

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

REPORT OF SAMPLE DELIVERY GROUP #1400013

Project: Petcoke Dust Investigation, Southeast Chicago, IL
 Analysis method: Actinides (Thorium) by Extraction Chromatography
 Report ID: 1400013-TH
 Report type: Original
 Date reported: 04/17/2014
 Total pages in report: 21

SAMPLES

NAREL Sample #	Client Sample ID	Location	Matrix	Date Collected	Date Received
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

- 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.
- Documentation** – No problems were observed.
- Sample preparation** – No problems were encountered.
- Analysis** – No problems were encountered.
- Holding times** – No holding times were specified.

QUALITY CONTROL

- QC samples** – All QC analysis results met NAREL acceptance criteria.
- Yields** – All chemical yields were within acceptance limits.
- 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 TN1 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 4-21-14
Mary F. Wisdom Date
Quality Assurance Manager, NAREL

Cynthia White 4-22-14
Cynthia White Date
Director, Center for Environmental Radioanalytical
Laboratory Science

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 ²²⁸ 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
NATIONAL ANALYTICAL RADIATION ENVIRONMENTAL LABORATORY**

SDG #1400013

ANALYSIS SUMMARY

Analysis method: NAREL TH-EICHROM
Title: Actinides (Thorium) by Extraction Chromatography

NAREL Sample #	Client Sample ID	QC Type	Date Completed	Preparation Batch #	Assay Batch #
B4.02512P	S-1		04/11/2014	0010880P	0018037E
B4.02513Q	S-2		04/11/2014	0010880P	0018037E
B4.02514R	S-3		04/11/2014	0010880P	0018037E
B4.02515T	S-4		04/11/2014	0010880P	0018037E
B4.02515T	S-4	DUP	04/11/2014	0010880P	0018037E
B4.02516U	S-5		04/11/2014	0010880P	0018037E
B4.02517V	S-6		04/11/2014	0010880P	0018037E
B4.02518W	N-1		04/11/2014	0010880P	0018037E
B4.02519X	N-2		04/11/2014	0010880P	0018037E
B4.02520P	N-3		04/11/2014	0010880P	0018037E
B4.02521Q	N-4		04/11/2014	0010880P	0018037E
B4.02522R	N-5		04/11/2014	0010880P	0018037E
B4.02523T	N-6		04/11/2014	0010880P	0018037E
B4.02524U	N-2 DUP		04/11/2014	0010880P	0018037E
LCS-00687695H *		LCS	04/11/2014	0010880P	0018037E
RBK-00687694G *		RBK	04/11/2014	0010880P	0018037E

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

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02512P	Amount analyzed:	1.055e+00 GDRY
Client sample ID:	S-1	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-03 08:30 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	90.95 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS100	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	9.11e-03	2.0e-02	3.4e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	2.93e-02	2.2e-02	2.5e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	3.30e-03	3.2e-02	6.1e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	3.43e-03	1.3e-02	2.7e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02513Q	Amount analyzed:	1.054e+00 GDRY
Client sample ID:	S-2	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-03 09:50 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	95.20 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS101	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	9.24e-03	1.6e-02	2.3e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	2.45e-02	2.0e-02	2.5e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	-3.78e-03	3.0e-02	5.8e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	-2.42e-03	6.0e-03	1.9e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02514R	Amount analyzed:	1.031e+00 GDRY
Client sample ID:	S-3	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-03 10:40 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	92.65 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS102	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	1.73e-03	1.6e-02	3.6e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228 J	4.82e-02	2.6e-02	2.4e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	1.79e-02	3.4e-02	6.0e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	1.25e-03	8.7e-03	1.9e-02	PCI/GDRY	04/10/2014 17:05 CDT

Note: A "J" qualifier indicates a result that may be significantly under or overestimated.

