Management and Interpretation of Real-time Data Collected by US EPA's Environmental Air Radiation Monitoring Network (RadNet)

National Environmental Monitoring Conference

Big Data: Environmental Measurement and Monitoring Data in the 21st Century

Chicago, IL
July 14, 2015

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Montgomery, AL

Overview

- Introduction to EPA's Radiation Monitoring Program
  - National Analytical Radiation Environmental Laboratory (NAREL), OAR/ORIA, Montgomery, AL
- Acquisition of real-time data
- Management and interpretation of real-time data
  - *Big Data: Environmental Measurement and Monitoring Data in the 21st Century*
- Acquisition and management of laboratory analyses

RadNet's Mission

- EPA has developed a nationwide environmental radiation monitoring program known as RadNet
  - To track national / regional ambient radiation levels
  - To identify the degree and extent of contamination in the event of an emergency
- RadNet
  - Supports EPA's role in incident assessment
  - Focuses on monitoring potential impacts to population and public health

RadNet Objectives

- RadNet provides data quickly in the event of a radiation incident to
  - Decision makers for use concerning potential actions to protect public health
  - Dispersion modelers to assist in predicting/refining source term and dispersion characteristics
  - Nuclear/radiation health experts to enable further assessment of national impact
- RadNet provides ambient background data and data related to a known radiological incident (such as Fukushima)

RadNet Objectives (continued)

- RadNet is <u>not</u> intended to
  - Be regulatory
  - Monitor nuclear facilities
  - Provide an early warning system for nuclear accidents
  - Provide a means to monitor in the immediate locality of the incident – this is addressed by other assets

Monitoring Systems

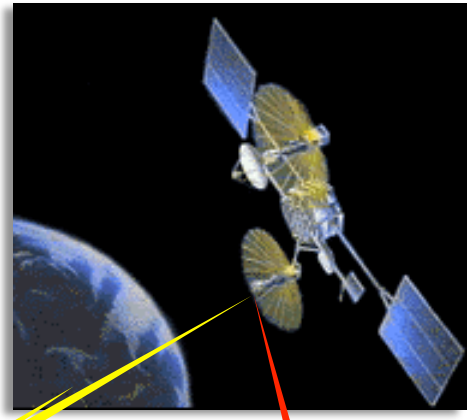
134 monitors installed.
6 additional sites sought in/around:

- Fargo, ND
- Ellensburg, WA
- Mobile, AL
- Great Falls, MT
- Medford, OR
- Middleton, IA
- Minot, ND
- Savannah, GA
- Dodge City, KS

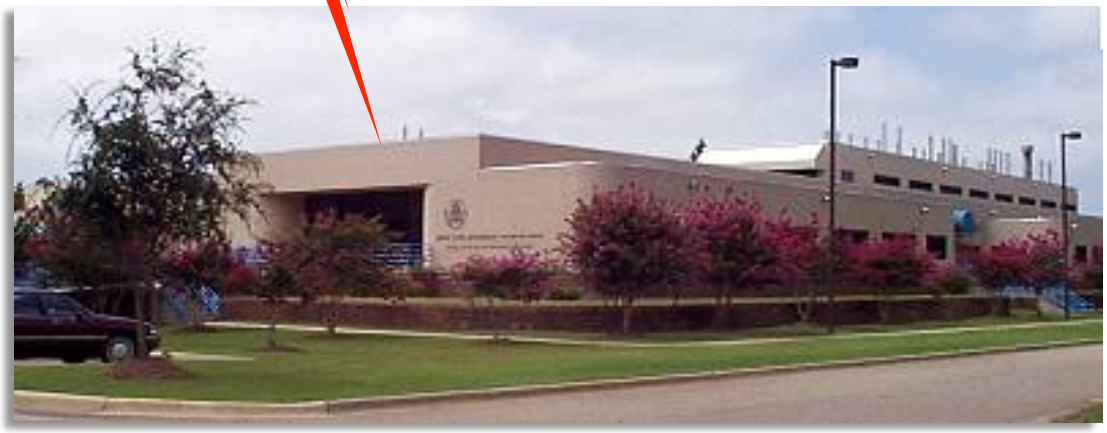
Monitoring Systems

Monitoring Systems

Each fixed air monitor provides real-time capability and transmits data to the NAREL facility.

