO 11 γ container

Work up: See Attached QASS

Expected activity and uncertainty: 53.99 pCi/g

Results of Counting and counting uncertainty: ≃ 57.5 ± 11.25

= 106.5% of expected

Radiochemistry Technical Manager: [signature] Date: 12/3/99

Radiochemistry QA Manager: Date:

ATI FM 718FC
(2/27/95

PROJECT Ra-226 primary dilution 460.1572.45 Continued From Page

1/28/98 Open ampule sol#2557-4 (RSO#460), transfer to 40 ml VOA vial + dilute w/ 0.5 N HCL.

Diluent = 0.5 N HCl

Balance 12 used

VOA start: 26.5345 g (empty)
VOA final: 65.8813 g (final, Ra226 + 0.5 HCl)

Δ transferred: 39.3468 g

Balance 12 used

initial ampule + beaker: 38.0054 g
empty ampule + beaker: 33.0913 g
4.9141 g mass Ra-226 added to VOA

11,900 pCi/g
× 4.9141
58,477.79 pCi
÷ 39.35
1486 pCi/g final activity conc.
as of 1/93
$t_{1/2}$ = 1600 y
total unc = ± 5.5%

Standard verification Balance 21 GEOMERY 10
Hermer jar tare: 61.03 g
total wt: 181.33 g

181.33 − 61.03 g =
120.30 g solution

Continued on Page

Read and Understood By

Signed 1/28/99 Date

Signed 2/3/99 Date

Parsons ID 460
Recd 8-25-97

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide: Radium-226 Half-life: 1600 years

Nominal activity: 60 nano curies

Nominal volume: 5 ml in ampoule/bottle number 2557-4

Measurement Activity of principal radionuclide

Activity per gram of this solution

11.9 nano curies of Radium-226

at 0400 hours PST on January 1993

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

curies Per gram

of the daughter nuclide

Total mass of this solution

Approximately 5.0 grams

Method of measurement

This standard was prepared by gravimetric dilution of NBS Standard Reference Material 4964-B. The specific activity of the dilution was determined by gamma spectrometry by comparing the sum of the activities of the 242, 352 and 609 KeV gamma ray emissions to those of several NBS SRM 4957 Radium-226 sources.

Useful Life

This radionuclide has decayed through half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after Indefinite

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1)	less than equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than ± 0.6 %

(The 99.7% confidence limits are given by t(sm) where t is obtained from the student t factor for the degree of freedom (n-1)).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error ($+\delta - \delta'$). These have been estimated not to exceed

+ 3.7 % or - 3.7 %

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error [t(sm)] at the 99.7% confidence limits and the worst case estimate of the systematic errors ($+\delta$, $-\delta'$)
The overall uncertainty is therefore calculated on the basis of + [t(sm) $+\delta$], − [t(sm) $+\delta'$]
and is + 5.5 %, - 5.5 % of the quoted radioactive concentration.

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

Radium-226 is a member of the Uranium-238 decay chain. Radium-226 decays 100 percent by alpha emission to Radon-222.

Chemical Composition of Solution

Carrier content per gram of solution:	Other components:
0.8 micrograms Ba	0.5M HCl

Preservative:

Remarks

The measured value and the expected value using the gravimetric factors and the NBS calibration of SRM-4964B differed by 1.6 percent. The average of the two values was used for this standard.

Date Certificate Prepared January 21, 1993

Approval Signature Paul B. Hahn

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide	Radium-226
Source identification	2557-4, prepared by EMSL
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.0 grams
Source composition	Radium-226 plus 0.8 μg of non-radioactive barium per gram of 0.5 $mol \cdot L^{-1}$ HCl
Reference time	0700 EST January 1, 1993

	NIST DATA	EMSL DATA
Radioactivity concentration	447.5 $Bq \cdot g^{-1}$	440.3 $Bq \cdot g^{-1}$
Expanded uncertainty	2.5 percent (1)*	±5.5 percent (2)
Photon-emitting impurities (Activities at reference time)	None observed (3)	None reported
Measuring instrument	NIST pressurized "4π"γ ionization chamber A calibrated with SRM 4955	Dilution of SRM 4964-B verified using germanium spectrometer system
Half life	1600 ± 7 years (4)	
Difference from NIST		-1.61 percent (5)

For the Director,

J.M. Robin Hutchinson, Group Leader
Radioactivity Group
Physics Laboratory

Gaithersburg, MD 20899
September 1994

*Notes on next page

(over)

NOTES

(1) The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1297* (1993)].

(2) The combined standard uncertainty, u_c = 1.24 percent, is the quadratic combination of the standard deviation (or standard deviation of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a)	100 ionization chamber measurements on each of 2 samples	0.31 percent
b)	activity of SRM 4955-55	1.21 percent
c)	gravimetric	0.05 percent
d)	half-life propagation (Δt = 25 y)	0.005 percent

The expanded uncertainty, U = 2.5 percent, is obtained by multiplying u_c by a coverage factor of k = 2 and is assumed to provide an uncertainty interval of approximately 95 percent confidence.

(3) Overall uncertainty reported by EMSL.

(4) The limits of detection are:

$$12.6\ \gamma\ s^{-1}\ g^{-1} \text{ between 40 and 348 keV,}$$
$$4.75\ \gamma\ s^{-1}\ g^{-1} \text{ between 356 and 605 keV, and}$$
$$1.58\ \gamma\ s^{-1}\ g^{-1} \text{ between 613 and 1900 keV,}$$

provided that impurity photons are separated in energy by four keV or more from the principle gamma-ray emissions of radium-226 and its daughters.

(5) Evaluated Nuclear Structure Data File (1990).

(6) This result demonstrates the traceability of EMSL to NIST, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NIST interagency agreement of April 1976, as amended.

For further information, please contact Jeffrey T. Cessna at 301-975-5539.

Source identification 2557-4

Daily Checks

Lucas Cell + PMT Daily Performance Check Summary - Detector A, Scalar #1

r:\inst\alphscnt\dailychk.xls

Historical control limts established 8/28/01.

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
421	6/1/04	1	9495	OK	9047	9762
422	6/1/04	1	9285	OK	9047	9762
423	6/7/04	1	9467	OK	9047	9762
424	6/7/04	1	9479	OK	9047	9762
425	6/17/04	1	9513	OK	9047	9762
426	6/17/04	1	9454	OK	9047	9762
427	6/21/04	1	9429	OK	9047	9762
428	6/22/04	1	9496	OK	9047	9762
429	6/23/04	1	9571	OK	9047	9762
430	6/24/04	1	9468	OK	9047	9762
431	6/24/04	1	9452	OK	9047	9762

Lucas Cell + PMT Daily Performance Check Summary - Detector B, Scalar #2

r:\inst\alphscnt\dailychk.xls

Historical control limts established 9/25/01.

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
402	6/1/04	1	9490	OK	9074	9734
403	6/1/04	1	9449	OK	9074	9734
404	6/7/04	1	9568	OK	9074	9734
405	6/7/04	1	9430	OK	9074	9734
406	6/17/04	1	9449	OK	9074	9734
407	6/17/04	1	9335	OK	9074	9734
408	6/21/04	1	9333	OK	9074	9734
409	6/22/04	1	9475	OK	9074	9734
410	6/23/04	1	9339	OK	9074	9734
411	6/24/04	1	9324	OK	9074	9734
412	6/24/04	1	9612	OK	9074	9734

Logbook No./Page 248266

Paragon Analytics, Inc.

Sample 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.
0405040.9DUP	4D	22	17	5/27/04	08:12	33	90		5/27/04	15:49	67	90	
↓ .10	6C	23	↓	↓	09:53	18	↓		↓	17:31	86	↓	
↓ .11	4D	24	↓	↓	↓	23	↓		↓	↓	51	↓	
CALIB. SOURCE	1A	NA							5/28/04	08:08	9420	1	
↓	2B	↓							↓	08:09	9397	↓	↓
	6C									08:10	9344		
	4D									08:11	9421		
~~0404265.8~~	~~6C~~	~~25~~	~~17~~	~~5/28/04~~	~~08:13~~								
↓ ~~.8DUP~~	~~4D~~	~~26~~			↓				5/28/04				
0405040.12	1A 6C	25	17	5/28/04	08:26	54	90			15:15	67	90	
↓ .13	2B 4D	26	↓	↓	↓	27	↓		↓	↓	63	↓	
↓ .13DUP	6C	27			09:58	22				16:55	51		
RE04DS15.2.MB	4D	28			↓	18				↓	39		
CALIB. SOURCE	1A	NA							5/29/04	14:39	9446	1	
↓	2B	↓							↓	14:40	9307	↓	↓
	6C									14:41	9398		
	4D									14:42	9368		
	1A								6/1/04	09:34	9495		
	2B									09:35	9490		
	6C									09:36	9320		
	4D									09:37	9387		
0404265.8	6C	29	17	6/1/04	09:54	4	30			16:07	241	30	
↓ .8DUP	4D	30	↓	↓	↓	4	↓		↓	↓	238	↓	

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 6/1/04

000181

Logbook No./Page 248267

Paragon Analytics, Inc.

Sample 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.
RE040525-1-LCS	1A	14	20	6/1/04	09:54	29	30		6/1/04	16:07	4784	30	
↓ .MB	6C	31	17	↓	10:28	3	↓		↓	16:41	11	↓	
CALIB SOURCE	1A	1A								18:07	9285	1	
	2B									18:08	9449		
	6C									18:09	9317		
	4D									18:10	9508		
	1A								6/7/04	08:08	9467		
	2B									08:09	9568		
	6C									08:10	9454		
	4D									08:11	9555		
040509S.1	6C	21	17	6/7/04	08:28	3	15			13:38	4	15	
.1DUP	4D	22			↓	4				↓	4		
.2	6C	23			08:48	5				14:01	8		
.3	4D	24			↓	4				↓	8		
.4	6C	25			09:19	3				14:29	18		
.6	4D	26			↓	4				↓	93		
RE040602-1.MB	6C	27			09:42	6				14:58	7		
↓ .LCS	4D	28			↓	0				↓	1292		
CALIB SOURCE	1A	1A								15:45	9479	1	
	2B									15:46	9430		
	6C									15:47	9484		
	4D									15:48	9280		
	1A								~~6/7/04~~ 6/17/04	08:28	9513		

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 6/17/04

000182

Logbook No./Page 248268

Paragon Analytics, Inc.

Sample 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.
CALIB SOURCE	2B	NA							6/17/04	08:29	9449	1	
	6C									08:30	9409		
	4D									08:31	9295		
0405175.1	Gelitby #6C	29	18	6/17/04	08:34	0	15			14:31	6	15	
.1 DUP	4D	30				5					10		
.2	6C	31			09:21	3				15:00	7		
RE040613.1 MB	4D	20	19			3					4		
.LCS	6C	21			10:30	3				15:33	1140		
CALIB. SOURCE	1A	NA								17:21	9454		
	2B									17:22	9335		
	6C									17:23	9644		
	4D									17:24	9439		
	1A								6/21/04	09:27	9429		
	2B									09:28	9333		
	6C									09:29	9460		
	4D									09:30	9375		
0418009.S1	1A	1	NA	6/21/04	09:29	18	15			15:44	11215	25	
.S2	2B	2				8					10665	20	
.S2	1A	2			09:46	17				16:13	10678	20	
.S1	2B	1				19					10464	25	
.S3	1A	3			10:47	19				17:15	10515	20	
.S4	2B	4				5					17192	35	
.S4	1A	4			11:13	22				18:01	12410	25	

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 6/24/04

000183

Logbook No./Page 248269

Paragon Analytics, Inc.

Sample 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.
0418009·S3	2B	3	NA	6/21/04	11:13	8	15		6/21/04	18.01	12327	25	
CALIB. SOURCE	1A	NA							6/22/04	08:26	9496	1	
	2B									08:27	9475		
	6C									08:28	9460		
	4D									08:29	9421		
0418009·S5	1A	6	NA	6/22/04	08:29	17	15			14:50	10392	20	
·S6	2B	7				8					10786	25	
·S6	1A	7			09:13	10			15:31 6/22/04	~~15:36~~	11929	25	
·S5	2B	6				11					12116	25	
·S7	1A	8			09:35	14				17:24	10800	25	
·S8	2B	9				7					10308	20	
·S8	1A	9			10:00	23				18:01	10863	20	
·S7	2B	8				12					10197	25	
CALIB. SOURCE	1A	NA							6/23/04	08:29	9571	1	
	2B									08:30	9339		
	6C									08:31	9292		
	4D									08:32	9490		
0418009·S9	1A	10	NA	6/23/04	08:39	22	15			16:10	10966	25	
·S10	2B	12				9					11573	25	
·S10	~~6C~~ 1A	12			08:59	21				17:15	11777	25	
·S9 6/23/04	~~4D~~ 2B	10				15					10762	25	
·S11	1A	13			09:27	25				17:53	11718	25	
·S12	2B	14				13					12473	25	

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 6/24/04

000184

Logbook No./Page 248270

Paragon Analytics, Inc.

Sample 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.
0418009.S12	1A	14	NA	6/23/04	09:51	23	15		6/23/04	18:38	12729	25	
↓ .S11	2B	13	↓	↓	↓	11	↓		↓	↓	11061	25	
CALIB SOURCE	1A	NA							6/24/04	07:59	9468	1	
↓	2B	↓							↓	08:00	9324	↓	↓
	6C									08:01	9539		
	4D									08:02	9640		
0418009.S13	1A	2	NA	6/24/04	08:03	49	15			13:49	11272	20	
.S14	2B	9	↓	↓	↓	34	↓			↓	10310	20	
.S14	1A	9			08:21	42				14:24	10711	20	
.S13	2B	2			↓	52				↓	10766	20	
.S15	1A	10			08:43	57				15:21	11801	25	
↓ .S15	2B	10			09:22	34				16:12	11027	25	
0418009.ICV1	1A	1	1		10:07	39				16:54	6304	15	
↓ .ICV2	2B	3	↓	↓	↓	49	↓			↓	6836	↓	
CALIB. SOURCE	1A	NA								18:34	9452	1	
↓	2B	↓								18:35	9612	↓	↓
	6C									18:36	9473		
	4D									18:37	9472		

6/25/04

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 6/25/04

000185

ESOURCE INC.
adiation standards and check sources
810 Siler Lane Santa Fe, NM 87501
505)473-9538 FAX(505)473-5805

Yarbrough 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 traceability.

