

Public Health Preparedness Summit
 2/18-20/2009
 

Rapid Clinical Radiochemical Analytical Methods for Emergency and Terrorism Preparedness and Response

Robert L. Jones, PhD
and Kathleen L. Caldwell, PhD

Inorganic and Radiation Analytical Toxicology Branch
 Division of Laboratory Sciences
 National Center for Environmental Health
 Centers for Disease Control and Prevention
SAFER • HEALTHIER • PEOPLE™

Disclaimer

Mention of company or product names does not constitute endorsement by the National Center for Environmental Health (NCEH), Centers for Disease Control (CDC), or the Public Health Service.

Potential Radiological Terrorist Scenarios

- Nuclear
 - Targeted attack on nuclear facility
 - Improvised nuclear device
 - Nuclear weapon
- Radiological
 - Radiological dispersion device (RDD); e.g., "Dirty bomb"

Some examples: ^{60}Co , ^{90}Sr , ^{137}Cs , ^{192}Ir , ^{210}Po , ^{241}Am , ^{238}Pu , ^{239}Pu , ^{244}Cm , ^{252}Cf , and others...





Radiological Dispersal Device (RDD)

A device that disperses radioactive material by conventional explosive or other mechanical means, such as a spray



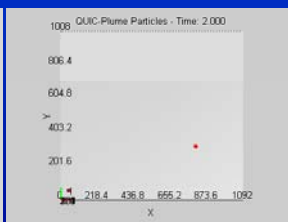
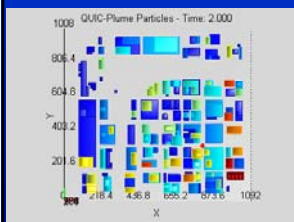
After a Radiation Event, Public Health Officials Will Need to Answer the following:

- **What** are people exposed to or contaminated with
- **Who** was exposed
- **How much** exposure or contamination did each person have

The decision to medically treat people will depend on our ability to rapidly and accurately identify and quantify **internal contamination**

Comparison of Dispersion Patterns

[5µm particles using QUIC model with and without buildings]
Mike Brown (Los Alamos National Laboratory)



*We can't model our way out of this;
We need to measure our way out!*

Radionuclide Analytical Methods (typical in DOE / DOD facilities)

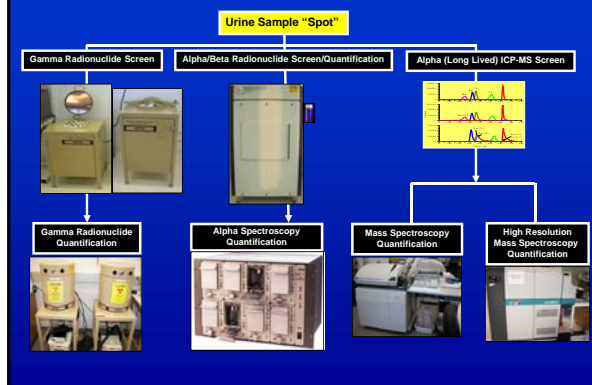
- Requires a **24 hour** Urine Collection
- Most results available in **3-21 days**
- **Limited** radionuclide analytical methods
- Sample throughput of **5-20 samples/day/lab**

Urgent Needs for Evaluation of a Population Exposed to an IND / RDD (Future Rad Lab Requirements)

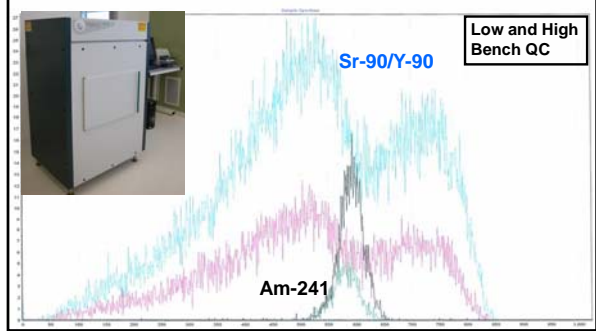
- Analytical methods that require only **5-50 mL of urine**
- Analytical methods for a **wide variety** of radionuclides
- Results available in **4-36 hours**
- Sample throughput of **100-2000+** samples/day/lab

This will provide the decision makers essential exposure data in the shortest possible time