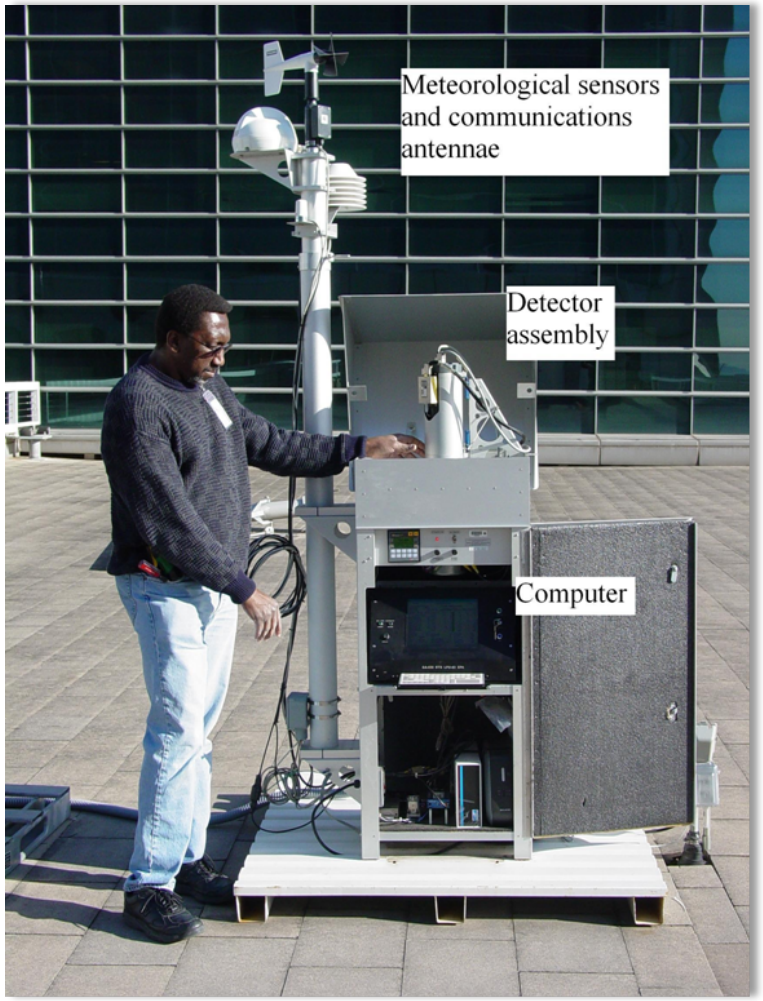


Data are transmitted by satellite telemetry and cell phone.



Monitoring Systems

- First installation 2006
- 134 installed
- Environmental chamber testing
- Wind tunnel testing
- Data publically available



Monitoring Systems

Systems have a high volume air sampler and a gamma spectrometry detector, allowing for continuous monitoring of radiation emanating from particles collected on an air filter.

Filters are sent to NAREL for more sensitive analysis and further identification of radionuclides.

Monitoring Systems

The monitor's radiation detector is positioned above a 4" polyester filter, which samples at 60 m^3/hr.