Active Diameter(or area) 44mm
Total Diameter(or area) 47mm
9,150 cpm ± 460 cpm 2pi
18,000 dpm ± 900 dpm 4pi
0.00812 microcurie
08/20/92 date of measurement
92TH4703015 source serial number

Mounting Material SS
Thickness 0.79mm

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.

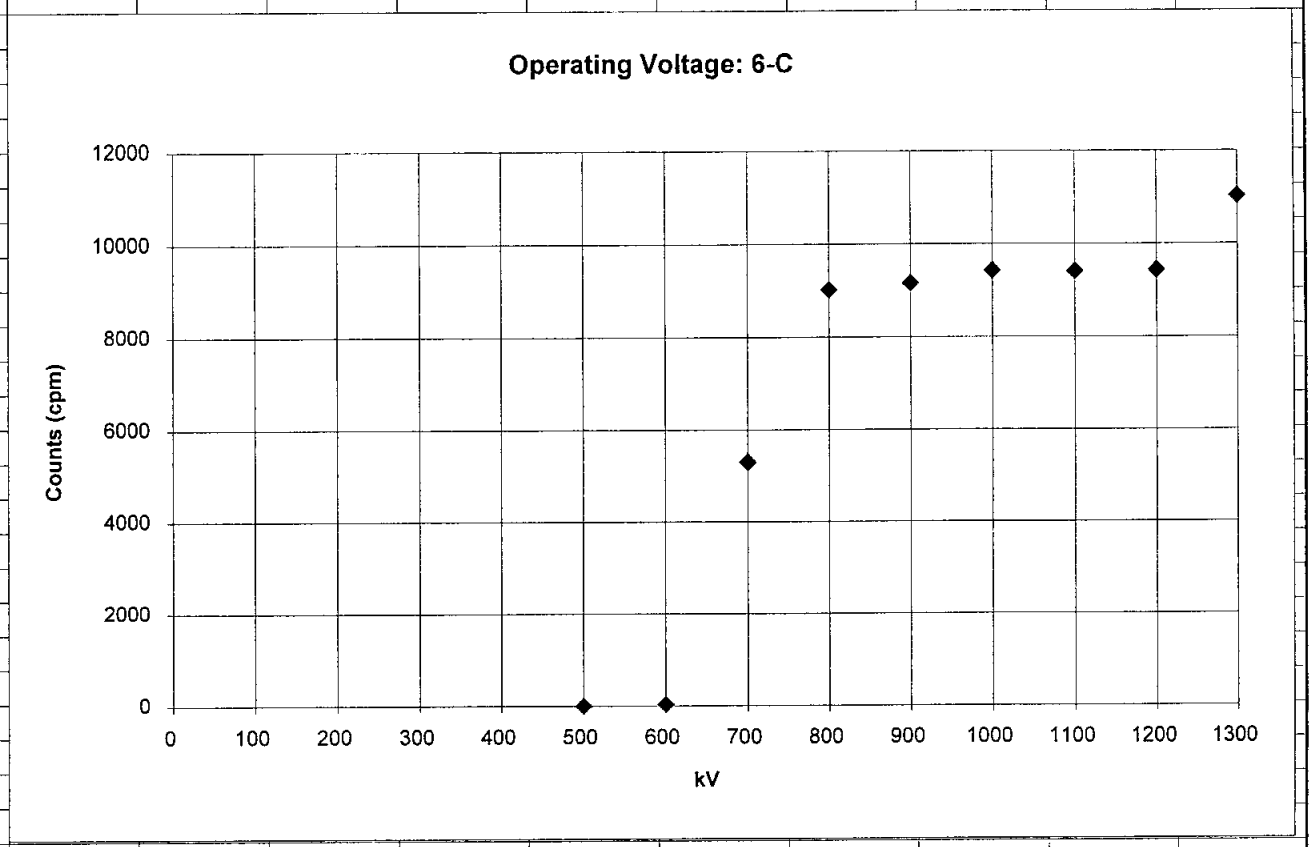
AC005

^{226}Ra by Rn Emanation Calibration Package for Detectors C and D

Voltage Plateau Data

kV	COUNTS
500	0
600	37
700	5287
800	9017
900	9159
1000	9431
1100	9411
1200	9437
1300	11022

Voltage	Slope
600	26.435
700	44.9
800	19.36
900	2.07
1000	1.26
1100	0.03
1200	8.055
1300	7.86417
1400	8.47846



Background Efficiency

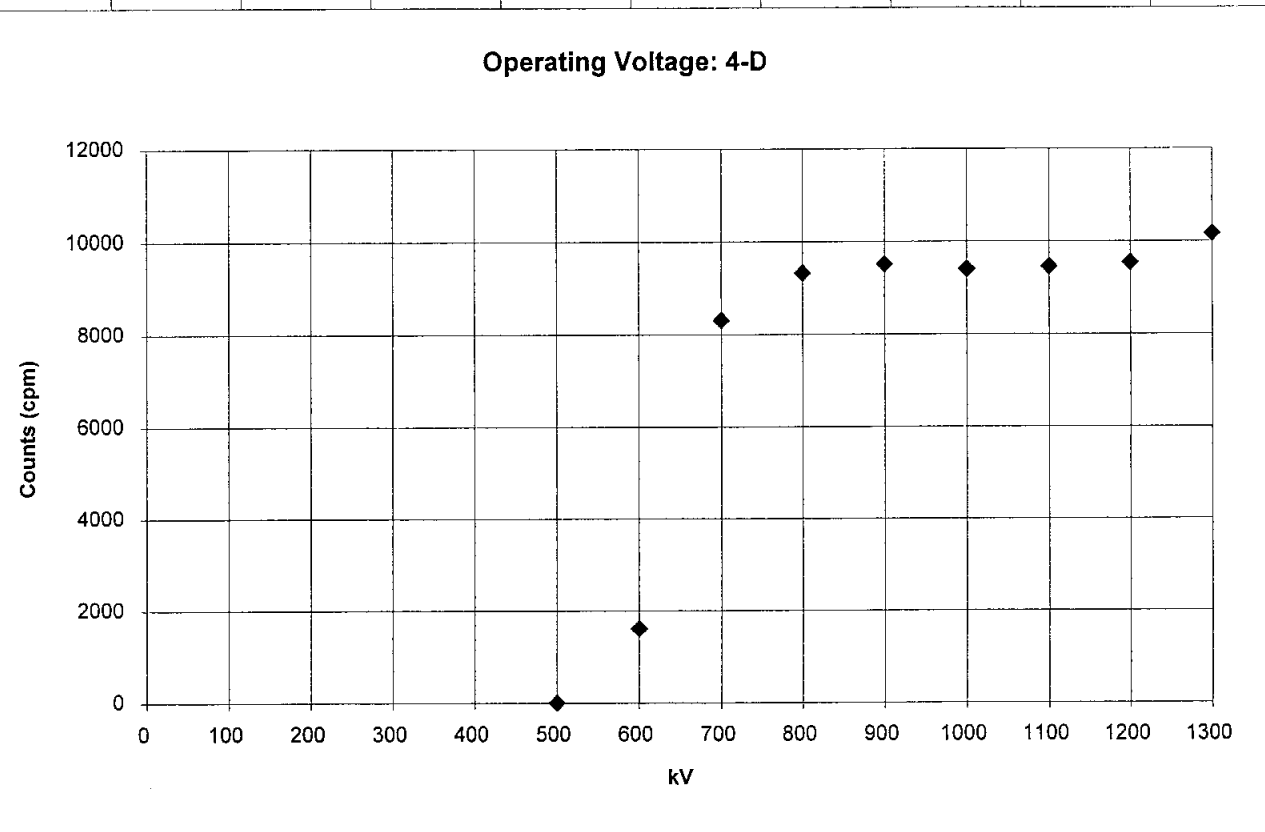
kV	COUNTS (average of 5)
900	0
1000	0
1100	0.4

In the analyst's judgement, it is appropriate to choose an operating voltage on the plateau that also gives the lowest possible background counts. Therefore, it is the analysts' opinion that the operating voltage for this scalar/detector combination be set at 1000 kV.

000189

kV	COUNTS
500	0
600	1607
700	8311
800	9320
900	9504
1000	9400
1100	9460
1200	9544
1300	10165

Voltage	Slope
600	41.555
700	38.565
800	5.965
900	0.4
1000	0.22
1100	0.72
1200	3.525
1300	7.95333
1400	7.81923



Background Efficiency

kV	COUNTS (average of 5)
900	0
1000	1.2
1100	11.8

In the analyst's judgement, it is appropriate to choose an operating voltage on the plateau that also gives the lowest possible background counts. Therefore, it is the analysts' opinion that the operating voltage for this scalar/detector combination be set at 900 kV.

000190

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION
TEST 226Ra
METHOD 9031
SOP/REV (PREP) 783R5
SOP/REV (ANAL) —

271033

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.

02/03/04

THE OPERATING VOLTAGE FOR SCALAR/DETECTOR COMBINATIONS WAS DETERMINED AS FOLLOWS:

1. ADJUST THE VOLTAGE OF THE SCALAR TO A LOW VOLTAGE (500V).
2. COUNT THE 18,000 dpm ^{230}Th SOURCE FOR 1 MINUTE AND RECORD THE COUNTS IN THE EMANATION MAINTENANCE LOG.
3. ADJUST THE VOLTAGE OF THE SCALAR BY 100V AND REPEAT STEP 2.
4. CONTINUE THIS PROCESS UNTIL THE GROSS COUNTS ARE CLEARLY OUT OF RANGE (>10,000, USUALLY ABOUT 1500V). 02/03/04
5. PLOT THE VOLTAGE AGAINST THE GROSS COUNTS ON A SCATTER PLOT. 02/03/04
6. REPEAT THE PROCESS DESCRIBED IN STEP 2 WITH NOTHING IN THE DETECTOR FOR OPERATING VOLTAGES ON THE PLATEAU TO DETERMINE DETECTOR BACKGROUND AT DIFFERENT OPERATING VOLTAGES. RECORD THE COUNTS IN THE EMANATION MAINTENANCE LOG.
7. CHOOSE AN OPERATING VOLTAGE ON THE PLATEAU THAT GIVES THE LOWEST POSSIBLE BACKGROUND COUNTS (PREFERABLY 0).

02/03/04

02/03/04

TECHNICIAN/ANALYST _____ DATE 02/03/04

DEPARTMENT MANAGER _____ DATE 2/3/04

VOLTAGE PLATEAUS FOR COUNTERS 6C + 4D.
Th. SOURCE COUNTED FOR 1MIN. AT EACH VOLTAGE.

VOLT. (KV)	6C	4D
0.5	Ø	Ø
0.6	37	1607
0.7	5287	8311
0.8	9017	9320
0.9	9159	9504
1.0	9431	9400
1.1	9411	9460
1.2	9437	9544
1.3	11022	10165
~~1.4~~		

01/23/04

BACKGROUND ~~ENERGIES~~ COUNTS 01/23/04 (NO SOURCE COUNTED) AT PLATEAU ENERGIES FOR COUNTERS 6C + 4D. 1MIN. COUNTS

VOLT (KV)	6C					4D				
~~0.8~~ 01/23/04	1	2	3	4	5	1	2	3	4	5
0.9	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø
1.0	Ø	Ø	Ø	Ø	Ø	1	3	Ø	2	Ø
1.1	Ø	1	Ø	1	Ø	10	12	12	12	13

01/23/04

Continued on Page

Read and Understood By

Signed 01/23/04 Date Signed 1/26/04 Date

Efficiency Data

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION
TEST 226 Ra
METHOD 903.1
SOP/REV (PREP) 783R5
SOP/REV (ANAL)

271013

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.

01/19/04

♦ DUE TO RECENT LCS FAILURES A SERIES OF TRIALS WERE PERFORMED. IT WAS DETERMINED FROM THESE TRIALS AND A REVIEW OF CALIBRATION DATA THAT THE CALIBRATION SOURCES USED HAS POSSIBLY LOST ACTIVITY, RESULTING IN A LOWER EFFICIENCY FOR THE CELLS. A NEW SET OF CALIBRATION SOURCES WAS PREPARED AND USED TO RECALIBRATE THE DETECTOR/CELL COMBINATIONS.

01/19/04

01/19/04

♦ EFFICIENCY CONTROL LIMITS WERE REDUCED FROM 80-120% TO 90-110%. THE EFFICIENCIES OBTAINED FOR THIS CALIBRATION WILL BE USED AS THE BASE FOR CONTROL LIMIT CALCULATIONS, PER THE RADIOCHEMISTRY DEPARTMENT SUPERVISOR.

01/19/04

01/19/04

TECHNICIAN/ANALYST _____ DATE 01/19/04

DEPARTMENT MANAGER _____ DATE 1/19/04

FORM 302r5.FRM (04/30/01)

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION

TEST ^{226}Ra

271011

METHOD 903.1

SOP/REV (PREP) 783 R5

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.

