



RADNET
Tracking Environmental Radiation Nationwide

Long-Lived Airborne Gamma-Emitting Particulate Radioactivity in the United States

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- Air Particulate monitoring begun in 1950's by Public Health Service
- "Radiation Alert Network" monitored population centers nationwide
- Assess public health impacts from atmospheric weapons tests
- Fixed location high volume samplers
- Cellulose filter media impregnated with charcoal
- Field estimate of gross beta activity, pancake GM/ratemeter
- Laboratory gross beta count, low background proportional counter
- Periodic composites analyzed for Pu and U



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- EPA took over from PHS when EPA was created in 1970
- Consolidated into “Environmental Radiation Ambient Monitoring System” in 1973
- Original filter media discontinued by manufacturer in mid-1980’s, replaced with polyester felt
- Re-evaluated post 9/11
 - Major expansion of monitored locations – population and geographical distribution considered
 - Add near-real-time beta and gamma monitoring capability
 - Mission re-defined



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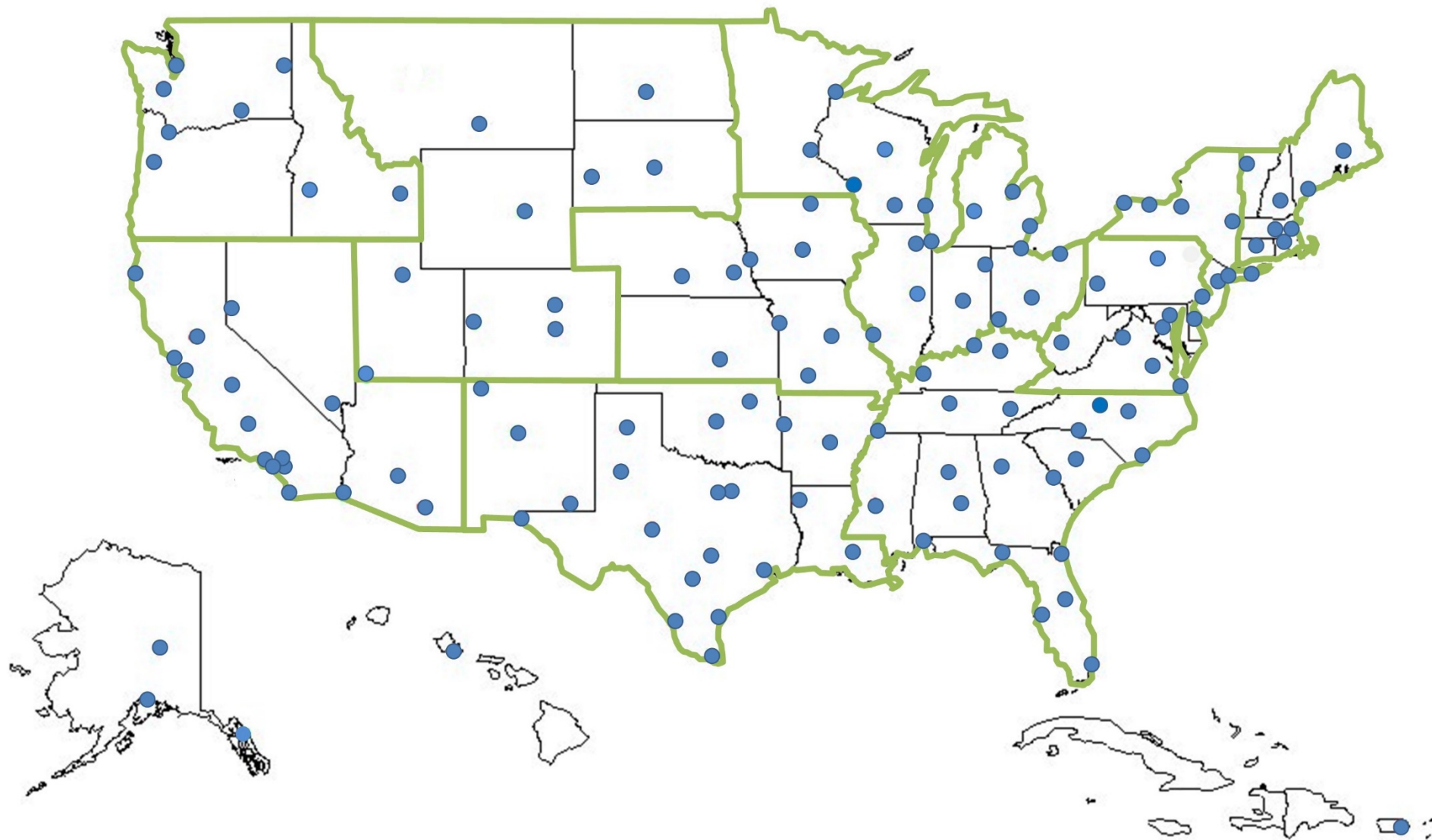
RadNet mission includes:

- Provide data for radiological emergency response assessments in support of homeland security and other responders to radiological accidents and incidents.
- Inform public officials and the general public of the impacts resulting from major radiological incidents/accidents and on ambient levels of radiation in the environment.
- Provide data on baseline levels of radiation in the environment.
- More information about RadNet available at <http://www2.epa.gov/radnet>



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Samplers are very similar to Total Suspended Particulate (TSP) high volume samplers. Only one location is sampled in each city. Most sampling locations are on roof tops, or co-located with developed sampling platforms where EPA-mandated ambient air quality monitoring is conducted.



Samplers operate 24/7 at a nominal flow rate of one cubic meter per minute, except for a few minutes each week when filters are changed, and several hours once a year for re-calibration. Unless there are equipment problems, the volume of air sampled is about 10,000 cubic meters per week or about 500,000 cubic meters per year.

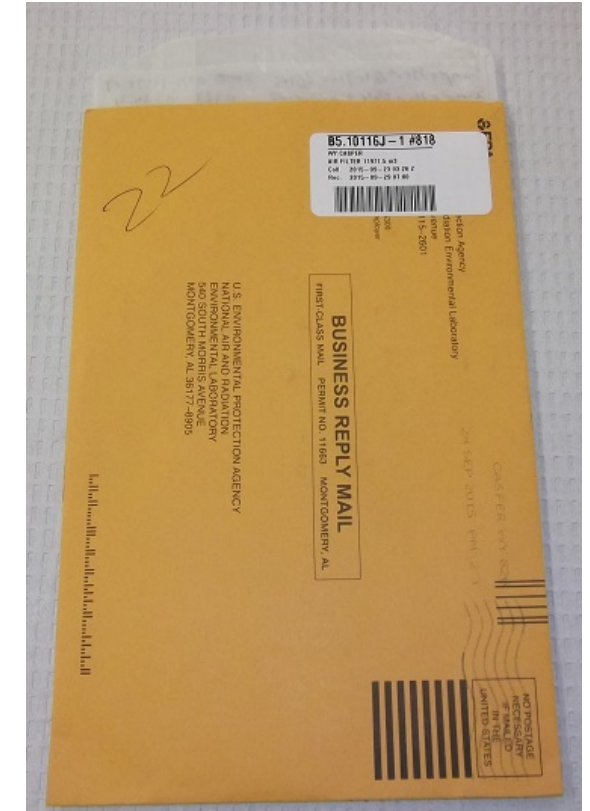


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Filter media is changed once or twice a week and mailed to the National Analytical Radiation Environmental Laboratory (NAREL) in Montgomery AL. Individual filters are screened for gross beta activity. Additional analysis of individual filters is performed if the screening action level is exceeded (rare).





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Each year, a composite of all filters collected at each sampling location is prepared by dry ashing at 1050^oF in a muffle furnace.



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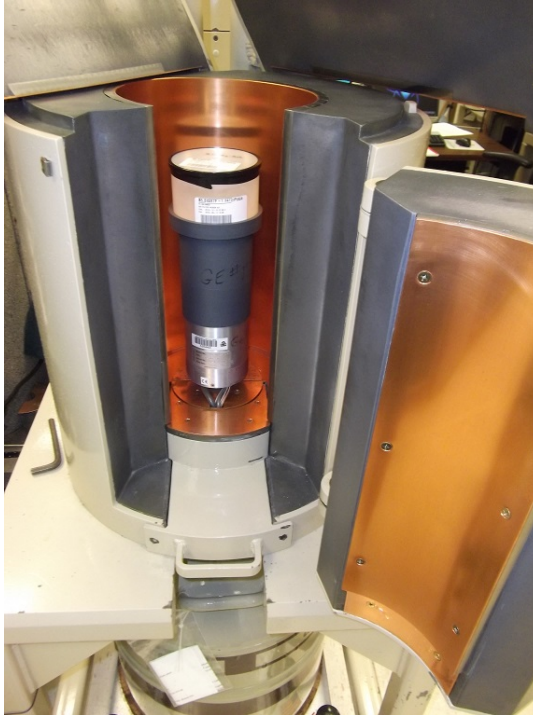


The composited ash is placed in containers for which the laboratory has calibrated geometries for analysis with High Purity Germanium (HPGe) detectors.