Data Collection

- Collect air sample continuously
  - Acquire continuous radiation data and summarize once per hour
- Transmit data to the NAREL facility in Montgomery, AL
  - Encrypted telemetry system with redundant telecommunications capabilities
- Receive and store data at NAREL, assess incoming data for upper and lower limits, notify staff with out-of-range "alarm"
  - Perform quantitative analysis at NAREL as indicated
- Supplement real-time data with laboratory analyses of filters
  - NAREL performs additional analyses if laboratory screening levels are exceeded

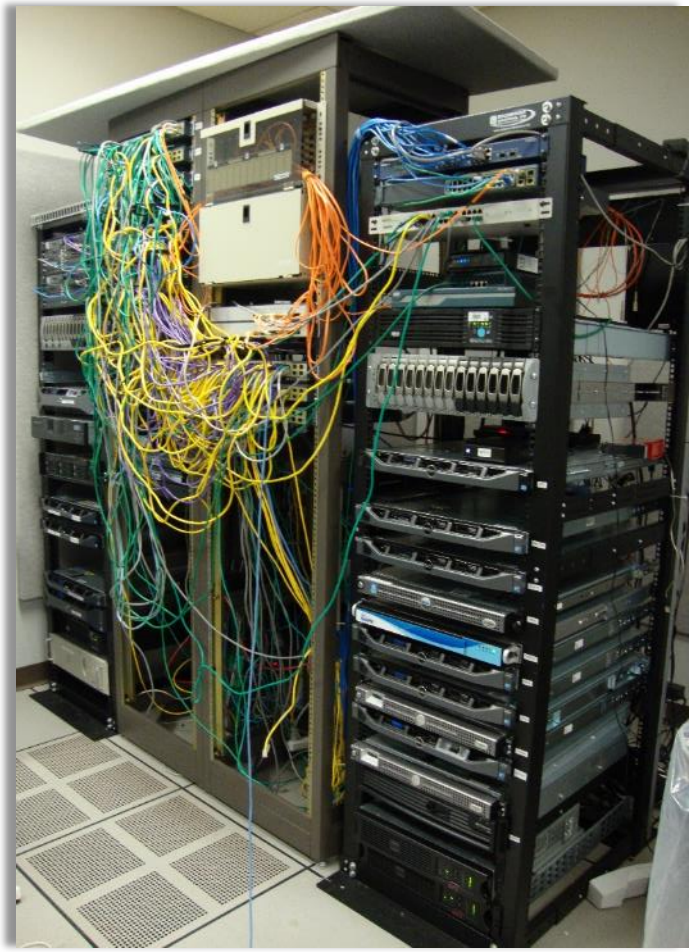
Data Management

Big Data: Environmental Measurement and Monitoring Data in the 21st Century

- 3,000 data files each day
- Over 1,000,000 data files annually
- Managing and interpreting large quantities of analytical data require a combination of automated and manual processes