01/19/04

CALIBRATION SOURCES WERE PREPARED IN THE FOLLOWING MANNER:

1. 23 mL OF EDTA WAS ADDED TO EACH VOA VIAL.
2. EACH VIAL WAS SPIKED WITH 2 mL OF THE CALIBRATION SOURCE (460.1572.47)
3. THE VIALS WERE PURGED WITH He AND ALLOWED TO INGROW FOR AT LEAST 7 DAYS.

01/19/04

01/19/04

INDEPENDENT CALIBRATION VERIFICATION (ICV) SOURCES WERE PREPARED IN THE MANNER STATED ABOVE, USING THE ^{226}Ra SPIKING SOURCE TO SPIKE THE VIALS.

01/19/04

01/19/04

TECHNICIAN/ANALYST DATE 01/19/04

DEPARTMENT MANAGER DATE 1/19/04

FORM 302r5.FRM (04/30/01)

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION

TEST ^{226}Ra

265504

METHOD 903.1

SOP/REV (PREP) 783 R5

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.

11/12/03

BACKGROUND COUNTS FOR SOME CELL-DETECTOR COMBINATIONS WERE COUNTED FOR LESS THAN THE SAMPLE COUNT TIME AND EXTRAPOLATED TO THE LONGER COUNT TIME (SEE CALCULATION BELOW). SINCE >10000 COUNTS ARE OBTAINED FOR EACH SAMPLE, THE ERROR ASSOCIATED WITH CORRECTING THE BACKGROUND COUNTS TO THE SAMPLE COUNT TIME IS NOT SIGNIFICANT. THE CORRECTED DATA IS THEREFORE SUBMITTED WITHOUT QUALIFICATION.

11/12/03

11/12/03

BACKGROUND COUNT CORRECTION:

$$\frac{\text{BKG COUNTS}}{\text{BKG COUNT TIME}} = \frac{\text{CORRECTED BKG}}{\text{SAMPLE COUNT TIME}}$$

11/12/03

11/12/03

TECHNICIAN/ANALYST _____ DATE 11/12/03

DEPARTMENT MANAGER _____ DATE 11/12/03

FORM 302r5.FRM (04/30/01)

Paragon Analytics, Inc.

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH CALIBRATION
TEST 226Ra
METHOD 903.1
SOP/REV (PREP) 783R5
SOP/REV (ANAL)

271031

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.

During calibration, cell 31 was found to be leaking. The cell was repaired and a new calibration source was used to obtain the calibration efficiency for that cell.

02/02/04

TECHNICIAN/ANALYST _____ DATE 02/02/04

DEPARTMENT MANAGER Nicholas Tsib DATE 2/2/04

FORM 302r5.FRM (04/30/01)

Lucas Cell + PMT Calibration Control Summary
r:\inst\alphscnt\cell_cal.xls
*Control limits established 01/26/04-01/30/04

Det+Flask ID Date	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29	C30	C31
Initial calibration	2.6521	2.2539	2.0801	2.4859	2.5317	2.4733	2.3482	2.0557	2.4736	2.3230	2.3544	1.9769
UCL	2.9173	2.4793	2.2881	2.7345	2.7848	2.7207	2.5831	2.2613	2.7210	2.5553	2.5899	2.1746
LCL	2.3869	2.0285	1.8721	2.2373	2.2785	2.2260	2.1134	1.8502	2.2263	2.0907	2.1190	1.7792

CW 2/4/04
Reviewed By Date

000193

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

Calibration results

Analyst:	af					
Prep. Date S:	12/31/03		Count Date:	01/26/04-01/30/04		
Prep. Date C:	12/31/03					
SOP Used:	783R5					
	S	Flask	Counter	Scaler	Ra-226	
W.O.#	ID	No.	No.	No.	Standard (dpm)	Efficiency
324022	S15	20	6	C	239	2.6521
324022	S16	21	6	C	239	2.2539
324022	S17	22	6	C	239	2.0801
324022	S18	23	6	C	239	2.4859
324022	S19	24	6	C	239	2.5317
324022	S20	25	6	C	239	2.4733
324022	S21	26	6	C	239	2.3482
324022	S22	27	6	C	239	2.0557
324022	S23	28	6	C	239	2.4736
324022	S24	29	6	C	239	2.3230
324022	S1	30	6	C	239	2.3544
324022	S3	31	6	C	239	1.9769

000193

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

Analyst: AF
Prep. Date S: #####
Prep. Date C: 12/31/03
SOP Used: 783R5

		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.)	#	
03-24-022	S1	1	1/14/04	9:57	30	6	C	5	5	1/29/04	10:53	1/29/04	15:46	30	15195	
03-24-022	S3	1	12/31/03	9:15	31	6	C	40	80	1/30/04	10:52	1/30/04	15:06	30	13736	
03-24-022	S15	1	12/31/03	9:15	20	6	C	4	8	1/26/04	10:32	1/26/04	14:37	30	18264	
03-24-022	S16	1	12/31/03	9:15	21	6	C	8	16	1/26/04	10:32	1/26/04	15:15	30	15457	
03-24-022	S17	1	12/31/03	9:15	22	6	C	8	16	1/26/04	11:16	1/26/04	15:49	30	14285	
03-24-022	S18	1	12/31/03	9:15	23	6	C	3	6	1/26/04	11:16	1/26/04	16:21	30	16990	
03-24-022	S19	1	12/31/03	9:15	24	6	C	3	6	1/27/04	10:39	1/27/04	14:40	30	17468	
03-24-022	S20	1	12/31/03	9:15	25	6	C	0	0	1/27/04	10:39	1/27/04	15:12	30	16991	
03-24-022	S21	1	12/31/03	9:15	26	6	C	1	2	1/27/04	11:27	1/27/04	15:43	30	16169	
03-24-022	S22	1	12/31/03	9:15	27	6	C	3	6	1/27/04	11:27	1/27/04	16:14	30	14104	
03-24-022	S23	1	12/31/03	9:15	28	6	C	2	4	1/29/04	10:24	1/29/04	14:33	30	17087	
03-24-022	S24	1	12/31/03	9:15	29	6	C	5	10	1/29/04	10:24	1/29/04	15:08	30	15982	

SEE QASS#

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47	Ra 226	2.0	rs011

Spiked by: AF 12/31/03
Spike Witness: JRK 12/31/03
Reviewed by: [illegible] 2/4/04

000200

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

Analyst: AF
Prep. Date S: #####
Prep. Date C: 12/31/03
SOP Used: 783R5

		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.)	#	
03-24-022	S1	1	1/14/04	9:57	30	6	C	5	0	01/29/04	10:53	01/29/04	15:46	30	15195	
03-24-022	S2	1	1/14/04	9:57	31	6	C	5	0	↓	↓	↓	16:18		9990	
03-24-022	S15	1	12/31/03	9:15	20	6	C	4	0	01/26/04	10:32	01/26/04	14:37		18264	
03-24-022	S16	1	12/31/03	9:15	21	6	C	8	0		↓		15:15		15457	
03-24-022	S17	1	12/31/03	9:15	22	6	C	8	0		11:16		15:49		14285	
03-24-022	S18	1	12/31/03	9:15	23	6	C	3	0	↓	↓	↓	16:21		16990	
03-24-022	S19	1	12/31/03	9:15	24	6	C	3	0	01/27/04	10:35	01/27/04	1440		17468	
03-24-022	S20	1	12/31/03	9:15	25	6	C	4	01/27/04		↓		1512 01/27/04		16991	
03-24-022	S21	1	12/31/03	9:15	26	6	C	3 1	0		11.27		1543		16169	
03-24-022	S22	1	12/31/03	9:15	27	6	C	3	0	↓	↓	↓	1614		14104	
03-24-022	S23	1	12/31/03	9:15	28	6	C	2	0	01/29/04	10:24	01/29/04	1433		17087	
03-24-022	S24	1	12/31/03	9:15	29	6	C	5	0	↓	↓	↓	15:08	↓	15982	

SEE QASS#

~~01/14/04 10:34 30 31~~ 5 01/29/04 40

01/30/04 10:52 01/30/04 15:06 30 13736

Std./Ba Carrier ID	Std./ Carrier Type	Spike Vol. (ml)	31 pipet No.
460.1572.47	Ra 226	2.0	rs011

Spiked by: AF 12/31/03
Spike Witness: JRK 12/31/03
Reviewed by: _____

000201

Lucas Cell + PMT Calibration Control Summary
r:\inst\alphscnt\cell_cal.xls
*Control limits established 01/26/04-01/30/04

Det+Flask ID																														
Date	D20		D21		D22		D23		D24		D25		D26		D27		D28		D29		D30		D31	
Initial calibration	2.5943		2.2659		2.0210		2.4785		2.5608		2.5092		2.3472		2.0354		2.5180		2.3944		2.3409		1.9421	
UCL	2.8537		2.4925		2.2231		2.7263		2.8169		2.7601		2.5819		2.2389		2.7698		2.6339		2.5750		2.1363	
LCL	2.3349		2.0393		1.8189		2.2306		2.3047		2.2583		2.1125		1.8318		2.2662		2.1550		2.1068		1.7479	

CW 2/4/04
Reviewed By Date

000202

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

Calibration results

Analyst:	af					
Prep. Date S:	12/31/03	Count Date:	01/26/04-01/30/04			
Prep. Date C:	12/31/03					
SOP Used:	783R5					
	S	Flask	Counter	Scaler	Ra-226	
W.O.#	ID	No.	No.	No.	Standard (dpm)	Efficiency
324022	S15	20	4	D	239	2.5943
324022	S16	21	4	D	239	2.2659
324022	S17	22	4	D	239	2.0210
324022	S18	23	4	D	239	2.4785
324022	S19	24	4	D	239	2.5608
324022	S20	25	4	D	239	2.5092
324022	S21	26	4	D	239	2.3472
324022	S22	27	4	D	239	2.0354
324022	S23	28	4	D	239	2.5180
324022	S24	29	4	D	239	2.3944
324022	S1	30	4	D	239	2.3409
324022	S3	31	4	D	239	1.9421

000203

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

Analyst: AF
Prep. Date S: #####
Prep. Date C: 12/31/03
SOP Used: 783R5

		S	Purge (end)							Deeman. (end)		Count Start		Count		REMARKS
	S	V	Date	Time	Flask	Counter	Scaler	CBKG	CBKG	Date	Time	Date	Time	Duration	COUNT	
W.O.#	ID	(L)	D1	T1	No.	No.	No.	#	(CORR.)	D2	T2	D3	T3	(min.)	#	
03-24-022	S1	1	1/14/04	9:57	30	4	D	7	7	1/29/04	10:53	1/29/04	16:18	30	15049	
03-24-022	S3	1	12/31/03	9:15	31	4	D	49	98	1/30/04	10:52	1/30/04	16:01	30	13421	
03-24-022	S15	1	12/31/03	9:15	20	4	D	1	2	1/26/04	10:32	1/26/04	15:15	30	17775	
03-24-022	S16	1	12/31/03	9:15	21	4	D	4	8	1/26/04	10:32	1/26/04	14:37	30	15606	
03-24-022	S17	1	12/31/03	9:15	22	4	D	10	20	1/26/04	11:16	1/26/04	16:21	30	13828	
03-24-022	S18	1	12/31/03	9:15	23	4	D	3	6	1/26/04	11:16	1/26/04	15:49	30	17008	
03-24-022	S19	1	12/31/03	9:15	24	4	D	4	8	1/27/04	10:39	1/27/04	15:12	30	17600	
03-24-022	S20	1	12/31/03	9:15	25	4	D	0	0	1/27/04	10:39	1/27/04	14:40	30	17307	
03-24-022	S21	1	12/31/03	9:15	26	4	D	5	10	1/27/04	11:27	1/27/04	16:14	30	16107	
03-24-022	S22	1	12/31/03	9:15	27	4	D	4	8	1/27/04	11:27	1/27/04	15:43	30	14021	
03-24-022	S23	1	12/31/03	9:15	28	4	D	7	14	1/29/04	10:24	1/29/04	15:08	30	17327	
03-24-022	S24	1	12/31/03	9:15	29	4	D	5	10	1/29/04	10:24	1/29/04	14:33	30	16546	

SEE QASS#

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47	Ra 226	2.0	rs011

Spiked by: AF 12/31/03
Spike Witness: JRK 12/31/03
Reviewed by: [illegible] 2/3/04

000204

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

Analyst: AF
Prep. Date S: #####
Prep. Date C: 12/31/03
SOP Used: 783R5

		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.)	#	
03-24-022	S1	1	1/14/04	9:57	30	4	D	7	0	01/29/04	10:53	01/29/04	16:18	30	15049	
03-24-022	S2	1	1/14/04	9:57	31	4	D	8	0	↓	↓	↓	15:46		9990	
03-24-022	S15	1	12/31/03	9:15	20	4	D	1	0	01/26/04	10:32	01/26/04	15:15		17775	
03-24-022	S16	1	12/31/03	9:15	21	4	D	4	0	01/26/04	↓	01/26/04	14:37		15656	
03-24-022	S17	1	12/31/03	9:15	22	4	D	10	0	↓	11:16	↓	16:21		13828	
03-24-022	S18	1	12/31/03	9:15	23	4	D	32	0	↓	↓	↓	15:49		17008	
03-24-022	S19	1	12/31/03	9:15	24	4	D	24	0	01/27/04	10:39	01/27/04	~~1318~~ 1440		17600	
03-24-022	S20	1	12/31/03	9:15	25	4	D	0	0	↓	↓	↓	1440		17307	
03-24-022	S21	1	12/31/03	9:15	26	4	D	5	0	↓	11:27	↓	1614		16107	
03-24-022	S22	1	12/31/03	9:15	27	4	D	4	0	↓	↓	↓	1543		14021	
03-24-022	S23	1	12/31/03	9:15	28	4	D	7	0	01/29/04	10:24	01/29/04	15:08		17327	
03-24-022	S24	1	12/31/03	9:15	29	4	D	145	0	↓	↓	↓	1433		16546	

SEE QASS#

30
31
8
01/29/04

Std./Ba Carrier ID	'Std./ 'Carrier Type	Spike Vol. (ml)	pipet No.
460.1572.47	Ra 226	2.0	rs011

Spiked by: AF 12/31/03
Spike Witness: JRK 12/31/03
Reviewed by: _____

01/14/04 10:34/31 49 01/30/04 10:52 01/30/04 ~~15:06~~ 30 13421
16:01
01/30/04

000205

01/16/04
CELL 10 FOUND TO BE LEAKING - REPAIRED WITH SUPER GLUE 01/16/04

01/20/04
CELL 10 FOUND TO BE LEAKING FROM ANOTHER SPOT - REPAIRED WITH SUPER GLUE. 01/20/04

01/14/04 - 01/22/04
DETECTORS A & B RECALIBRATED USING NEW SOURCES - OLD SOURCES MAY BE BAD. 01/22/04

01/26/04 - 01/30/04
- DETECTORS C & D RECALIBRATED USING NEW SOURCES - OLD SOURCES MAY BE BAD
- DURING CALIBRATION, CELL 31 FOUND TO BE LEAKING - REPAIRED WITH SUPER GLUE 02/02/04
- SCALAR 5 DISPLAY NOT WORKING, REPLACED WITH SCALAR 6 02/04/04

02/04/04

Continued on Page

Read and Understood By

Signed 02/04/04 Date

Signed 2/4/04 Date

Logbook No./Page 248231

Paragon Analytics, Inc.

