

**U.S.ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY  
540 S. MORRIS AVE., MONTGOMERY, AL 36115  
RA228 ANALYSES**

**REPORT OF SAMPLE DELIVERY GROUP #1400013**

Project: Petcoke Dust Investigation, Southeast Chicago, IL  
 Analysis method: Radium-228 in Environmental Matrices  
 Report ID: 1400013-RA228  
 Report type: Original  
 Date reported: 04/17/2014  
 Total pages in report: 25

**SAMPLES**

<b>NAREL Sample #</b>	<b>Client Sample ID</b>	<b>Location</b>	<b>Matrix</b>	<b>Date Collected</b>	<b>Date Received</b>
B4.02512P	S-1	IL:CHICAGO	SOIL	03/03/2014	03/06/2014
B4.02513Q	S-2	IL:CHICAGO	SOIL	03/03/2014	03/06/2014
B4.02514R	S-3	IL:CHICAGO	SOIL	03/03/2014	03/06/2014
B4.02515T	S-4	IL:CHICAGO	SOIL	03/03/2014	03/06/2014
B4.02516U	S-5	IL:CHICAGO	SOIL	03/03/2014	03/06/2014
B4.02517V	S-6	IL:CHICAGO	SOIL	03/03/2014	03/06/2014
B4.02518W	N-1	IL:CHICAGO	SOIL	03/04/2014	03/06/2014
B4.02519X	N-2	IL:CHICAGO	SOIL	03/04/2014	03/06/2014
B4.02520P	N-3	IL:CHICAGO	SOIL	03/04/2014	03/06/2014
B4.02521Q	N-4	IL:CHICAGO	SOIL	03/04/2014	03/06/2014
B4.02522R	N-5	IL:CHICAGO	SOIL	03/04/2014	03/06/2014
B4.02523T	N-6	IL:CHICAGO	SOIL	03/04/2014	03/06/2014
B4.02524U	N-2 DUP	IL:CHICAGO	SOIL	03/04/2014	03/06/2014

**EXCEPTIONS**

1. **Packaging and shipping** – Included in the shipment was an empty jar labeled “Blank Rad.” This jar was not logged as a sample, and the client was informed.
2. **Documentation** – No problems were observed.
3. **Sample preparation** – No problems were encountered.
4. **Analysis** – No problems were encountered.
5. **Holding times** – No holding times were specified.

**QUALITY CONTROL**

1. **QC samples** – All QC analysis results met NAREL acceptance criteria.
2. **Yields** – All chemical yields were within acceptance limits.
3. **Instruments** – Response and background checks for all instruments used in these analyses met NAREL acceptance criteria.

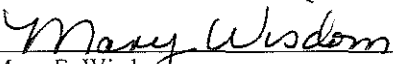
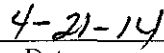

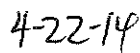
## ACCREDITATION



All analyses included in this data package are accredited by the Oregon Environmental Laboratory Accreditation Program (ORELAP) to the TNI standard.

## CERTIFICATION

I certify that this data report complies with the terms and conditions of the Quality Assurance Project Plan, except as noted above. Release of the data contained in this report has been authorized by the Director of the Center for Environmental Radioanalytical Laboratory Science and the NAREL Quality Assurance Manager, or their designees, as verified by the following signatures.

 _____ Mary F. Wisdom Quality Assurance Manager, NAREL	 _____ Date
 _____ Cynthia White Director, Center for Environmental Radioanalytical Laboratory Science	 _____ Date

## GENERAL INFORMATION

### SAMPLE TYPES

BLD	Blind sample
FBK	Field blank
SAM	Normal sample

### ANALYSIS QC TYPES

ANA	Normal analysis
DUP	Laboratory duplicate
LCS	Laboratory control sample, or blank spike
MS	Matrix spike
MSD	Matrix spike duplicate (not currently analyzed)
RBK	Method blank
STD	External standard (used for <sup>228</sup> Ra yield determination)

### QUALITY INDICATORS

RPD	Relative Percent Difference
%R	Percent Recovery
Z	Number of standard deviations by which a QC measurement differs from the expected value

### RADIOCHEMICAL DATA

Radiochemical analyses usually require the subtraction of an instrument background measurement result from a gross sample measurement result. Both values are positive, but when the sample activity is low, random variations in the two measurements can cause the gross value to be less than the background, resulting in a measured activity less than zero. Although negative activities have no physical significance, they do have statistical importance, as for example in the evaluation of trends or the comparison of two groups of samples.

To the extent practical, it is the policy of NAREL to report results as generated, whether positive, negative, or zero, together with the “2-sigma” measurement uncertainty and a sample-specific estimate of the minimum detectable concentration (MDC). The measurement result, uncertainty, and MDC are always expressed in the same unit of measurement.