Data Management

Server to Relational Database



Data Management

Initial Screening

Data Management

Two-tiered notification

WINDOWO

INQUIRY-MODIFY

RADNET
Tracking Environmental Radiation Nationwide

19 - JUN - 2015 10:01:24

MONITOR PARAMETERS

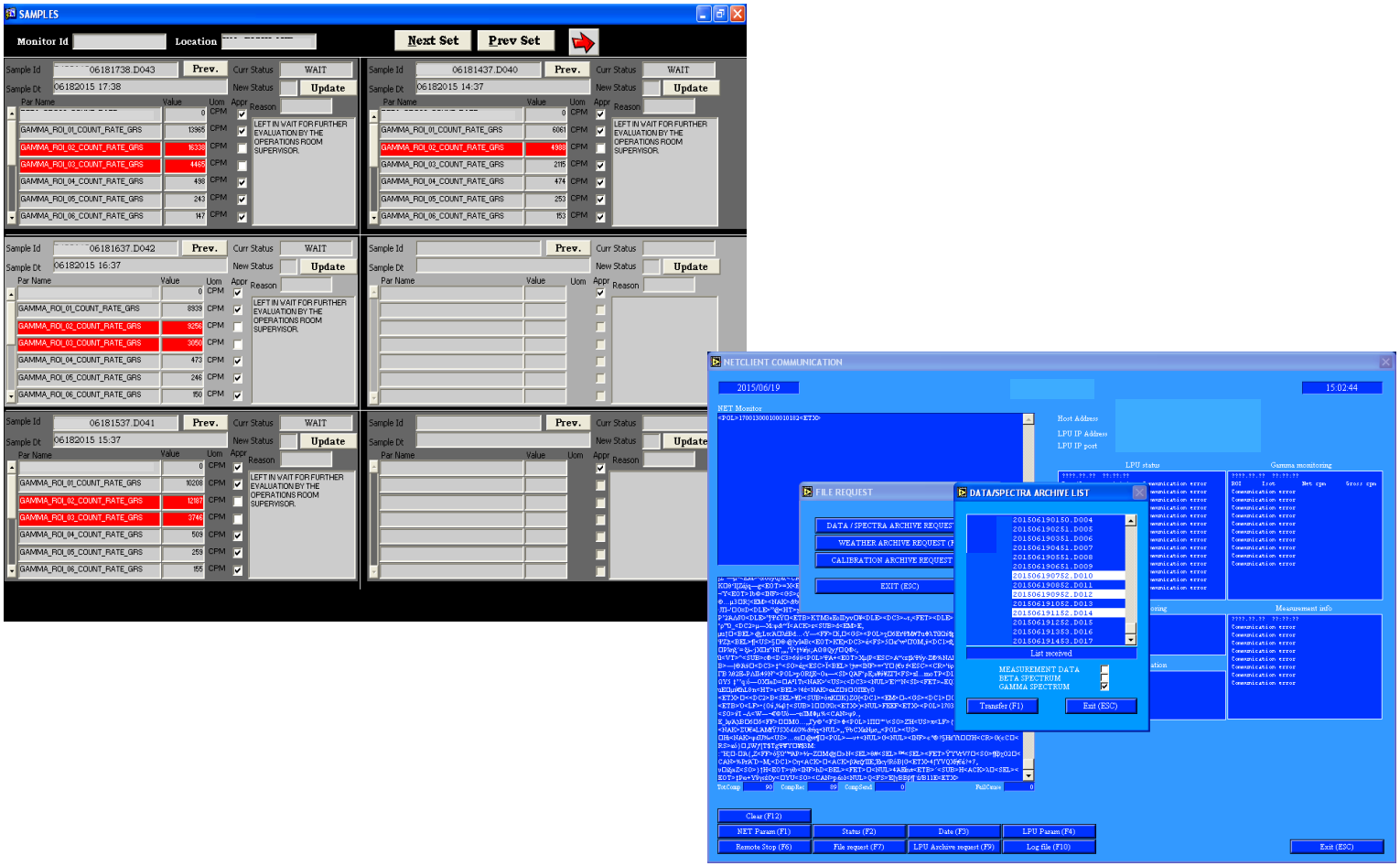
Monitor ID | Monitor Type: F | Monitor Location