Sample 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.
CALIB. SOURCE	1A	NA							01/22/04	16:07	9403	1	
	2B									16:08	9475		
	5C									16:09	9470		
	4D									16:10	9462		
	1A								01/26/04	09:25	9420		
	2B									09:26	9458		
	01/26/04 ~~5C~~ 6C									09:28	9344		
	4D									09:29	9371		
0324022.S14S15	6C	20	NA	01/26/04	09:31	4	15			14:37	18264	30	
.S15S16	4D	21				4					15606		
.S15S16	6C	21			09:48	8				15:15	15457		
.S14S15	4D	20				1					17775		
.S16S17	6C	22			10:08	8				15:49	14285		
.S17S18	4D	23				3					17008		
.S17S18	6C	23			10:25	3				16:21	16990		
.S16S17	4D	22				10					13828		
CALIB. SOURCE	1A	NA							01/27/04	09:20	9383	1	
	2B									09:21	9355		
	01/27/04 ~~5C~~ 6C									09:22	9340		
	4D									09:23	9354		
0324022.S19	6C	24		01/27/04	09:27	3	15			14:40	17468	30	CW
.S20	4D	25				0					17307		CW
.S20	6C	25			09:44	0				15:12	16991		CW

Comments:

Reviewed by/date: CW 1/27/04

Form 795r2.xls (9/23/2002)

000207

Logbook No./Page 248232

Paragon Analytics, Inc.

Sample 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.
0324022·S19	4D	24	NA	01/27/04	08:44	4	15		01/27/04	1512	17600	30	CW
·S20 S21	6C	26			10:00	1				1543	16169		CW
·S21 S22	4D	27				4					14021		CW
·S21 S22	6C	27			10:24	3				1614	14104		CW
·S20 S21	4D	26				5					16107		CW
Calib Source	1A	NA							1/27/04	1641	9367	1	CW
	2B									1642	9541		CW
	6C									1645	9564		CW
	4D									1646	9439		CW
Calib Source	1A	NA							1/28/04	0733	9525	1	CW
	2B									0734	9444		CW
	6C									0735	9548		CW
	4D									0736	9392		CW
Calib Source	1A	NA							1/29/04	0754	9573	1	CW
	2B									0755	9567		CW
	6C									0756	9508		CW
	4D									0757	9312		CW
0324022·S22 S23	6C	28		01/29/04	08:00	2	30			14:33	17087	30	
·S23 S24	4D	29				5					16546		
·S23 S24	6C	29			08:31	5				15:08	15982		
·S23	4D	28				7					17327		
·S1	6C	30			09:04	5				15:46	15195		
·S2	4D	31				8					9990		

1/28/04

Comments:

Form 795r2.xls (9/23/2002)

Reviewed by/date: 02/02/04

000208

Logbook No./Page 248233

Paragon Analytics, Inc.

Sample 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.
0324022.S2	6C	31	NA	01/29/04	09:35	5	30		01/29/04	16:18	9772	30	
↓ .S1	4D	30	↓	↓	↓	7	↓			↓	15049		
0401150.1	1A	3	1		08:00	40				14:37	52		
↓ .1Dup	2B	4			↓	23				↓	24		
↓ .2	1A	6			08:31	62				15:09	247		
RE040122.2.MB	2B	7			↓	27				↓	37		
↓ .LCS	1A	8	↓	↓	09:04	38	↓		↓	15:46	4610	↓	
CALIB SOURCE	1A	NA								16:50	9346	1	
	2B									16:51	9489		
	6C									16:52	9631		
	4D									16:53	9481		
	1A								01/30/04	09:43	9504		
	2B									09:44	9554		
	6C									09:45	9454		
	4D									09:46	9314		
0324022.S3	6C	31	NA	01/30/04	09:54	40	15			15:06	13736	30	
↓	4D	↓	↓	↓	10:12	49	↓			16:01	1342	↓	
CALIB. SOURCE	1A	NA								16:44	9382	1	
	2B									16:45	9401		
	6C									16:46	9490		
	4D									16:47	9429		
	1A								02/02/04	09:06	9470		
	2B									09:07	9408		

Comments:

Reviewed by/date: 02/02/04

Form 795r2.xls (9/23/2002)

PROJECT Ra 226 working standard

Continued From Page

JMM 1-28-99 ~~461~~ 460 1572.47

Take primary standard ~~461~~ 460 1572.45 and dilute JMM 1-28-99

using 0.5 N HCl JMM 1-28-99

Balance 12 used

VOA initial: 65.8813 g
VOA final: 48.5167 g
amt transferred: 17.3646 g (Ra 226 primary standard)

bottle: ~~71.008~~ g JMM 1-28-99 Balance 12 used
55.7098 g (w/ Ra 226 primary standard)
Ra 226 1° std: 17.3646 g
38.3452 g (wt of empty bottle)

density of 0.5 N HCl Balance 12 used

empty vol. flask: 36.5852 g
50 mL final: 86.7189 g
50.1337 g

density = 1.00027 g/mL

Balance 21 used

final bottle: 516.29 g − 38.3452 g (empty bottle) = 477.9448 g solution

activity = 17.3646 g · 1486 pCi/g = 25,803.7956 pCi

$$\frac{25{,}803.7956 \text{ pCi}}{\cancel{516.29}\ 477.9448 \text{ g}} = 53.99 \text{ pCi/g}$$

JMM 1-28-99

$$53.99 \text{ pCi/g} \times 1.0027 \text{ g/mL} = 54.136 \text{ pCi/mL}$$

Stnd ID: 460.1572.47

Description: Ra-226 Working Solution
Activity: 54.136 pCi/mL
Uncertainty: 2.977 pCi/mL
Ref. Date: 1/1/93
Ref Time: na
Prep Date 6/8/99 Prep by: JMM
Expiration 6/7/04
Matrix/Comp. 0.5 N HCl
Half Life (y): 1.60E+03

DCB 12/3/99

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
J. Mansell	6/8/99	Daniel C. Burn	12/3/99

1/28/98 Open ampule sol#2557-4 (RSO#460), transfer to 40 ml VOA vial + dilute w/ 0.5 N HCL.

Diluent = 0.5 N HCl

Balance 12 used

VOA start: 26.5345 g (empty)
- VOA final: 65.8813 g (final, Ra 226 + 0.5 HCl)

Δ transferred: 39.3468 g

Balance 12 used

initial ampule + beaker: 38.0054 g
empty ampule + beaker: 33.0913 g
4.9141 g Ra-226 mass added to VOA

11,900 pCi/g
× 4.9141
58,477.79 pCi
÷ 39.35
1486 pCi/g final activity conc.
as of 1/93
$t_{1/2}$ = 1600 y
total unc = ± 5.5%

Standard verification balance 21 GEOMETRY 10
Homer jar tare: 61.03 g
total wt: 181.33 g
181.33 - 61.03 g =
120.30 g solution

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
[signature]	1/28/99	[signature]	2/3/99

Parsons ID 460
Rec'd 8-25-97

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide: Radium-226 Half-life: 1600 years

Nominal activity: 60 nano curies

Nominal volume: 5 ml in ampoule/bottle number: 2557-4

Measurement Activity of principal radionuclide

Activity per gram of this solution

11.9 nano curies of Radium-226

at 0400 hours PST on January 1993

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

curies Per gram

of the daughter nuclide

Total mass of this solution

Approximately 5.0 grams

Method of measurement

This standard was prepared by gravimetric dilution of NBS Standard Reference Material 4964-B. The specific activity of the dilution was determined by gamma spectrometry by comparing the sum of the activities of the 242, 352 and 609 KeV gamma ray emissions to those of several NBS SRM 4957 Radium-226 sources.

Useful Life

This radionuclide has decayed through half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after Indefinite

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1)	less than equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than ± 0.6 %

(The 99.7% confidence limits are given by t(sm) where t is obtained from the student t factor for the degree of freedom (n-1)).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error ($+\delta - \delta'$). These have been estimated not to exceed

+ 3.7 % or - 3.7 %

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error [t(sm)] at the 99.7% confidence limits and the worst case estimate of the systematic errors ($+\delta, -\delta'$)
The overall uncertainty is therefore calculated on the basis of + [t(sm) $+\delta$], - [t(sm) $+\delta'$]
and is + 5.5 %, - 5.5 % of the quoted radioactive concentration.

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

Radium-226 is a member of the Uranium-238 decay chain. Radium-226 decays 100 percent by alpha emission to Radon-222.

Chemical Composition of Solution

Carrier content per gram of solution:	Other components:
0.8 micrograms Ba	0.5M HCl

Preservative:

Remarks

The measured value and the expected value using the gravimetric factors and the NBS calibration of SRM-4964B differed by 1.6 percent. The average of the two values was used for this standard.

Date Certificate Prepared January 21, 1993

Approval Signature Paul B. Hahn

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide	Radium-226
Source identification	2557-4, prepared by EMSL
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.0 grams
Source composition	Radium-226 plus 0.8 μg of non-radioactive barium per gram of 0.5 $mol \cdot L^{-1}$ HCl
Reference time	0700 EST January 1, 1993

	NIST DATA	EMSL DATA
Radioactivity concentration	447.5 $Bq \cdot g^{-1}$	440.3 $Bq \cdot g^{-1}$
Expanded uncertainty	2.5 percent (1)*	±5.5 percent (2)
Photon-emitting impurities (Activities at reference time)	None observed (3)	None reported
Measuring instrument	NIST pressurized "4π"γ ionization chamber A calibrated with SRM 4955	Dilution of SRM 4964-B verified using germanium spectrometer system
Half life	1600 ± 7 years (4)	
Difference from NIST		-1.61 percent (5)

For the Director,

J.M. Robin Hutchinson, Group Leader
Radioactivity Group
Physics Laboratory

Gaithersburg, MD 20899
September 1994

*Notes on next page

(over)

NOTES

(1) The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1297* (1993)].

(2) The combined standard uncertainty, u_c = 1.24 percent, is the quadratic combination of the standard deviation (or standard deviation of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a)	100 ionization chamber measurements on each of 2 samples	0.31 percent
b)	activity of SRM 4955-55	1.21 percent
c)	gravimetric	0.05 percent
d)	half-life propagation (Δt = 25 y)	0.005 percent

The expanded uncertainty, U = 2.5 percent, is obtained by multiplying u_c by a coverage factor of k = 2 and is assumed to provide an uncertainty interval of approximately 95 percent confidence.

(3) Overall uncertainty reported by EMSL.

(4) The limits of detection are:

$12.6\ \gamma\ s^{-1}\ g^{-1}$ between 40 and 348 keV,
$4.75\ \gamma\ s^{-1}\ g^{-1}$ between 356 and 605 keV, and
$1.58\ \gamma\ s^{-1}\ g^{-1}$ between 613 and 1900 keV,

provided that impurity photons are separated in energy by four keV or more from the principle gamma-ray emissions of radium-226 and its daughters.

(5) Evaluated Nuclear Structure Data File (1990).

(6) This result demonstrates the traceability of EMSL to NIST, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NIST interagency agreement of April 1976, as amended.

For further information, please contact Jeffrey T. Cessna at 301-975-5539.

Source identification 2557-4

STANDARD VERIFICATION FORM

Code #: 460.15.72.47 Name of Standard: Ra 226 Working Std.