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Calendar year 2014 composite samples were counted for 1000 minutes on six different HPGe detectors selected for their relatively high efficiency for Pb-210 gamma rays at 46 keV: Canberra P-type XtRa extended range with carbon fiber windows and ORTEC N-type GMX with Beryllium windows.

Disclaimer: EPA uses hardware and software from all three current and former major US suppliers, Canberra, ORTEC, and Princeton Gamma-Tech, depending on the specific application. No endorsement of any supplier's hardware or software is intended.



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Gamma spectra were analyzed with GammaVision using ENV32 analysis engine:

- Library included:
 - Be-7, Na-22, Al-26, K-40, Cs-137, Pb-210 – half life was that of the nuclide
 - Tl-208, Bi-212, Pb-212, Ac-228 – 5.75 year half life of Ra-228 was used
 - Bi-214, Pb-214 – 1600 year half life of Ra-226 was used
- Half lives and gamma intensities taken from Decay Data Evaluation Project
- Decay corrected during collection
- NAREL does not attempt to quantify U-235 or Ra-226 by gamma spectrometry
- All radon and thoron daughter activities and concentrations are flagged as “estimated”

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Nationwide Annual Average Activity Concentrations in pCi/m³

	Be-7	Na-22	Pb-210	K-40	Cs-137
Average, all locations	6.30E-02	7.70E-06	8.39E-03	2.27E-04	4.27E-06
Minimum	1.25E-02	7.50E-07	2.31E-03	5.20E-05	1.38E-06
Maximum	1.34E-01	1.52E-05	1.46E-02	9.75E-04	1.57E-05
Average Relative Standard Uncertainty of Individual Measurements	6.3%	22.7%	5.6%	11.8%	29.7%

Note: Al-26 was included in the analysis library but was not detected in any samples.



Nationwide Annual Average Activity Concentrations in pCi/m³

	Ac-228	Pb-212	Tl-208	Bi-214	Pb-214
Average, all locations	2.78E-05	1.60E-05	8.25E-06	1.46E-05	1.71E-05
Minimum	7.20E-06	3.70E-06	1.53E-06	2.30E-06	3.60E-06
Maximum	7.20E-05	5.59E-05	2.49E-05	4.32E-05	5.09E-05
Average Relative Standard Uncertainty of Individual Measurements	24.1%	19.6%	24.1%	24.8%	21.3%



Nationwide Annual Average Activity Concentrations of ash in pCi/g

	K-40	Cs-137	Ac-228	Pb-212	Tl-208	Pb-210	Bi-214	Pb-214
Average, all locations	1.57E+01	3.11E-01	1.99E+00	1.13E+00	5.82E-01	6.79E+02	9.75E-01	1.17E+00
Minimum	6.57E+00	1.10E-01	4.28E-01	2.34E-01	1.63E-01	1.66E+02	2.30E-01	3.32E-01
Maximum	2.68E+01	1.01E+00	8.55E+00	4.37E+00	2.51E+00	2.13E+03	2.70E+00	2.46E+00

Activity concentrations in the ash are typical of surface soil in the US, except for Pb-210 which is several orders of magnitude greater than typically found in surface soil. Results suggest that concentrations of Thorium series radionuclides in surface soil are higher than concentrations of Uranium series radionuclides, and that airborne Pb-210 activity is primarily from decay of radon progeny that remains suspended in the air rather than from re-suspension of surface soil.



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Analysis results for individual locations is publicly available at the EPA EnviroFacts web site:
http://iaspub.epa.gov/enviro/erams_query_v2.simple_query

Any analytes that were flagged as “estimated” are excluded from the EnviroFacts database. All radon and thoron daughter concentrations are “estimated” and are not transferred to EnviroFacts.

Acknowledgements

Sampling equipment is operated, and samples are collected by employees of city, county, and state governments, universities, and private companies at 135 locations throughout the US and territories. They are not compensated by EPA; their time is volunteered. The RadNet program could not function without them.

Most of the analyses for this study were performed by Michelle Owens, principal gamma spectrometrist at NAREL.