Parameter Name				Email	UOM	IB Fld Pos	Disp Seq	Par Type	Val Y/N	From Date	To Date
GAMMA_ROI_04_COUNT_RATE	.0000	1000.0000			CPM	39	64	N	N	1/2007 00:00	2/2222 00:00
GAMMA_ROI_05_COUNT_RATE	.0000	1000.0000			CPM	40	65	N	N	1/2007 00:00	2/2222 00:00
GAMMA_ROI_06_COUNT_RATE	.0000	1000.0000			CPM	41	66	N	N	1/2007 00:00	2/2222 00:00
GAMMA_ROI_07_COUNT_RATE	.0000	1000.0000			CPM	42	67	N	N	1/2007 00:00	2/2222 00:00
GAMMA_ROI_08_COUNT_RATE	.0000	1000.0000			CPM	43	68	N	N	1/2007 00:00	2/2222 00:00
GAMMA_ROI_09_COUNT_RATE	.0000	1000.0000			CPM	44	69	N	N	1/2007 00:00	2/2222 00:00
GAMMA_ROI_10_COUNT_RATE	.0000	1000.0000			CPM	45	70	N	N	1/2007 00:00	2/2222 00:00
GAMMA_ROI_01_COUNT_RATE_GRS	10.0000	400000.0000	1000000.0000	N	CPM	46	8	C	Y		
GAMMA_ROI_02_COUNT_RATE_GRS	10.0000	3697.0000	500000.0000	Y	CPM	47	10	C	Y		
GAMMA_ROI_03_COUNT_RATE_GRS	10.0000	1950.0000	7500.0000	Y	CPM	48	12	C	Y		
GAMMA_ROI_04_COUNT_RATE_GRS	10.0000	564.0000	2500.0000	Y	CPM	49	14	C	Y		
GAMMA_ROI_05_COUNT_RATE_GRS	10.0000	264.0000	2500.0000	Y	CPM	50	16	C	Y		
GAMMA_ROI_06_COUNT_RATE_GRS	10.0000	169.0000	2500.0000	Y	CPM	51	18	C	Y		
GAMMA_ROI_07_COUNT_RATE_GRS	10.0000	196.0000	2500.0000	Y	CPM	52	20	C	Y		
GAMMA_ROI_08_COUNT_RATE_GRS	10.0000	124.0000	2500.0000	Y	CPM	53	22	C	Y		
GAMMA_ROI_09_COUNT_RATE_GRS	10.0000	91.0000	2500.0000	Y	CPM	54	24	C	Y		
GAMMA_ROI_10_COUNT_RATE_GRS	10.0000	145.0000	2500.0000	Y	CPM	55	26	C	Y		

F10 Save | Down Next | F8 Query | Up Prev | Clear | Notification Types | Monitor Type Parameters | Parameters Report | Cntrl-Q Exit