Date: 12/1/99 Analyst: JASON MODEST

Aliquot for verification: Two 64.6 g Aliquots placed in GEO 11 γ container

Work up: See Attached QASS

Expected activity and uncertainty: 53.99 pCi/g

Results of Counting and counting uncertainty: = 57.5 ± 11.25 (4%)

= 106.5% of expected

Radiochemistry Technical Manager: [signature] Date: 12/3/99

Radiochemistry QA Manager: Date:

ATI FM 718FC
(2/27/95

STD # 460.1 7x.7 1 N-0226

Gamma Spectroscopy Analysis Benchsheet

Spreadsheet Unprotected: NA

Batch ID: 23010gsw.xls
Analyst: AV
Prep. Date: 11-30-99
SOP: 739 R3

Analytical Balance No.: XXXX
Top Load Balance No.: 22

QASS/NCR: Y / N ID # NA
Pretreatment Y / N Batch: NA

	Work Order Number		Client Sample ID	Collection Date	Aliquot Size	Aliquot Units g	Aliquot Basis w	% Moist.	Report Size	Report Units g	Report Basis w	Remarks	Det. No.	Geo. No.	Count Dur	Count Date
1	99-23-010	1	STD.VER	11-30-99	64.63	g	D	N/A	64.6	g	D		1	11	30min	12/1/99
2	99-23-010	2	STD VER	see WO	64.64	g	D	N/A	64.6	g	D	SAME STD!(DUP)	3	11	30min	12/1/99
3		D1	↓						64.6	g	D		3	11	30min	12/1/99
4		D2	↓						64.6	g	D		1	11	30min	12/1/99
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
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17																
18																
19																
20																
21																
22																
23																
24																

Relinquished by: AV
date: 11-30-99

Received by: [signature]
date: 11/30/99

Reviewed by:
Date:

000217

QUALITY ASSURANCE SUMMARY SHEET

PAI W.O. # / BATCH 99-23-010-1, 2
TEST γ
METHOD prep. std. var.
SOP NA (VERBAL INSTRUCTION FROM DCB)

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.

99-23-010-01 and -02 are the same std. of Ra-226 (# 460.1572.47) As per DCB, Geo-11 std geometry was used to make this standard.

AV

TECHNICIAN/ANALYST AV DATE 11/30/99

RESOURCE MANAGER A.M. Wagner DATE 11/30/99.

171621

FORM 302FC3.FRM (10-30-98)

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Std. verification Total Radium
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-01
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:48
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.3	BDL	U
Na-22	< 0.19	BDL	U
K-40	< 2.0	BDL	U
Sc-46	< 0.24	BDL	U
Cr-51	< 1.2	BDL	U
Mn-54	< 0.18	BDL	U
Co-56	< 0.32	BDL	U
Co-57	< 0.10	BDL	U
Co-58	< 0.18	BDL	U
Fe-59	< 0.31	BDL	U
Co-60	< 0.25	BDL	U
Zn-65	< 0.64	BDL	U
Sr-85	< 0.23	BDL	U
Nb-95	< 0.28	BDL	U
Ru-106	< 1.3	BDL	U
Ag-110m	< 0.14	BDL	U
Sb-124	< 0.20	BDL	U
Sb-125	< 0.41	BDL	U
I-131	< 0.18	BDL	U
Cs-134	< 0.24	BDL	U
Cs-137	< 0.18	BDL	U
Ce-139	< 0.12	BDL	U
Ce-144	< 0.77	BDL	U
Eu-152	< 1.1	BDL	U
Eu-154	< 0.53	BDL	U
Eu-155	< 0.47	BDL	U
Tl-208	< 0.18	BDL	U
Bi-212	< 2.0	BDL	U
Pb-212	< 0.24	BDL	U
Bi-214	6.3 ± 1.2	18.9	
Pb-214	7.0 ± 1.3	18.0	
Ra-226	57 ± 11	18.8	

Data stored in file 10007826.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Std. verification Total Radium
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-01
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:48
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 0.88	BDL	U
Ac-228	< 0.63	BDL	U
Pa-234m	< 31	BDL	U
Th-234	< 2.2	BDL	U
U-235	< 0.85	BDL	U
Am-241	< 0.74	BDL	U

Data stored in file 10007826.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra 226 Std. Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D1
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 09:25
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.9	BDL	U
Na-22	< 0.33	BDL	U
K-40	< 2.9	BDL	U
Sc-46	< 0.17	BDL	U
Cr-51	< 1.3	BDL	U
Mn-54	< 0.24	BDL	U
Co-56	< 0.57	BDL	U
Co-57	< 0.11	BDL	U
Co-58	< 0.20	BDL	U
Fe-59	< 0.57	BDL	U
Co-60	< 0.41	BDL	U
Zn-65	< 0.44	BDL	U
Sr-85	< 0.31	BDL	U
Nb-95	< 0.28	BDL	U
Ru-106	< 2.1	BDL	U
Ag-110m	< 0.26	BDL	U
Sb-124	< 0.24	BDL	U
Sb-125	< 0.57	BDL	U
I-131	< 0.18	BDL	U
Cs-134	< 0.26	BDL	U
Cs-137	< 0.30	BDL	U
Ce-139	< 0.12	BDL	U
Ce-144	< 1.0	BDL	U
Eu-152	< 2.3	BDL	U
Eu-154	< 0.92	BDL	U
Eu-155	< 0.63	BDL	U
Tl-208	< 0.27	BDL	U
Bi-212	< 3.0	BDL	U
Pb-212	< 0.32	BDL	U
Bi-214	5.5 ± 1.2	22.5	
Pb-214	5.6 ± 1.1	20.1	
Ra-226	62 ± 12	20.1	

Data stored in file 10007832.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra 226 Std. Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D1
Sample Matrix: Liquid
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 09:25
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 1.2	BDL	U
Ac-228	< 0.94	BDL	U
Pa-234m	< 48	BDL	U
Th-234	< 2.7	BDL	U
U-235	< 0.89	BDL	U
Am-241	< 1.1	BDL	U

Data stored in file 10007832.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Remarks: Sample 99-23-010-D1 is a duplicate of 99-23-010-01.

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Standard Verification Ra226.
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-02
Sample Matrix: LIQUID
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:51
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.4	BDL	U
Na-22	< 0.33	BDL	U
K-40	< 3.8	BDL	U
Sc-46	< 0.24	BDL	U
Cr-51	< 1.5	BDL	U
Mn-54	< 0.27	BDL	U
Co-56	< 0.37	BDL	U
Co-57	< 0.12	BDL	U
Co-58	< 0.31	BDL	U
Fe-59	< 0.52	BDL	U
Co-60	< 0.43	BDL	U
Zn-65	< 0.85	BDL	U
Sr-85	< 0.33	BDL	U
Nb-95	< 0.37	BDL	U
Ru-106	< 2.3	BDL	U
Ag-110m	< 0.18	BDL	U
Sb-124	< 0.29	BDL	U
Sb-125	< 0.53	BDL	U
I-131	< 0.21	BDL	U
Cs-134	< 0.26	BDL	U
Cs-137	< 0.26	BDL	U
Ce-139	< 0.14	BDL	U
Ce-144	< 0.89	BDL	U
Eu-152	< 2.1	BDL	U
Eu-154	< 0.92	BDL	U
Eu-155	< 0.63	BDL	U
Tl-208	< 0.28	BDL	U
Bi-212	< 2.8	BDL	U
Pb-212	< 0.29	BDL	U
Bi-214	6.5 ± 1.4	21.0	
Pb-214	6.7 ± 1.3	19.4	
Ra-226	57 ± 12	20.4	

Data stored in file 10007827.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Standard Verification Ra226.
Client Project Id:
Client Sample ID: #460.1572.47

Lab Sample ID: 99-23-010-02
Sample Matrix: LIQUID
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 08:51
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 1.4	BDL	U
Ac-228	< 1.1	BDL	U
Pa-234m	< 57	BDL	U
Th-234	< 2.6	BDL	U
U-235	< 1.0	BDL	U
Am-241	< 1.1	BDL	U

Data stored in file 10007827.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra226 Std.Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D2 Date Collected: 11/30/99 12:00
Sample Matrix: Date Analyzed: 12/01/99 09:23
Count Duration: 30 Min. Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Be-7	< 1.3	BDL	U
Na-22	< 0.20	BDL	U
K-40	< 2.9	BDL	U
Sc-46	< 0.19	BDL	U
Cr-51	< 1.2	BDL	U
Mn-54	< 0.17	BDL	U
Co-56	< 0.32	BDL	U
Co-57	< 0.092	BDL	U
Co-58	< 0.16	BDL	U
Fe-59	< 0.43	BDL	U
Co-60	< 0.21	BDL	U
Zn-65	< 0.61	BDL	U
Sr-85	< 0.24	BDL	U
Nb-95	< 0.26	BDL	U
Ru-106	< 1.7	BDL	U
Ag-110m	< 0.15	BDL	U
Sb-124	< 0.23	BDL	U
Sb-125	< 0.49	BDL	U
I-131	< 0.17	BDL	U
Cs-134	< 0.24	BDL	U
Cs-137	< 0.21	BDL	U
Ce-139	< 0.11	BDL	U
Ce-144	< 0.84	BDL	U
Eu-152	< 1.3	BDL	U
Eu-154	< 0.56	BDL	U
Eu-155	< 0.48	BDL	U
Tl-208	< 0.22	BDL	U
Bi-212	< 2.3	BDL	U
Pb-212	< 0.25	BDL	U
Bi-214	7.4 ± 1.4	18.5	
Pb-214	7.0 ± 1.3	18.0	
Ra-226	54 ± 10	19.2	

Data stored in file 10007831.SPC

Continued on next page...

Paragon Analytics, Inc.

GAMMA SPECTROMETRY RESULTS SUMMARY

Method 901.1 (Modified)

Client Name: Ra226 Std.Verification
Client Project Id:
Client Sample ID: Duplicate

Lab Sample ID: 99-23-010-D2
Sample Matrix:
Count Duration: 30 Min.

Date Collected: 11/30/99 12:00
Date Analyzed: 12/01/99 09:23
Aliquot: 64.600

Nuclide	Activity (pCi/Gram)	% Uncertainty	Flag
Th-227	< 0.84	BDL	U
Ac-228	< 0.60	BDL	U
Pa-234m	< 37	BDL	U
Th-234	< 2.6	BDL	U
U-235	< 0.82	BDL	U
Am-241	< 0.73	BDL	U

Data stored in file 10007831.SPC

Reported Uncertainties are the Estimated Total Propagated Uncertainty (2σ). See PAI SOP 743 for details of the TPU determination.

BDL = Below Detection Limit; see method for DL determination

Flags:
U = Result is less than the sample specific minimum detectable activity.

Remarks: Sample 99-23-010-D2 is a duplicate of 99-23-010-02.

GDR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

Sample ID : 99-23-010-02 B:STD.ACT.VERIFIC.

Sample Size . . . . 1.00e+000 Sample	Spectrum File GDR03.SPC
Sampling Start. 11-30-99 12:00	Counting Start. 12-01-99 08:51
Sampling Stop 11-30-99 12:00	Live Time . . . . . 1800 Sec
Current Date. 12-01-99 08:16	Real Time . . . . . 1806 Sec

Detector #: 3

Energy(keV)= -0.52 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

FWHM(keV) = 0.80 + 0.011*En + 6.71e-004*En^2 + 0.00e+000*En^3 11-08-99 11:57
Where En = Sqrt(Energy in keV)

Sensitivity 0.20	Search Start / End. . . . . 30 / 4000
Sigma Multiplier. 2.00	

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.77	150.34	46	38	33	129	1.05 a	
2	77.17	155.13	116	39	28	115	0.96 b	
3	86.89	174.53	22	36	32	125	0.48	NET < CL
4	186.13	372.68	443	52	27	89	1.16	
5	238.37	477.00	14	17	13	31	0.66 a	
6	241.98	484.20	126	31	19	47	1.15 b	
7	295.18	590.44	203	37	22	52	1.33	
8	351.81	703.50	357	43	19	40	1.23	
9	379.29	758.37	18	17	14	22	1.28	
10	486.19	971.82	10	16	14	18	0.85	NET < CL
11	511.04	1021.44	39	21	16	27	2.52	
12	609.27	1217.58	272	37	15	21	1.61	
13	768.42	1535.36	28	17	13	16	1.36	
14	934.00	1865.98	13	14	11	13	1.06	
15	989.85	1977.50	5	13	11	11	1.11	NET < CL
16	1120.22	2237.82	46	18	11	9	1.74	
17	1238.12	2473.24	22	11	6	4	1.88	
18	1315.24	2627.22	5	9	7	4	0.60	NET < CL
19	1400.32	2797.10	10	6	0	0	2.35	
20	1408.58	2813.61	19	9	0	0	2.23	
21	1764.67	3524.62	39	14	5	2	2.06	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

Sample ID : 99-23-010-02 B:STD.ACT.VERIFIC.

Bkg File: . . . . . DET03.bkg | Counting Start. 12-01-99 08:51
ID.: 99-23-006-03 B:11/29/99 WK.BKG | Current Date 12-01-99 08:16

PK#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
4	186.13	1.16	443	52	431	52	
5	238.37	0.66	14	17	11	18	NET < CL
8	351.81	1.23	357	43	347	43	
11	511.04	2.52	39	21	-7	22	NET < CL
12	609.27	1.61	272	37	265	37	
21	1764.67	2.06	39	14	37	14	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

Sample ID: 99-23-010-02 B:STD.ACT.VERIFIC.