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02515T	Amount analyzed:	1.053e+00 GDRY
Client sample ID:	S-4	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-03 11:15 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	92.88 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS103	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	0.00e+00	1.1e-02	2.6e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	5.63e-02	2.8e-02	2.1e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	3.63e-02	3.7e-02	5.9e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	2.87e-02	2.1e-02	2.3e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02515T	Amount analyzed:	1.053e+00 GDRY
Client sample ID:	S-4	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-03 11:15 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	92.88 %	Analyst:	AS
Ash/dry weight:	2.71 %	QC type:	DUP
Sample description:	N/A		
Comment:	N/A		

COUNTING INFORMATION

Date and time	Duration (min)	Detector ID	Operator
04/10/2014 17:05	1000.0	AS104	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	3.38e-03	1.5e-02	3.1e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228 J	7.38e-02	3.3e-02	2.9e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	4.71e-02	3.9e-02	6.0e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	2.89e-02	2.0e-02	2.1e-02	PCI/GDRY	04/10/2014 17:05 CDT

Note: A "J" qualifier indicates a result that may be significantly under or overestimated.

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02516U	Amount analyzed:	1.030e+00 GDRY
Client sample ID:	S-5	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-03 13:10 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	91.89 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS106	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	2.13e-02	2.7e-02	3.6e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	3.77e-02	2.8e-02	3.8e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	-6.47e-03	3.1e-02	6.4e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	6.94e-03	1.4e-02	2.4e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02517V	Amount analyzed:	1.038e+00 GDRY
Client sample ID:	S-6	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-03 13:35 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	90.96 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS107	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	5.26e-03	1.5e-02	2.6e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	2.71e-02	2.2e-02	3.0e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	1.97e-02	3.5e-02	6.1e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	1.02e-02	1.4e-02	2.0e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02518W	Amount analyzed:	1.069e+00 GDRY
Client sample ID:	N-1	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-04 08:38 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	94.98 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS108	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	9.20e-03	1.6e-02	2.3e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228 J	2.87e-02	2.0e-02	2.3e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	2.51e-02	3.5e-02	5.8e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	2.01e-02	1.7e-02	2.1e-02	PCI/GDRY	04/10/2014 17:05 CDT

Note: A "J" qualifier indicates a result that may be significantly under or overestimated.

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02519X	Amount analyzed:	1.055e+00 GDRY
Client sample ID:	N-2	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-04 09:10 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	94.84 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS109	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	9.84e-03	1.7e-02	2.5e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	2.43e-02	1.9e-02	2.2e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	1.36e-03	3.1e-02	5.9e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	1.17e-03	8.3e-03	1.8e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02520P	Amount analyzed:	1.067e+00 GDRY
Client sample ID:	N-3	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-04 10:30 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	91.44 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS111	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	0.00e+00	1.7e-02	4.1e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228 J	4.94e-02	2.8e-02	3.0e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	-4.80e-03	3.0e-02	6.0e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	3.44e-04	9.3e-03	2.2e-02	PCI/GDRY	04/10/2014 17:05 CDT

Note: A "J" qualifier indicates a result that may be significantly under or overestimated.

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02521Q	Amount analyzed:	1.047e+00 GDRY
Client sample ID:	N-4	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-04 09:50 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	87.42 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS112	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	8.73e-03	1.9e-02	3.2e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	2.40e-02	2.1e-02	2.9e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	-2.05e-03	3.0e-02	6.0e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	5.22e-03	1.0e-02	1.7e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02522R	Amount analyzed:	1.058e+00 GDRY
Client sample ID:	N-5	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-04 12:50 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	94.56 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS119	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	0.00e+00	1.3e-02	3.1e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	4.32e-02	2.4e-02	2.8e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	2.32e-02	3.3e-02	5.5e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	6.26e-03	9.4e-03	1.4e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	B4.02523T	Amount analyzed:	1.059e+00 GDRY
Client sample ID:	N-6	Preparation batch #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-04 13:20 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	91.09 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS114	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	2.83e-03	1.3e-02	2.6e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	2.80e-02	2.1e-02	2.7e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	4.18e-02	3.6e-02	5.7e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	8.11e-03	1.1e-02	1.6e-02	PCI/GDRY	04/10/2014 17:05 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 #:	0010880P
Matrix:	SOIL	Assay batch #:	0018037E
Collected:	2014-03-04 09:10 CST	Prep procedure:	N/A
Sample type:	SAM	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	95.06 %	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS115	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	-1.50e-03	1.0e-02	2.8e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th228	1.20e-02	1.5e-02	2.3e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th230	2.54e-02	3.4e-02	5.7e-02	PCI/GDRY	04/10/2014 17:05 CDT
Th232	6.09e-03	1.2e-02	2.1e-02	PCI/GDRY	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	LCS-00687695H	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0010880P
Matrix:	N/A	Assay batch #:	0018037E
Collected:	N/A	Prep procedure:	N/A
Sample type:	N/A	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS116	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	4.26e-03	1.6e-02	3.2e-02	PCI	04/10/2014 17:05 CDT
Th228	-6.50e-03	8.5e-03	2.6e-02	PCI	04/10/2014 17:05 CDT
Th230	2.02e+00	2.1e-01	5.9e-02	PCI	04/10/2014 17:05 CDT
Th232	2.49e-03	8.8e-03	1.8e-02	PCI	04/10/2014 17:05 CDT