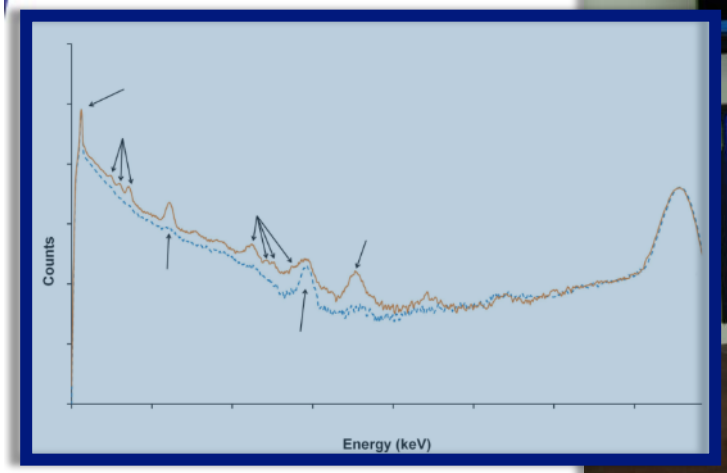
Data Management

Flagged Values



Data Management

Manual Review



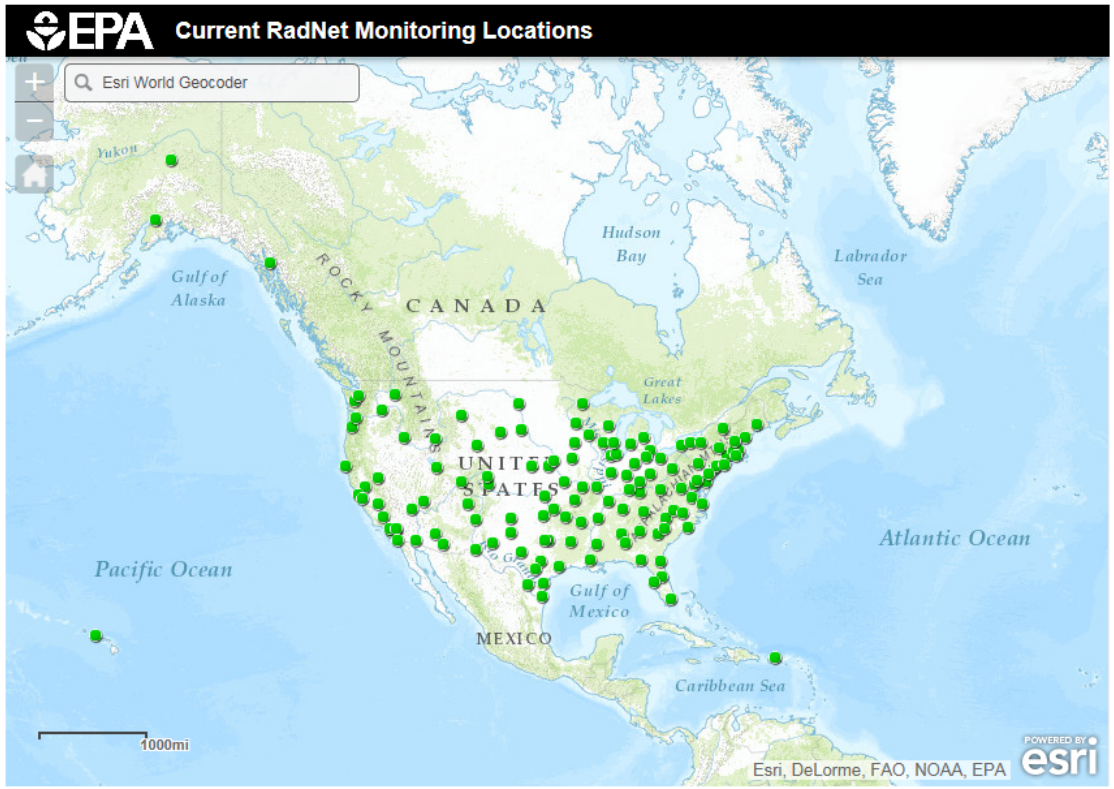
Data Management

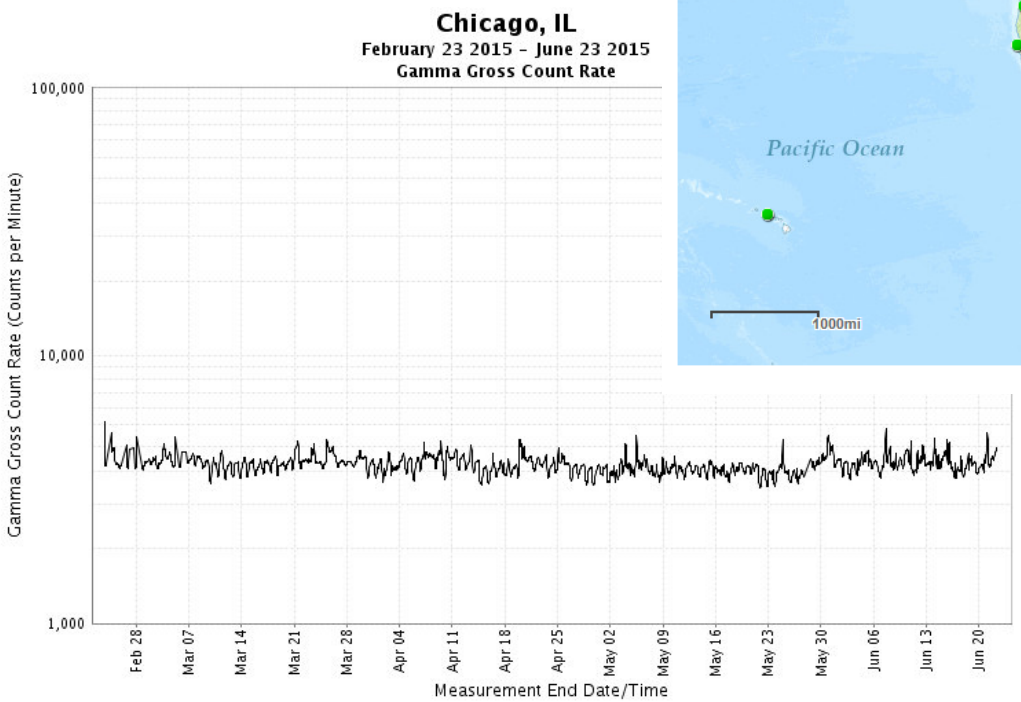
Data Verification

Gamma Energy Range 2 Gross(CPM)	Gamma Energy Range 3 Gross(CPM)	Gamma Energy Range 4 Gross(CPM)	Gamma Energy Range 5 Gross(CPM)	Gamma Energy Range 6 Gross(CPM)						
1976	1236	347	197	113						
1975	1247	347	199	111						
1983	1256	346	201	112						
1954	1221	344	198	110						
1948	1224	340	192	113						
1972	1227	337	187	108						
1945	1200	330	183	104						
1971	1223	333	188	108						
2002	1252	343	191	108						
2044	1268	351	193	112						
2066	1283	344	195	111						
2070	1298	347	196	111	134	85	36	41	6/22/2015 4:53	6/22/2015 3:53
2092	1307	356	197	113	134	85	36	40	6/22/2015 5:53	6/22/2015 4:53
2128	1313	351	198	114	136	85	35	40	6/22/2015 6:53	6/22/2015 5:53
2136	1323	354	200	114	135	88	35	40	6/22/2015 7:53	6/22/2015 6:53
2147	1332	359	196	114	134	85	34	42	6/22/2015 8:54	6/22/2015 7:54