Sample Size . . . . 1.00e+000 Sample	Spectrum File GDR03.SPC
Sampling Start. 11-30-99 12:00	Counting Start. 12-01-99 08:51
Sampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
Current Date. 12-01-99 08:16	Decay Time. . . . . 2.09e+001 Hrs
Efficiency File. DET0311.EFF	Library File. FANPR6.LIB
ID. GEO11 534	IDFiss. Act. and Nat. Library RTS 02/17

Eff.= 1/[2.28e-003*En^-3.58e+000 + 7.58e+001*En^8.58e-001] 08-25-99 14:19

Gamma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
Library Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	8.24e+003 +-9.94e+002	1.40e+007	1 of 1
Pb-214	Average:	9.58e+002 +-9.87e+001	1.40e+007	2 of 2
	295.21	9.45e+002 +-1.72e+002		
	351.92	9.64e+002 +-1.21e+002		
Bi-214	Average:	9.31e+002 +-1.22e+002	1.40e+007	2 of 2
	609.31	9.46e+002 +-1.31e+002		
	1120.29	8.42e+002 +-3.23e+002		
Am-241	59.54	< 1.60e+002	3.79e+006	MDA
Eu-155	86.55	< 9.01e+001	4.34e+004	MDA
Th-234	92.60	< 3.67e+002	3.91e+013	MDA
Co-57	122.06	< 1.76e+001	6.50e+003	MDA
Ce-144	133.54	< 1.27e+002	6.82e+003	MDA
U-235	143.76	< 1.46e+002	6.17e+012	MDA
Ce-139	165.85	< 2.01e+001	3.30e+003	MDA
Th-227	236.00	< 1.97e+002	1.91e+005	MDA
Pb-212	238.63	< 4.10e+001	1.67e+004	MDA
Cr-51	320.08	< 2.16e+002	6.65e+002	MDA
I-131	364.48	< 3.07e+001	1.93e+002	MDA
Sb-125	427.89	< 7.59e+001	2.43e+004	MDA
Be-7	477.59	< 1.95e+002	1.28e+003	MDA
Sr-85	513.99	< 4.77e+001	1.56e+003	MDA
Tl-208	583.14	< 4.03e+001	1.67e+004	MDA
Sb-124	602.71	< 4.14e+001	1.44e+003	MDA
Cs-134	604.70	< 3.78e+001	1.81e+004	MDA
Ru-106	621.84	< 3.35e+002	8.84e+003	MDA
Ag-110m	657.75	< 2.64e+001	6.00e+003	MDA
Cs-137	661.65	< 3.78e+001	2.64e+005	MDA
Bi-212	727.17	< 4.04e+002	1.67e+004	MDA
Nb-95	765.79	< 5.37e+001	1.54e+003	MDA
Co-58	810.76	< 4.44e+001	1.70e+003	MDA
Mn-54	834.83	< 3.92e+001	7.50e+003	MDA

Sc-46	889.25	< 3.42e+001	2.01e+003	MDA
Ac-228	911.07	< 1.52e+002	5.04e+004	MDA
Pa-234m	1001.03	< 8.11e+003	3.91e+013	MDA
Fe-59	1099.22	< 7.43e+001	1.07e+003	MDA
Zn-65	1115.52	< 1.22e+002	5.87e+003	MDA
Co-60	1173.22	< 6.18e+001	4.62e+004	MDA
Co-56	1238.25	< 5.24e+001	1.89e+003	MDA
Eu-154	1274.45	< 1.32e+002	7.71e+004	MDA
Na-22	1274.54	< 4.71e+001	2.28e+004	MDA
Eu-152	1407.95	< 3.00e+002	1.19e+005	MDA
K-40	1460.81	< 5.44e+002	1.12e+013	MDA

TOTAL: 1.01e+004 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.77	150.34	46	38	33	129	1.05	8.293e-001
77.17	155.13	116	39	28	115	0.96	1.943e+000
241.98	484.20	126	31	19	47	1.15	1.594e+000
379.29	758.37	18	17	14	22	1.28	3.250e-001
768.42	1535.36	28	17	13	16	1.36	9.405e-001
934.00	1865.98	13	14	11	13	1.06	5.188e-001
1238.12	2473.24	22	11	6	4	1.88	1.111e+000
1400.32	2797.10	10	6	0	0	2.35	5.621e-001
1408.58	2813.61	19	9	0	0	2.23	1.073e+000
1764.67	3524.63	37	14	5	2	2.06	2.534e+000

GDR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

Sample ID : 99-23-010-01 B:TOTAL RA.STD.ACT.VER

Sample Size	1.00e+000 Sample	Spectrum File	GDR01.SPC
Sampling Start.	11-30-99 12:00	Counting Start.	12-01-99 08:48
Sampling Stop	11-30-99 12:00	Live Time	1800 Sec
Current Date.	12-01-99 08:12	Real Time	1806 Sec

Detector #: 1

Energy(keV)= -1.41 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

FWHM(keV) = 1.15 + -0.013*En + 1.64e-003*En^2 +-1.10e-005*En^3 11-08-99 09:40
Where En = Sqrt(Energy in keV)

Sensitivity	0.20	Search Start / End.	60 / 4000
Sigma Multiplier.	2.00		

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.76	152.07	105	55	48	229	1.21	a
2	77.01	156.57	216	53	39	210	1.15	b
3	83.49	169.50	18	36	30	142	0.59	a NET < CL
4	87.06	176.62	62	46	38	202	1.08	b
5	186.06	374.27	823	70	36	147	1.31	
6	241.80	485.55	191	46	33	128	1.00	
7	295.10	591.96	411	53	33	106	1.18	
8	323.10	647.86	6	31	28	82	0.32	NET < CL
9	351.73	705.01	788	64	28	81	1.33	
10	511.16	1023.30	117	37	29	76	2.14	
11	609.22	1219.07	580	56	26	70	1.87	
12	768.45	1536.95	69	28	22	41	1.42	
13	934.04	1867.54	36	22	18	26	2.36	
14	1104.88	2208.60	21	16	13	14	3.31	
15	1120.22	2239.23	144	33	22	37	2.16	
16	1237.99	2474.35	68	21	13	14	1.88	
17	1377.52	2752.90	32	23	20	27	2.86	
18	1401.33	2800.45	21	19	16	20	13.60	
19	1460.96	2919.48	48	23	18	25	1.49	
20	1729.26	3455.12	37	21	16	20	3.07	
21	1764.14	3524.74	154	28	14	11	3.09	
22	1847.60	3691.38	24	15	11	8	2.50	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

Sample ID : 99-23-010-01 B:TOTAL RA.STD.ACT.VER

Bkg File: . . . . . det01.bkg | Counting Start. 12-01-99 08:48
ID.: 99-23-006-01 B:11/29/99 WK. BK | Current Date 12-01-99 08:12

PK#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
5	186.06	1.31	823	70	789	70	
7	295.10	1.18	411	53	402	54	
9	351.73	1.33	788	64	767	64	
10	511.16	2.14	117	37	-20	39	NET < CL
11	609.22	1.87	580	56	562	57	
17	1377.52	2.86	32	23	29	23	
19	1460.96	1.49	48	23	0	24	NET < CL
21	1764.14	3.09	154	28	147	29	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

Sample ID: 99-23-010-01 B:TOTAL RA.STD.ACT.VER

Sample Size . . . . 1.00e+000 Sample	Spectrum File GDR01.SPC
Sampling Start. 11-30-99 12:00	Counting Start. 12-01-99 08:48
Sampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
Current Date. 12-01-99 08:12	Decay Time. . . . . 2.08e+001 Hrs
Efficiency File. DET0111.EFF	Library File. FANPR6.LIB
ID. . . . . Geo11 #534	IDFiss. Act. and Nat. Library RTS 02/17

Eff.= 1/[2.85e-003*En^-3.16e+000 + 3.06e+001*En^6.85e-001] 08-30-99 08:13

Gamma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
Library Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	8.23e+003 +-7.35e+002	1.40e+007	1 of 1
Pb-214	Average:	1.00e+003 +-7.15e+001	1.40e+007	2 of 2
	295.21	9.35e+002 +-1.26e+002		
	351.92	1.03e+003 +-8.69e+001		
Bi-214	Average:	9.04e+002 +-8.33e+001	1.40e+007	2 of 2
	609.31	8.83e+002 +-8.89e+001		
	1120.29	1.05e+003 +-2.39e+002		
Am-241	59.54	< 1.06e+002	3.79e+006	MDA
Eu-155	86.55	< 6.79e+001	4.34e+004	MDA
Th-234	92.60	< 3.22e+002	3.91e+013	MDA
Co-57	122.06	< 1.48e+001	6.50e+003	MDA
Ce-144	133.54	< 1.11e+002	6.82e+003	MDA
U-235	143.76	< 1.21e+002	6.17e+012	MDA
Ce-139	165.85	< 1.69e+001	3.30e+003	MDA
Th-227	236.00	< 1.26e+002	1.91e+005	MDA
Pb-212	238.63	< 3.42e+001	1.67e+004	MDA
Cr-51	320.08	< 1.76e+002	6.65e+002	MDA
I-131	364.48	< 2.52e+001	1.93e+002	MDA
Sb-125	427.89	< 5.90e+001	2.43e+004	MDA
Be-7	477.59	< 1.83e+002	1.28e+003	MDA
Sr-85	513.99	< 3.32e+001	1.56e+003	MDA
Tl-208	583.14	< 2.59e+001	1.67e+004	MDA
Sb-124	602.71	< 2.92e+001	1.44e+003	MDA
Cs-134	604.70	< 3.50e+001	1.81e+004	MDA
Ru-106	621.84	< 1.84e+002	8.84e+003	MDA
Ag-110m	657.75	< 1.99e+001	6.00e+003	MDA
Cs-137	661.65	< 2.65e+001	2.64e+005	MDA
Bi-212	727.17	< 2.93e+002	1.67e+004	MDA
Nb-95	765.79	< 4.06e+001	1.54e+003	MDA
Co-58	810.76	< 2.63e+001	1.70e+003	MDA
Mn-54	834.83	< 2.56e+001	7.50e+003	MDA

Sc-46	889.25	< 3.37e+001	2.01e+003	MDA
Ac-228	911.07	< 8.97e+001	5.04e+004	MDA
Pa-234m	1001.03	< 4.47e+003	3.91e+013	MDA
Fe-59	1099.22	< 4.39e+001	1.07e+003	MDA
Zn-65	1115.52	< 9.17e+001	5.87e+003	MDA
Co-60	1173.22	< 3.59e+001	4.62e+004	MDA
Co-56	1238.25	< 4.60e+001	1.89e+003	MDA
Eu-154	1274.45	< 7.62e+001	7.71e+004	MDA
Na-22	1274.54	< 2.71e+001	2.28e+004	MDA
Eu-152	1407.95	< 1.62e+002	1.19e+005	MDA
K-40	1460.81	< 2.87e+002	1.12e+013	MDA

TOTAL: 1.01e+004 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.76	152.07	105	55	48	229	1.21	9.091e-001
77.01	156.57	216	53	39	210	1.15	1.769e+000
87.06	176.62	62	46	38	202	1.08	4.184e-001
241.80	485.55	191	46	33	128	1.00	1.258e+000
768.45	1536.94	69	28	22	41	1.42	9.780e-001
934.04	1867.54	36	22	18	26	2.36	5.823e-001
1104.88	2208.60	21	16	13	14	3.31	3.818e-001
1237.99	2474.35	68	21	13	14	1.88	1.339e+000
1377.52	2752.90	29	23	20	27	2.86	6.213e-001
1401.33	2800.45	21	19	16	20	13.60	4.485e-001
1729.26	3455.12	37	21	16	20	3.07	9.158e-001
1764.14	3524.74	147	29	14	11	3.09	3.688e+000
1847.60	3691.38	24	15	11	8	2.50	6.216e-001

GDR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

Sample ID : 99-23-010-D1 B:RA226 STD.VER.

Sample Size . . . . 1.00e+000 Sample	Spectrum File GDR03.SPC
Sampling Start. 11-30-99 12:00	Counting Start. 12-01-99 09:25
Sampling Stop 11-30-99 12:00	Live Time . . . . . 1800 Sec
Current Date. 12-01-99 08:50	Real Time . . . . . 1806 Sec

Detector #: 3

Energy(keV)= -0.52 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

FWHM(keV) = 0.80 + 0.011*En + 6.71e-004*En^2 + 0.00e+000*En^3 11-08-99 11:57
Where En = Sqrt(Energy in keV)

Sensitivity 0.20	Search Start / End. . . . . 30 / 4000
Sigma Multiplier. 2.00	

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.80	150.39	60	36	30	106	0.90	a
2	77.13	155.05	87	36	26	108	0.94	b
3	87.25	175.25	28	28	23	81	0.66	
4	186.21	372.85	476	53	27	82	1.07	
5	238.61	477.48	25	27	24	50	1.38	a
6	241.89	484.03	96	30	21	48	1.49	b
7	295.12	590.32	181	36	22	55	1.19	
8	351.86	703.60	294	39	17	36	1.29	
9	511.43	1022.24	34	25	21	39	3.20	
10	609.22	1217.48	231	35	17	29	1.37	
11	768.67	1535.86	18	17	14	17	1.93	
12	933.79	1865.57	18	13	9	8	2.70	
13	1120.23	2237.84	40	21	16	22	2.28	
14	1238.02	2473.03	25	16	12	12	3.72	
15	1378.11	2752.76	11	11	9	6	2.05	
16	1450.72	2897.75	4	8	7	4	1.03	NET < CL
17	1461.53	2919.32	8	11	9	7	1.12	NET < CL
18	1764.42	3524.11	55	16	6	3	2.90	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

Sample ID : 99-23-010-D1 B:RA226 STD.VER.

Bkg File: DET03.bkg	Counting Start. 12-01-99 09:25
ID.: 99-23-006-03 B:11/29/99 WK.BKG	Current Date 12-01-99 08:50

PK#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
4	186.21	1.07	476	53	464	53	
5	238.61	1.38	25	27	19	27	NET < CL
8	351.86	1.29	294	39	284	40	
9	511.43	3.20	34	25	-12	26	NET < CL
10	609.22	1.37	231	35	224	36	
17	1461.53	1.12	8	11	0	12	NET < CL
18	1764.42	2.90	55	16	53	16	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

Sample ID: 99-23-010-D1 B:RA226 STD.VER.