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

SDG #1400013

SAMPLE ANALYSIS REPORT

Lab sample #:	RBK-00687694G	Amount analyzed:	1.000e+00 SAMP
Client sample ID:	N/A	Preparation batch #:	0010880P
Matrix:	N/A	Assay batch #:	0018037E
Collected:	N/A	Prep procedure:	N/A
Sample type:	N/A	Analysis method:	NAREL TH-EICHROM
Dry/wet weight:	N/A	Analyst:	AS
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
04/10/2014 17:05	1000.0	AS117	CEB

ANALYTICAL RESULTS

Analyte	Activity	$\pm 2 \sigma$ Uncertainty	MDC	Unit	Reference Date
Th227	6.04e-03	1.7e-02	3.1e-02	PCI	04/10/2014 17:05 CDT
Th228	8.69e-04	9.5e-03	2.1e-02	PCI	04/10/2014 17:05 CDT
Th230	-7.28e-03	3.0e-02	5.9e-02	PCI	04/10/2014 17:05 CDT
Th232	3.54e-03	1.1e-02	2.2e-02	PCI	04/10/2014 17:05 CDT

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

SDG 1400013

PREPARATION BATCH SUMMARY

Preparation batch #: 0010880P
Analysis method: NAREL TH-EICHROM
Preparation procedure: N/A

NAREL Sample #	Client Sample ID	Analysis #	QC Type	Yield	$\pm 2 \sigma$ Uncertainty	Analyst
B4.02512P	S-1	00686323B	DUP	87.99 %	8.20 %	AS
B4.02513Q	S-2	00686329H		104.29 %	9.08 %	AS
B4.02514R	S-3	00686335F		96.42 %	8.73 %	AS
B4.02515T	S-4	00686341D		92.07 %	8.41 %	AS
B4.02515T	S-4	00687693F		93.51 %	8.45 %	AS
B4.02516U	S-5	00686347K		84.31 %	7.83 %	AS
B4.02517V	S-6	00686353H		87.05 %	7.77 %	AS
B4.02518W	N-1	00686359P		98.13 %	8.38 %	AS
B4.02519X	N-2	00686365M		95.24 %	8.32 %	AS
B4.02520P	N-3	00686371K		87.79 %	8.20 %	AS
B4.02521Q	N-4	00686377R		91.86 %	8.39 %	AS
B4.02522R	N-5	00686383P		92.71 %	7.52 %	AS
B4.02523T	N-6	00686389W		90.85 %	7.48 %	AS
B4.02524U	N-2 DUP	00686395U		84.79 %	7.14 %	AS
LCS-00687695H *		00687695H	LCS	93.16 %	7.47 %	AS
RBK-00687694G *		00687694G	RBK	93.04 %	7.69 %	AS

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

QC RESULTS FOR BATCH 0010880P

NAREL Sample #	Analysis #	QC Type	Analyte	%R	RPD	Z	Evaluation
B4.02515T	00687693F	DUP	TH227	100.7	200.0	0.36	PASS
B4.02515T	00687693F	DUP	TH228		26.9	0.82	PASS-J
B4.02515T	00687693F	DUP	TH230		25.8	0.40	PASS
B4.02515T	00687693F	DUP	TH232		0.6	0.01	PASS
LCS-00687695H	00687695H	LCS	TH230		0.13		PASS
RBK-00687694G	00687694G	RBK	TH227				PASS
RBK-00687694G	00687694G	RBK	TH228				PASS
RBK-00687694G	00687694G	RBK	TH230				PASS
RBK-00687694G	00687694G	RBK	TH232			PASS	

Note: Results qualified with -J may be significantly under or over-estimated and are not evaluated for QC purposes.