2169	1364	357	205	113	139	85	35	41	6/22/2015 9:54	6/22/2015 8:54
2220	1401	366	214	118	143	89	36	42	6/22/2015 10:54	6/22/2015 9:54
2216	1412	369	218	118	144	90	36	42	6/22/2015 11:54	6/22/2015 10:54
2159	1374	368	216	115	140	89	36	44	6/22/2015 12:55	6/22/2015 11:54

Data Management

Approved Data



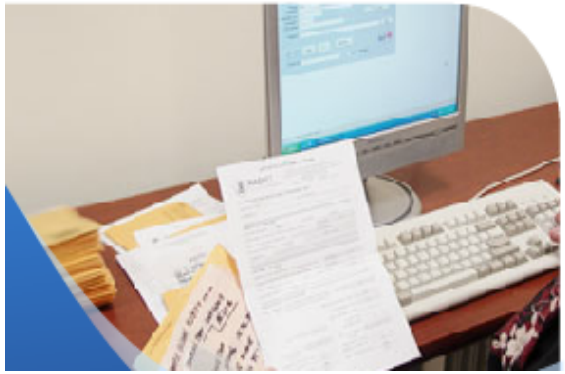


Data Management

Instrument maintenance

Laboratory analyses

Initial screening



Archival & annual composite analyses

Laboratory analyses

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RadNet

<< Return

Location: **CHICAGO,IL**
Medium: **AIR-FILTER**
Nuclides/Radiation: **Gross Beta**

Units: **Traditional**
Year Date Range : **2015 - 2015**

The following results are based on the temporal changes in radiation level or radionuclides concentration over a specific date range for a specified location and medium, or the nationwide distribution radiation level, or nuclide concentration for a specified date and medium.

Location Average vs. Overall Average Results or Graph it.