Sample Size . . . . 1.00e+000 Sample	Spectrum File GDR03.SPC
Sampling Start. 11-30-99 12:00	Counting Start. 12-01-99 09:25
Sampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
Current Date. 12-01-99 08:50	Decay Time. . . . . 2.14e+001 Hrs
Efficiency File. DET0311.EFF	Library File. FANPR6.LIB
ID. GEO11 534	IDFiss. Act. and Nat. Library RTS 02/17

Eff.= 1/[2.28e-003*En^-3.58e+000 + 7.58e+001*En^8.58e-001] 08-25-99 14:19

Gamma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
Library Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	8.89e+003 +-1.02e+003	1.40e+007	1 of 1
Pb-214	Average:	8.05e+002 +-9.20e+001	1.40e+007	2 of 2
	295.21	8.40e+002 +-1.68e+002		
	351.92	7.89e+002 +-1.10e+002		
Bi-214	Average:	7.92e+002 +-1.21e+002	1.40e+007	2 of 2
	609.31	7.98e+002 +-1.28e+002		
	1120.29	7.44e+002 +-3.85e+002		
Am-241	59.54	< 1.62e+002	3.79e+006	MDA
Eu-155	86.55	< 9.01e+001	4.34e+004	MDA
Th-234	92.60	< 3.82e+002	3.91e+013	MDA
Co-57	122.06	< 1.62e+001	6.50e+003	MDA
Ce-144	133.54	< 1.44e+002	6.82e+003	MDA
U-235	143.76	< 1.28e+002	6.17e+012	MDA
Ce-139	165.85	< 1.73e+001	3.30e+003	MDA
Th-227	236.00	< 1.66e+002	1.91e+005	MDA
Pb-212	238.63	< 4.59e+001	1.67e+004	MDA
Cr-51	320.08	< 1.90e+002	6.65e+002	MDA
I-131	364.48	< 2.58e+001	1.93e+002	MDA
Sb-125	427.89	< 8.17e+001	2.43e+004	MDA
Be-7	477.59	< 2.67e+002	1.28e+003	MDA
Sr-85	513.99	< 4.39e+001	1.56e+003	MDA
Tl-208	583.14	< 3.92e+001	1.67e+004	MDA
Sb-124	602.71	< 3.40e+001	1.44e+003	MDA
Cs-134	604.70	< 3.68e+001	1.81e+004	MDA
Ru-106	621.84	< 2.99e+002	8.84e+003	MDA
Ag-110m	657.75	< 3.77e+001	6.00e+003	MDA
Cs-137	661.65	< 4.32e+001	2.64e+005	MDA
Bi-212	727.17	< 4.24e+002	1.67e+004	MDA
Nb-95	765.79	< 3.96e+001	1.54e+003	MDA
Co-58	810.76	< 2.91e+001	1.70e+003	MDA
Mn-54	834.83	< 3.47e+001	7.50e+003	MDA

Sc-46	889.25	< 2.39e+001	2.01e+003	MDA
Ac-228	911.07	< 1.35e+002	5.04e+004	MDA
Pa-234m	1001.03	< 6.84e+003	3.91e+013	MDA
Fe-59	1099.22	< 8.15e+001	1.07e+003	MDA
Zn-65	1115.52	< 6.29e+001	5.87e+003	MDA
Co-60	1173.22	< 5.87e+001	4.62e+004	MDA
Co-56	1238.25	< 8.18e+001	1.89e+003	MDA
Eu-154	1274.45	< 1.32e+002	7.71e+004	MDA
Na-22	1274.54	< 4.71e+001	2.28e+004	MDA
Eu-152	1407.95	< 3.24e+002	1.19e+005	MDA
K-40	1460.81	< 4.11e+002	1.12e+013	MDA

TOTAL: 1.05e+004 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.80	150.39	60	36	30	106	0.90	1.082e+000
77.13	155.05	87	36	26	108	0.94	1.454e+000
87.25	175.25	28	28	23	81	0.66	3.567e-001
241.89	484.03	96	30	21	48	1.49	1.221e+000
768.67	1535.86	18	17	14	17	1.93	5.990e-001
933.79	1865.57	18	13	9	8	2.70	7.299e-001
1238.02	2473.03	25	16	12	12	3.72	1.258e+000
1378.11	2752.76	11	11	9	6	2.05	5.958e-001
1764.42	3524.11	53	16	6	3	2.90	3.598e+000

GDR_C Paragon Analytics, Inc. Fort Collins, CO Version 6.2

Sample ID : 99-23-010-D2 B:RA226 STD.VER.

Sample Size . . . . 1.00e+000 Sample	Spectrum File GDR01.SPC
Sampling Start. 11-30-99 12:00	Counting Start. 12-01-99 09:23
Sampling Stop 11-30-99 12:00	Live Time . . . . . 1800 Sec
Current Date. 12-01-99 08:48	Real Time . . . . . 1806 Sec

Detector #: 1

Energy(keV)= -1.41 + 0.501*Ch + 0.00e+000*Ch^2 + 0.00e+000*Ch^3 12-01-99 07:54

FWHM(keV) = 1.15 + -0.013*En + 1.64e-003*En^2 +-1.10e-005*En^3 11-08-99 09:40
Where En = Sqrt(Energy in keV)

Sensitivity 0.20	Search Start / End. . . . . 60 / 4000
Sigma Multiplier. 2.00	

PEAK SEARCH RESULTS

PK. #	ENERGY (keV)	ADDRESS CHANNEL	NET COUNTS	UN-CERTAINTY	C.L. COUNTS	BKG COUNTS	FWHM (keV)	FLAG
1	74.67	151.90	125	47	36	177	0.93	a
2	77.02	156.59	232	51	36	192	0.98	b
3	87.10	176.71	-3	49	43	256	0.04	NET < CL
4	186.02	374.18	771	72	42	198	1.17	
5	241.96	485.86	165	46	35	133	1.20	
6	295.15	592.05	470	56	34	116	1.22	
7	351.71	704.97	749	64	32	101	1.53	
8	510.77	1022.52	184	37	24	48	2.53	
9	609.16	1218.94	655	60	29	85	1.77	
10	768.69	1537.43	84	28	20	33	1.83	
11	934.35	1868.16	22	23	20	36	2.63	
12	1120.25	2239.29	194	33	16	21	2.42	
13	1238.21	2474.79	57	25	20	30	1.92	
14	1377.87	2753.60	28	23	20	30	1.51	
15	1461.34	2920.24	61	27	22	30	2.54	
16	1510.06	3017.51	19	18	15	16	3.00	
17	1729.27	3455.13	43	18	12	11	3.83	
18	1764.40	3525.27	133	29	17	18	2.41	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

BACKGROUND SUBTRACT RESULTS

Sample ID : 99-23-010-D2 B:RA226 STD.VER.

Bkg File: . . . . . det01.bkg | Counting Start. 12-01-99 09:23
ID.: 99-23-006-01 B:11/29/99 WK. BK | Current Date 12-01-99 08:48

PK#	ENERGY (keV)	FWHM (keV)	OLD NET COUNTS	OLD UN-CERTAINTY	NEW NET COUNTS	NEW UN-CERTAINTY	FLAG
4	186.02	1.17	771	72	737	73	
6	295.15	1.22	470	56	461	57	
7	351.71	1.53	749	64	728	65	
8	510.77	2.53	184	37	47	39	
9	609.16	1.77	655	60	637	61	
14	1377.87	1.51	28	23	25	23	
15	1461.34	2.54	61	27	13	27	NET < CL
18	1764.40	2.41	133	29	126	29	

GDR/PC Paragon Analytics, Inc. Fort Collins, CO Ver. 6.02a

NUCLIDE ACTIVITY SUMMARY

Sample ID: 99-23-010-D2 B:RA226 STD.VER.

Sample Size . . . . 1.00e+000 Sample	Spectrum File GDR01.SPC
Sampling Start. 11-30-99 12:00	Counting Start. 12-01-99 09:23
Sampling Stop 11-30-99 12:00	Buildup Time. . . . . 0.00e+000 Hrs
Current Date. 12-01-99 08:48	Decay Time. . . . . 2.14e+001 Hrs
Efficiency File. DET0111.EFF	Library File. FANPR6.LIB
ID. . . . . Geo11 #534	IDFiss. Act. and Nat. Library RTS 02/17

Eff.= 1/[2.85e-003*En^-3.16e+000 + 3.06e+001*En^6.85e-001] 08-30-99 08:13

Gamma Fraction Limit >= . . . 75.00 %	Decay Limit <=. . . . 8.000 Halflives
Library Energy Tolerance. . . 2.00	

FINAL ACTIVITY REPORT

Nuclide	Energy (keV)	Conc +- 2.00sigma (DPM/Sample)	Halflife (hrs)	Peaks Found
Ra-226	186.21	7.68e+003 +-7.60e+002	1.40e+007	1 of 1
Pb-214	Average:	1.01e+003 +-7.32e+001	1.40e+007	2 of 2
	295.21	1.07e+003 +-1.33e+002		
	351.92	9.82e+002 +-8.76e+001		
Bi-214	Average:	1.06e+003 +-8.85e+001	1.40e+007	2 of 2
	609.31	1.00e+003 +-9.53e+001		
	1120.29	1.42e+003 +-2.38e+002		
Am-241	59.54	< 1.05e+002	3.79e+006	MDA
Eu-155	86.55	< 6.95e+001	4.34e+004	MDA
Th-234	92.60	< 3.67e+002	3.91e+013	MDA
Co-57	122.06	< 1.32e+001	6.50e+003	MDA
Ce-144	133.54	< 1.21e+002	6.82e+003	MDA
U-235	143.76	< 1.17e+002	6.17e+012	MDA
Ce-139	165.85	< 1.64e+001	3.30e+003	MDA
Th-227	236.00	< 1.20e+002	1.91e+005	MDA
Pb-212	238.63	< 3.64e+001	1.67e+004	MDA
Cr-51	320.08	< 1.76e+002	6.65e+002	MDA
I-131	364.48	< 2.46e+001	1.93e+002	MDA
Sb-125	427.89	< 7.01e+001	2.43e+004	MDA
Be-7	477.59	< 1.86e+002	1.28e+003	MDA
Sr-85	513.99	< 3.47e+001	1.56e+003	MDA
Tl-208	583.14	< 3.14e+001	1.67e+004	MDA
Sb-124	602.71	< 3.26e+001	1.44e+003	MDA
Cs-134	604.70	< 3.47e+001	1.81e+004	MDA
Ru-106	621.84	< 2.37e+002	8.84e+003	MDA
Ag-110m	657.75	< 2.20e+001	6.00e+003	MDA
Cs-137	661.65	< 3.06e+001	2.64e+005	MDA
Bi-212	727.17	< 3.30e+002	1.67e+004	MDA
Nb-95	765.79	< 3.70e+001	1.54e+003	MDA
Co-58	810.76	< 2.31e+001	1.70e+003	MDA
Mn-54	834.83	< 2.49e+001	7.50e+003	MDA

Sc-46	889.25	< 2.76e+001	2.01e+003	MDA
Ac-228	911.07	< 8.67e+001	5.04e+004	MDA
Pa-234m	1001.03	< 5.26e+003	3.91e+013	MDA
Fe-59	1099.22	< 6.15e+001	1.07e+003	MDA
Zn-65	1115.52	< 8.76e+001	5.87e+003	MDA
Co-60	1173.22	< 3.06e+001	4.62e+004	MDA
Co-56	1238.25	< 4.60e+001	1.89e+003	MDA
Eu-154	1274.45	< 8.03e+001	7.71e+004	MDA
Na-22	1274.54	< 2.85e+001	2.28e+004	MDA
Eu-152	1407.95	< 1.91e+002	1.19e+005	MDA
K-40	1460.81	< 4.17e+002	1.12e+013	MDA

TOTAL: 9.75e+003 DPM/Sample

UNKNOWN PEAKS

Energy (keV)	Centroid Channel	Net Counts	Un-Certainty	C.L. Counts	Bkg. Counts	FWHM (keV)	Net Gamma/sec
74.67	151.90	125	47	36	177	0.93	1.086e+000
77.02	156.59	232	51	36	192	0.98	1.898e+000
241.96	485.86	165	46	35	133	1.20	1.083e+000
510.77	1022.52	47	39	24	48	2.53	5.089e-001
768.69	1537.43	84	28	20	33	1.83	1.198e+000
934.35	1868.16	22	23	20	36	2.63	3.573e-001
1238.21	2474.79	57	25	20	30	1.92	1.116e+000
1377.87	2753.60	25	23	20	30	1.51	5.226e-001
1510.06	3017.51	19	18	15	16	3.00	4.286e-001
1729.27	3455.13	43	18	12	11	3.83	1.073e+000
1764.40	3525.27	126	29	17	18	2.41	3.162e+000

Radiochemistry Solution Report

Solution Id:	460.1572.47	Name:	Ra-226 Intermediate Standard	Type:	IS
		Lot:		Vendor Name:	

Final Vol:	476.6578	Dept:	RD	Prep By	DCB	on	6/ 8/99	Reviewed By	sed	on	1/14/04
Units:	mL	Location:		Opened By		on		Verified By	DCB	on	12/ 3/99
Matrix:	LIQUID	ExpireDate:	6/ 7/04	Received By		on		Deactivated By		on	

Comment:

Component Name	Component ID	Volume Added	Units
Ra-226 Intermediate Standard	460.1572.45	17.3646	g

CompName	Calibrated Primary Act/Conc	Calibration Date	Reference Date	1/2 Life (Yrs)	Final Act/Conc	Summed Conc	Units
Ra-226	11900	1/1/93	1/14/04	1600	53.8844821813323		pCi/ml

Associated Parent IDs

460	460.1572.45

Parent Solutions Sub Report

Solution Id:	460	Name:	Ra-226 Primary Standard	Type:	PS

Final Vol:	5	Units:	g	Matrix:	LIQUID

CompName	Calibration Date	Reference Date	Decay Corrected Act/Conc	Units
Ra-226	1/1/93	1/14/04	11843.2531719227	pCi/g

Solution Id:	460.1572.45	Name:	Ra-226 Intermediate Standard	Type:	IS

Final Vol:	39.3468	Units:	g	Matrix:	LIQUID

CompName	Calibration Date	Reference Date	Decay Corrected Act/Conc	Units
Ra-226	1/1/93	1/14/04	1479.12737571274	pCi/g

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

Code #: 460.15.72.47 Name of Standard: Ra 226 Working Std.