### EVALUATION OF QC ANALYSES

A method blank result is considered unacceptable if it is more than 3 standard deviations below zero or more than 3 standard deviations above a predetermined upper control limit. For some analyses NAREL has set the upper control limit at zero. For others the control limit is a small positive number.

NAREL evaluates the results of duplicate and spike analyses using “Z scores.” A Z score is the number of standard deviations by which the QC result differs from its ideal value. Generally the score is considered acceptable if its absolute value is not greater than 3.

The Z score for a spiked sample is computed by dividing the difference between the measured value and the target value by the combined standard uncertainty of the difference. The Z score for a duplicate analysis is computed by dividing the difference between the two measured values by the combined standard uncertainty of the difference.

NAREL reports the “relative percent difference,” or RPD, between duplicate results and the “percent recovery,” or %R, for spiked analyses, but does not use these values for evaluation of most analyses. An exception is the use of %R in the evaluation of gross alpha matrix spike results. A gross alpha matrix spike result is considered acceptable if either  $|Z| \leq 3$  or  $60 \leq \%R \leq 110$ .

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
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**SDG #1400013**

**ANALYSIS SUMMARY**

Analysis method: NAREL RA-05  
Title: Radium-228 in Environmental Matrices

NAREL Sample #	Client Sample ID	QC Type	Date Completed	Preparation Batch #	Assay Batch #
B4.02512P	S-1		04/14/2014	0010907H	0018017A
B4.02512P	S-1	DUP	04/14/2014	0010907H	0018017A
B4.02513Q	S-2		04/14/2014	0010907H	0018017A
B4.02514R	S-3		04/14/2014	0010907H	0018017A
B4.02515T	S-4		04/14/2014	0010907H	0018017A
B4.02516U	S-5		04/14/2014	0010907H	0018017A
B4.02517V	S-6		04/14/2014	0010907H	0018017A
B4.02518W	N-1		04/14/2014	0010907H	0018017A
B4.02519X	N-2		04/15/2014	0010907H	0018018B
B4.02520P	N-3		04/15/2014	0010907H	0018018B
B4.02521Q	N-4		04/15/2014	0010907H	0018018B
B4.02522R	N-5		04/15/2014	0010907H	0018018B
B4.02522R	N-5	MS	04/15/2014	0010907H	0018018B
B4.02523T	N-6		04/15/2014	0010907H	0018018B
B4.02524U	N-2 DUP		04/15/2014	0010907H	0018018B
LCS-00688239Q *		LCS	04/14/2014	0010907H	0018017A
RBK-00688238P *		RBK	04/15/2014	0010907H	0018018B
STD-00688240H *		STD	04/14/2014	0010907H	0018017A
STD-00688241J *		STD	04/15/2014	0010907H	0018018B

\* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02512P	Amount analyzed:	1.055e+00 GDRY
Client sample ID:	S-1	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-03 08:30 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	90.95 %	Analyst:	VH
Ash/dry weight:	0.55 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA1A	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	3.37e-02	5.2e-01	9.1e-01	PCI/GDRY	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02512P	Amount analyzed:	1.055e+00 GDRY
Client sample ID:	S-1	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-03 08:30 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	90.95 %	Analyst:	VH
Ash/dry weight:	0.55 %	QC type:	DUP
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA1B	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	2.74e-01	5.2e-01	8.9e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02513Q	Amount analyzed:	1.054e+00 GDRY
Client sample ID:	S-2	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-03 09:50 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	95.20 %	Analyst:	VH
Ash/dry weight:	0.49 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA1C	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	-1.54e-01	5.1e-01	9.3e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02514R	Amount analyzed:	1.031e+00 GDRY
Client sample ID:	S-3	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-03 10:40 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	92.65 %	Analyst:	VH
Ash/dry weight:	0.81 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA1D	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	3.06e-01	5.2e-01	8.8e-01	PCI/GDRY	04/03/2014 16:02 CDT