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Report an Error

Location	Medium	Sample Date	Procedure Name	Nuclides/Radiation	Result	Combined Standard Uncertainty	MDC	Unit
CHICAGO, IL	AIR-FILTER	24-MAR-15	Gross beta in air	Gross Beta	0.00823	0.00054	0.00018	pCi/m3
CHICAGO, IL	AIR-FILTER	26-MAR-15	Gross beta in air	Gross Beta	0.00767	0.00058	0.00042	pCi/m3
CHICAGO, IL	AIR-FILTER	31-MAR-15	Gross beta in air	Gross Beta	0.00558	0.00038	0.00018	pCi/m3
CHICAGO, IL	AIR-FILTER	02-APR-15	Gross beta in air	Gross Beta	0.0047	0.00041	0.00049	pCi/m3
CHICAGO, IL	AIR-FILTER	09-APR-15	Gross beta in air	Gross Beta	0.00751	0.00048	0.00012	pCi/m3
CHICAGO, IL	AIR-FILTER	14-APR-15	Gross beta in air	Gross Beta	0.00772	0.00051	0.00018	pCi/m3
CHICAGO, IL	AIR-FILTER	16-APR-15	Gross beta in air	Gross Beta	0.00446	0.0005	0.00065	pCi/m3
CHICAGO, IL	AIR-FILTER	21-APR-15	Gross beta in air	Gross Beta	0.0057	0.00039	0.00019	pCi/m3
CHICAGO, IL	AIR-FILTER	23-APR-15	Gross beta in air	Gross Beta	0.0052	0.00044	0.00044	pCi/m3
CHICAGO, IL	AIR-FILTER	28-APR-15	Gross beta in air	Gross Beta	0.00577	0.00039	0.00019	pCi/m3
CHICAGO, IL	AIR-FILTER	30-APR-15	Gross beta in air	Gross Beta	0.00354	0.00034	0.00046	pCi/m3
CHICAGO, IL	AIR-FILTER	05-MAY-15	Gross beta in air	Gross Beta	0.0064	0.00043	0.00019	pCi/m3
CHICAGO, IL	AIR-FILTER	07-MAY-15	Gross beta in air	Gross Beta	0.00896	0.00066	0.00046	pCi/m3

Location Average vs. Overall Average Results

The Location Average vs. Overall Average Results table compares the average results for a specific location to the average results for all locations monitored for each key radionuclide in the selected medium.

Graph it

Nuclides/Radiation	Location			Overall Average	States in Overall Average
	Minimum	Maximum	Average		
Gross Beta	0.00354	0.0191	0.00837	0.00899	MO, OR, SD, NJ, AZ,

Laboratory analyses

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RadNet

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Location: **CHICAGO,IL**
Medium: **AIR-FILTER**
Nuclides/Radiation: **Uranium-238**

Units: **Traditional**
Year Date Range : **2009 - 2015**
The following results are based on the temporal changes in radiation level or radionuclides concentration over a specific date range for a specified location and medium, or the nationwide distribution radiation level, or nuclide concentration for a specified date and medium.

Location Average vs. Overall Average Results or Graph it.

Location	Medium	Sample Date	Procedure Name	Nuclides/Radiation	Result	Combined Standard Uncertainty	MDC	Unit
CHICAGO, IL	AIR-FILTER	31-DEC-09	Actinides (Uranium) by Extraction Chromatography	Uranium-238	9.3	1.9	2.8	aCi/m3
CHICAGO, IL	AIR-FILTER	31-DEC-10	Actinides (Uranium) by Extraction Chromatography	Uranium-238	23.5	4.1	3.4	aCi/m3
CHICAGO, IL	AIR-FILTER	31-DEC-11	Actinides (Uranium) by Extraction Chromatography	Uranium-238	16.8	3.1	2.7	aCi/m3
CHICAGO, IL	AIR-FILTER	31-DEC-12	Actinides (Uranium) by Extraction Chromatography	Uranium-238	17.6	3.4	4.6	aCi/m3

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Summary

- EPA's RadNet radiation monitoring system
  - Tracks national / regional ambient radiation levels
  - Identifies the degree and extent of contamination in the event of an emergency
  - Generates over 1,000,000 data files annually
- Data are analyzed by a combination of automated and manual review, evaluation and verification
  - Permits rapid characterization of radiation levels
  - Enhances incident response
  - Allows efficient instrument trouble shooting and expedited maintenance/repair