Date: 12/1/99 Analyst: JASON MODEST

Aliquot for verification: Two 64.6 g Aliquots placed in GEO 11 γ container

Work up: See Attached QASS

Expected activity and uncertainty: 53.99 pCi/g

Results of Counting and counting uncertainty: ≃ 57.5 ± 11.75

= 106.5% of expected

Radiochemistry Technical Manager: [signature] Date: 12/3/99

Radiochemistry QA Manager: Date:

ATI FM 718FC
(2/27/95

1/28/98 Open ampule sol#2557-4 (RSO#460), transfer to 40 ml VOA vial + dilute w/ 0.5 N HCL.

Diluent = 0.5 N HCl

Balance 12 used

VOA start: 26.5345 g (empty)
- VOA final: 65.8813 g (final, Ra226 + 0.5 HCl)

Δ transfered: 39.3468 g

Balance 12 used

initial ampule + beaker: 38.0054 g
empty ampule + beaker: 33.0913 g
4.9141 g mass Ra-226 added to VOA

11,900 pCi/g
× 4.9141
58,477.79 pCi
÷ 39.35
1486 pCi/g final activity conc.
as of 1/93
$t_{1/2}$ = 1600 y
total unc = ± 5.5%

Standard verification balance 21 GEOMETRY 10
former g tare: 61.03 g
total wt: 181.33 g
181.33 − 61.03 g =
120.30 g solution

Continued on Page

Read and Understood By

Signed	Date	Signed	Date
[signature]	1/28/99	[signature]	2/3/99

Parsons ID 460
Rec'd 8-25-97

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory-Las Vegas
Nuclear Radiation Assessment Division

Calibration Certificate

Description

Principal radionuclide: Radium-226 Half-life: 1600 years

Nominal activity: 60 nano curies

Nominal volume: 5 ml in ampoule/bottle number 2557-4

Measurement Activity of principal radionuclide

Activity per gram of this solution

11.9 nano curies of Radium-226

at 0400 hours PST on January 1993

Activity of daughter radionuclide

The principal activity was accompanied at the quoted time by

curies Per gram

of the daughter nuclide

Total mass of this solution

Approximately 5.0 grams

Method of measurement

This standard was prepared by gravimetric dilution of NBS Standard Reference Material 4964-B. The specific activity of the dilution was determined by gamma spectrometry by comparing the sum of the activities of the 242, 352 and 609 KeV gamma ray emissions to those of several NBS SRM 4957 Radium-226 sources.

Useful Life

This radionuclide has decayed through half lives since it was obtained by EMSL-LV

We recommend that this solution should not be used after Indefinite

Purity

The manufacturer states that activities other than that of the principal nuclide and of its daughter nuclides, if any, were estimated/known to be:

(1)	less than equal to	%	of the principal activity
(2)	less than equal to	%	of the principal activity
(3)	less than equal to	%	of the principal activity

The activity of impurity (1) is not (2) is not (3) is not included in the quoted figures of the principal activity.

Random Errors

The precision of this standard was such that the certified value of the radioactive concentration of the principal activity had a standard error (sm) not greater than ± 0.6 %

(The 99.7% confidence limits are given by t(sm) where t is obtained from the student t factor for the degree of freedom (n-1)).

The maximum uncertainty due to the assessable systematic errors (dilution, counting, and known uncertainty of the standard) is obtained by the separate arithmetic summation of the positive and negative systematic error ($+\delta - \delta'$). These have been estimated not to exceed

+ 3.7 % or - 3.7 %

the overall uncertainty (often called accuracy) is an estimate of the possible divergence of the quoted result from the true value. It is a combination of random error [t(sm)] at the 99.7% confidence limits and the worst case estimate of the systematic errors ($+\delta$, $-\delta'$)
The overall uncertainty is therefore calculated on the basis of + [t(sm) $+\delta$], - [t(sm) $+\delta'$]
and is + 5.5 %, - 5.5 % of the quoted radioactive concentration.

Decay Schemes

This standardization is based on the following assumptions of the principle nuclide, its daughter nuclides and impurities (no allowance for error in these assumptions or the assumption of quoted half-life have been included in the statement of accuracy above).

Radium-226 is a member of the Uranium-238 decay chain. Radium-226 decays 100 percent by alpha emission to Radon-222.

Chemical Composition of Solution

Carrier content per gram of solution: 0.8 micrograms Ba

Other components: 0.5M HCl

Preservative:

Remarks

The measured value and the expected value using the gravimetric factors and the NBS calibration of SRM-4964B differed by 1.6 percent. The average of the two values was used for this standard.

Date Certificate Prepared January 21, 1993

Approval Signature Paul B. Hahn

Revised 1/84

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards & Technology
Gaithersburg, MD 20899

REPORT OF TRACEABILITY

U.S. Environmental Protection Agency
Environmental Monitoring Systems Laboratory
Las Vegas, Nevada

Radionuclide	Radium-226
Source identification	2557-4, prepared by EMSL
Source description	Liquid in 5-mL flame-sealed glass ampoule
Source mass	Approximately 5.0 grams
Source composition	Radium-226 plus 0.8 μg of non-radioactive barium per gram of 0.5 $mol \cdot L^{-1}$ HCl
Reference time	0700 EST January 1, 1993

	NIST DATA	EMSL DATA
Radioactivity concentration	447.5 $Bq \cdot g^{-1}$	440.3 $Bq \cdot g^{-1}$
Expanded uncertainty	2.5 percent (1)*	±5.5 percent (2)
Photon-emitting impurities (Activities at reference time)	None observed (3)	None reported
Measuring instrument	NIST pressurized "4π"γ ionization chamber A calibrated with SRM 4955	Dilution of SRM 4964-B verified using germanium spectrometer system
Half life	1600 ± 7 years (4)	
Difference from NIST		-1.61 percent (5)

For the Director,

J.M. Robin Hutchinson, Group Leader
Radioactivity Group
Physics Laboratory

Gaithersburg, MD 20899
September 1994

*Notes on next page

(over)

000248

NOTES

(1) The uncertainty analysis methodology and nomenclature used for the reported uncertainties are based on uniform NIST guidelines and are compatible with those adopted by the principal international metrology standardization bodies [cf., B.N. Taylor and C.E. Kuyatt, *NIST Technical Note 1297* (1993)].

(2) The combined standard uncertainty, u_c = 1.24 percent, is the quadratic combination of the standard deviation (or standard deviation of the mean where appropriate), or approximations thereof, for the following component uncertainties:

a)	100 ionization chamber measurements on each of 2 samples	0.31 percent
b)	activity of SRM 4955-55	1.21 percent
c)	gravimetric	0.05 percent
d)	half-life propagation (Δt = 25 y)	0.005 percent

The expanded uncertainty, U = 2.5 percent, is obtained by multiplying u_c by a coverage factor of k = 2 and is assumed to provide an uncertainty interval of approximately 95 percent confidence.

(3) Overall uncertainty reported by EMSL.

(4) The limits of detection are:

$$12.6\ \gamma\ s^{-1}\ g^{-1} \text{ between 40 and 348 keV,}$$
$$4.75\ \gamma\ s^{-1}\ g^{-1} \text{ between 356 and 605 keV, and}$$
$$1.58\ \gamma\ s^{-1}\ g^{-1} \text{ between 613 and 1900 keV,}$$

provided that impurity photons are separated in energy by four keV or more from the principle gamma-ray emissions of radium-226 and its daughters.

(5) Evaluated Nuclear Structure Data File (1990).

(6) This result demonstrates the traceability of EMSL to NIST, for this measurement, to within five percent as specified in the appendix, Traceability Studies, of the EPA-NIST interagency agreement of April 1976, as amended.

For further information, please contact Jeffrey T. Cessna at 301-975-5539.

Source identification 2557-4

Daily Checks

Lucas Cell + PMT Daily Performance Check Summary - Detector C, Scalar #6

r:\inst\alphscnt\dailychk.xls

Interim control limits established 01/26/04

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
1	1/26/04	1	9344	OK	8410	10278
2	1/27/04	1	9340	OK	8410	10278
3	1/27/04	1	9564	OK	8410	10278
4	1/28/04	1	9548	OK	8410	10278
5	1/29/04	1	9508	OK	8410	10278
6	1/29/04	1	9631	OK	8410	10278
7	1/30/04	1	9454	OK	8410	10278
8	1/30/04	1	9490	OK	8410	10278

Lucas Cell + PMT Daily Performance Check Summary - Detector D, Scalar #4

r:\inst\alphscnt\dailychk.xls

Historical control limits established 10/17/03

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
84	1/20/04	1	9488	OK	9105	9774
85	1/21/04	1	9617	OK	9105	9774
86	1/22/04	1	9370	OK	9105	9774
87	1/22/04	1	9462	OK	9105	9774
88	1/26/04	1	9371	OK	9105	9774
89	1/27/04	1	9354	OK	9105	9774
90	1/27/04	1	9439	OK	9105	9774
91	1/28/04	1	9392	OK	9105	9774
92	1/29/04	1	9392	OK	9105	9774
93	1/29/04	1	9481	OK	9105	9774
94	1/30/04	1	9314	OK	9105	9774
95	1/30/04	1	9429	OK	9105	9774

THE SOURCE INC.
Radiation standards and check sources
2810 Siler Lane Santa Fe, NM 87501
(505)473-9538 FAX(505)473-5805

Yarosz - 1 yr
recal 3-21-95

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 traceablility.

Active Diameter(or area) 44mm
Total Diameter(or area) 47mm

Mounting Material SS
Thickness 0.79mm

9.150	cpm	± 460	cpm 2pi
18.000	dpm	± 900	dpm 4pi
0.00812	microcurie		
08/20/92	date of measurement		
92TH4703015	source serial number		

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

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 A, Scalar #1

r:\inst\alphscnt\dailychk.xls

Historical control limts established 8/28/01.

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
428	6/22/04	1	9496	OK	9047	9762
429	6/23/04	1	9571	OK	9047	9762
430	6/24/04	1	9468	OK	9047	9762
431	6/24/04	1	9452	OK	9047	9762
432	6/28/04	1	9382	OK	9047	9762
433	6/29/04	1	9419	OK	9047	9762
434	6/30/04	1	9572	OK	9047	9762
435	7/1/04	1	9554	OK	9047	9762
436	7/2/04	1	9319	OK	9047	9762
437	7/2/04	1	9430	OK	9047	9762
438	7/6/04	1	9600	OK	9047	9762
439	7/7/04	1	9601	OK	9047	9762
440	7/8/04	1	9585	OK	9047	9762
441	7/8/04	1	9334	OK	9047	9762
442	7/11/04	1	9541	OK	9047	9762
443	7/13/04	1	9658	OK	9047	9762

Lucas Cell + PMT Daily Performance Check Summary - Detector B, Scalar #2

r:\inst\alphscnt\dailychk.xls

Historical control limts established 9/25/01.

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
409	6/22/04	1	9475	OK	9074	9734
410	6/23/04	1	9339	OK	9074	9734
411	6/24/04	1	9324	OK	9074	9734
412	6/24/04	1	9612	OK	9074	9734
413	6/28/04	1	9476	OK	9074	9734
414	6/29/04	1	9435	OK	9074	9734
415	6/30/04	1	9424	OK	9074	9734
416	7/1/04	1	9558	OK	9074	9734
417	7/2/04	1	9464	OK	9074	9734
418	7/2/04	1	9370	OK	9074	9734
419	7/6/04	1	9443	OK	9074	9734
420	7/7/04	1	9425	OK	9074	9734
421	7/8/04	1	9533	OK	9074	9734
422	7/8/04	1	9354	OK	9074	9734
423	7/11/04	1	9417	OK	9074	9734
424	7/13/04	1	9212	OK	9074	9734

Lucas Cell + PMT Daily Performance Check Summary - Detector C, Scalar #6

r:\inst\alphscnt\dailychk.xls

Historical control limits established 3/15/04

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
90	6/22/04	1	9460	OK	9146	9753
91	6/23/04	1	9292	OK	9146	9753
92	6/24/04	1	9539	OK	9146	9753
93	6/24/04	1	9473	OK	9146	9753
94	6/28/04	1	9347	OK	9146	9753
95	6/29/04	1	9458	OK	9146	9753
96	6/30/04	1	9461	OK	9146	9753
97	7/1/04	1	9390	OK	9146	9753
98	7/2/04	1	9508	OK	9146	9753
99	7/2/04	1	9367	OK	9146	9753
100	7/6/04	1	9384	OK	9146	9753
101	7/7/04	1	9467	OK	9146	9753
102		1				

Lucas Cell + PMT Daily Performance Check Summary - Detector D, Scalar #4

r:\inst\alphscnt\dailychk.xls

Historical control limits established 10/17/03

Obs. #	Date	Count Dur. (m)	Gross Counts	OK?	LCL	UCL
177	6/22/04	1	9421	OK	9105	9774
178	6/23/04	1	9490	OK	9105	9774
179	6/24/04	1	9640	OK	9105	9774
180	6/24/04	1	9472	OK	9105	9774
181	6/28/04	1	9287	OK	9105	9774
182	6/29/04	1	9448	OK	9105	9774
183	6/30/04	1	9543	OK	9105	9774
184	7/1/04	1	9453	OK	9105	9774
185	7/2/04	1	9344	OK	9105	9774
186	7/2/04	1	9366	OK	9105	9774
187	7/6/04	1	9512	OK	9105	9774
188	7/7/04	1	9321	OK	9105	9774