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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02515T	Amount analyzed:	1.053e+00 GDRY
Client sample ID:	S-4	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-03 11:15 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	92.88 %	Analyst:	VH
Ash/dry weight:	2.71 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA2A	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	1.64e-02	4.6e-01	8.2e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02516U	Amount analyzed:	1.030e+00 GDRY
Client sample ID:	S-5	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-03 13:10 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	91.89 %	Analyst:	VH
Ash/dry weight:	0.37 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA2B	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	-3.21e-01	4.5e-01	8.6e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02517V	Amount analyzed:	1.038e+00 GDRY
Client sample ID:	S-6	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-03 13:35 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	90.96 %	Analyst:	VH
Ash/dry weight:	1.56 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA2C	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	1.02e-01	4.7e-01	8.3e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02518W	Amount analyzed:	1.069e+00 GDRY
Client sample ID:	N-1	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018017A
Collected:	2014-03-04 08:38 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	94.98 %	Analyst:	VH
Ash/dry weight:	0.84 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:38	100.0	QA2D	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	5.19e-01	4.9e-01	7.8e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02519X	Amount analyzed:	1.055e+00 GDRY
Client sample ID:	N-2	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018018B
Collected:	2014-03-04 09:10 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	94.84 %	Analyst:	VH
Ash/dry weight:	0.92 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA1A	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	3.37e-02	5.2e-01	9.1e-01	PCI/GDRY	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02520P	Amount analyzed:	1.067e+00 GDRY
Client sample ID:	N-3	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018018B
Collected:	2014-03-04 10:30 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	91.44 %	Analyst:	VH
Ash/dry weight:	0.61 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA1B	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	-2.05e-01	4.8e-01	8.7e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02521Q	Amount analyzed:	1.047e+00 GDRY
Client sample ID:	N-4	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018018B
Collected:	2014-03-04 09:50 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	87.42 %	Analyst:	VH
Ash/dry weight:	0.32 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA1C	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	1.13e-01	5.4e-01	9.3e-01	PCI/GDRY	04/03/2014 16:02 CDT

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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02522R	Amount analyzed:	1.058e+00 GDRY
Client sample ID:	N-5	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018018B
Collected:	2014-03-04 12:50 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	94.56 %	Analyst:	VH
Ash/dry weight:	1.39 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA1D	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	3.44e-02	4.9e-01	8.6e-01	PCI/GDRY	04/03/2014 16:02 CDT



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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02522R	Amount analyzed:	1.058e+00 GDRY
Client sample ID:	N-5	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018018B
Collected:	2014-03-04 12:50 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	94.56 %	Analyst:	VH
Ash/dry weight:	1.39 %	QC type:	MS
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA2A	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	1.54e+01	2.2e+00	8.2e-01	PCI/GDRY	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02523T	Amount analyzed:	1.060e+00 GDRY
Client sample ID:	N-6	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018018B
Collected:	2014-03-04 13:20 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	91.09 %	Analyst:	VH
Ash/dry weight:	0.95 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:34	100.0	QB1A	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	-4.12e-01	4.7e-01	9.0e-01	PCI/GDRY	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	B4.02524U	Amount analyzed:	1.053e+00 GDRY
Client sample ID:	N-2 DUP	Preparation batch #:	0010907H
Matrix:	SOIL	Assay batch #:	0018018B
Collected:	2014-03-04 09:10 CST	Prep procedure:	NAREL RA-01
Sample type:	SAM	Analysis method:	NAREL RA-05
Dry/wet weight:	95.06 %	Analyst:	VH
Ash/dry weight:	0.85 %	QC type:	ANA
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA2B	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	1.27e-01	4.9e-01	8.4e-01	PCI/GDRY	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
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**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	LCS-00688239Q	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0010907H
Matrix:	N/A	Assay batch #:	0018017A
Collected:	N/A	Prep procedure:	NAREL RA-01
Sample type:	N/A	Analysis method:	NAREL RA-05
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	LCS
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:40	100.0	QB1A	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	1.68e+01	1.7e+00	9.5e-01	PCI	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	RBK-00688238P	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0010907H
Matrix:	N/A	Assay batch #:	0018018B
Collected:	N/A	Prep procedure:	NAREL RA-01
Sample type:	N/A	Analysis method:	NAREL RA-05
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	RBK
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA2C	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	3.36e-01	5.1e-01	8.5e-01	PCI	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	STD-00688240H	Amount analyzed:	1.000e+00 ML
Client sample ID:	N/A	Preparation batch #:	0010907H
Matrix:	N/A	Assay batch #:	0018017A
Collected:	N/A	Prep procedure:	NAREL RA-01
Sample type:	N/A	Analysis method:	NAREL RA-05
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	STD
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/14/2014 10:40	100.0	QB1B	RCL

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	6.79e+01	3.2e+00		%	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

**SDG #1400013**

**SAMPLE ANALYSIS REPORT**

Lab sample #:	STD-00688241J	Amount analyzed:	1.000e+00 ML
Client sample ID:	N/A	Preparation batch #:	0010907H
Matrix:	N/A	Assay batch #:	0018018B
Collected:	N/A	Prep procedure:	NAREL RA-01
Sample type:	N/A	Analysis method:	NAREL RA-05
Dry/wet weight:	N/A	Analyst:	VH
Ash/dry weight:	N/A	QC type:	STD
Sample description:	N/A		
Comment:	N/A		

**COUNTING INFORMATION**

Date and time	Duration (min)	Detector ID	Operator
04/15/2014 10:33	100.0	QA2D	JEA

**ANALYTICAL RESULTS**

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Ra228	6.80e+01	3.2e+00		%	04/03/2014 16:02 CDT

**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

**SDG 1400013**

**PREPARATION BATCH SUMMARY**

Preparation batch #: 0010907H  
 Analysis method: NAREL RA-05  
 Preparation procedure: NAREL RA-01

NAREL Sample #	Client Sample ID	Analysis #	QC Type	Yield	± 2 σ Uncertainty	Analyst
B4.02512P	S-1	00686321Z		N/A		VH
B4.02512P	S-1	00688236M	DUP	N/A		VH
B4.02513Q	S-2	00686327F		N/A		VH
B4.02514R	S-3	00686333D		N/A		VH
B4.02515T	S-4	00686339K		N/A		VH
B4.02516U	S-5	00686345H		N/A		VH
B4.02517V	S-6	00686351F		N/A		VH
B4.02518W	N-1	00686357M		N/A		VH
B4.02519X	N-2	00686363K		N/A		VH
B4.02520P	N-3	00686369R		N/A		VH
B4.02521Q	N-4	00686375P		N/A		VH
B4.02522R	N-5	00686381M		N/A		VH
B4.02522R	N-5	00688237N	MS	N/A		VH
B4.02523T	N-6	00686387U		N/A		VH
B4.02524U	N-2 DUP	00686393R		N/A		VH
LCS-00688239Q *		00688239Q	LCS	N/A		VH
RBK-00688238P *		00688238P	RBK	N/A		VH
STD-00688240H *		00688240H	STD	N/A		VH
STD-00688241J *		00688241J	STD	N/A		VH

\* Samples marked with an asterisk are not in this sample delivery group but were analyzed with it for QC purposes.

**QC RESULTS FOR BATCH 0010907H**

NAREL Sample #	Analysis #	QC Type	Analyte	%R	RPD	Z	Evaluation
B4.02512P	00688236M	DUP	RA228		156.2	0.65	PASS
LCS-00688239Q	00688239Q	LCS	RA228	127.9		2.83	WARN
B4.02522R	00688237N	MS	RA228	123.7		2.06	WARN
RBK-00688238P	00688238P	RBK	RA228				PASS



**U.S. ENVIRONMENTAL PROTECTION AGENCY  
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

**SDG 1400013**

**ASSAY BATCH SUMMARY**

**EXTERNAL STANDARD**

Assay Batch	Analysis #	Analyte	Standard Concentration	Reference Date	Yield	$\pm 2 \sigma$ Uncertainty
0018017A	00688240H	RA228	9.45e+01 PCI/ML	07/19/2013	67.91 %	3.23 %
0018018B	00688241J	RA228	9.45e+01 PCI/ML	07/19/2013	67.96 %	3.18 %

**SAMPLES ANALYZED**

NAREL Sample #	QC Type	Aliquot Size	Completion Date	Assay Batch	
B4.02512P	DUP	1.06e+00 GDRY	04/14/2014	0018017A	
B4.02512P		1.06e+00 GDRY	04/14/2014	0018017A	
B4.02513Q		1.05e+00 GDRY	04/14/2014	0018017A	
B4.02514R		1.03e+00 GDRY	04/14/2014	0018017A	
B4.02515T		1.05e+00 GDRY	04/14/2014	0018017A	
B4.02516U		1.03e+00 GDRY	04/14/2014	0018017A	
B4.02517V		1.04e+00 GDRY	04/14/2014	0018017A	
B4.02518W		1.07e+00 GDRY	04/14/2014	0018017A	
B4.02519X		1.06e+00 GDRY	04/15/2014	0018018B	
B4.02520P		1.07e+00 GDRY	04/15/2014	0018018B	
B4.02521Q		1.05e+00 GDRY	04/15/2014	0018018B	
B4.02522R		MS	1.06e+00 GDRY	04/15/2014	0018018B
B4.02522R			1.06e+00 GDRY	04/15/2014	0018018B
B4.02523T			1.06e+00 GDRY	04/15/2014	0018018B
B4.02524U	1.05e+00 GDRY		04/15/2014	0018018B	
LCS-00688239Q *	LCS	1.00e+00 SAMP	04/14/2014	0018017A	
RBK-00688238P *	RBK	1.00e+00 SAMP	04/15/2014	0018018B	
STD-00688240H *	STD	1.00e+00 ML	04/14/2014	0018017A	
STD-00688241J *	STD	1.00e+00 ML	04/15/2014	0018018B	

Samples marked with an asterisk (\*) are not in SDG #1400013 but were analyzed with it for QC purposes