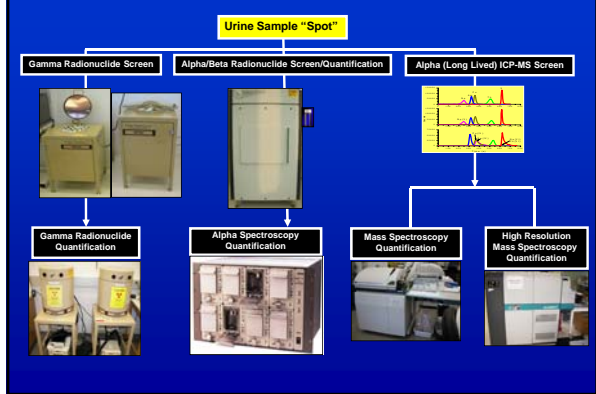
CDC's Urine Radionuclide Screen



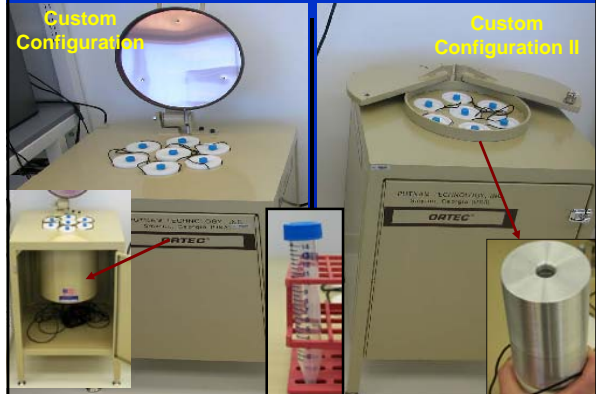
Liquid Scintillation: Gross Alpha/Beta Screen

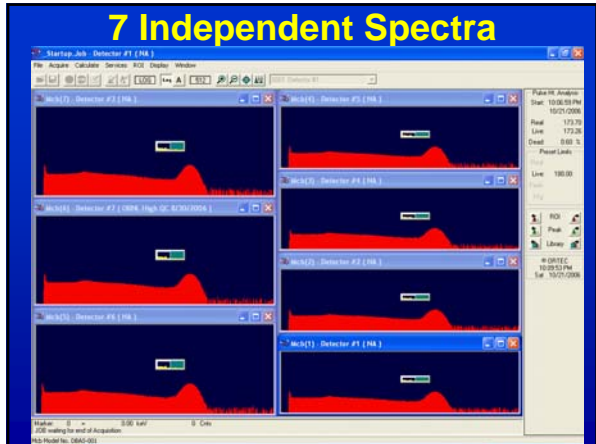


CDC's Urine Radionuclide Screen



Sodium Iodide 'Well Type'





NaI Well Detector Report

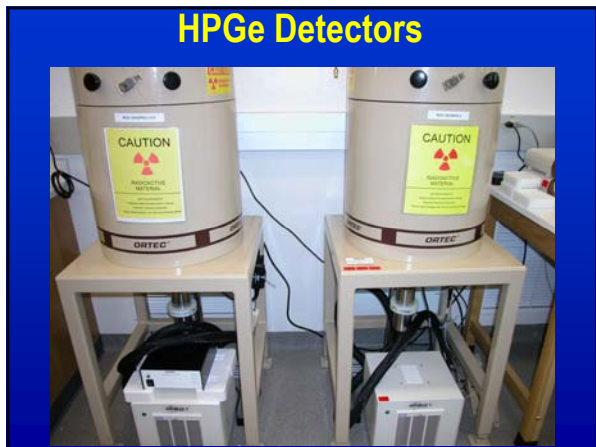
ORTEC Gross Gamma Counter Sample Evaluation

Sample Date/Time: Friday, September 22, 2006 2:05:08

	Actual (CPS)	SPID	Limit (CPS)	Evaluation
Det: 1	17.27	00000001	20.00	PASSED
Det: 2	17.83	00000002	20.00	PASSED
Det: 3	17.21	00000003	20.00	PASSED
Det: 4	17.44	00000004	20.00	PASSED
Det: 5	16.52	00000005	20.00	PASSED
Det: 6	16.79	00000006	20.00	PASSED
Det: 7	12.11	00000007	15.00	PASSED

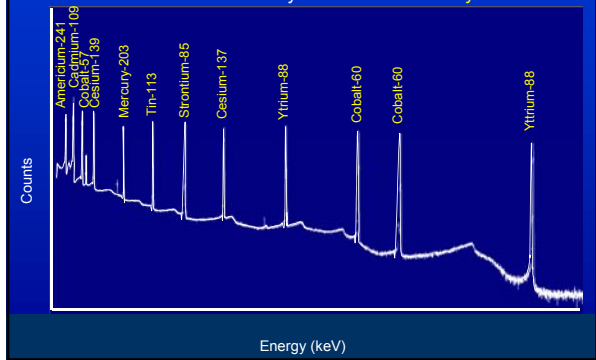
Detector #7 is the centrally located detector

We currently have 42 detectors

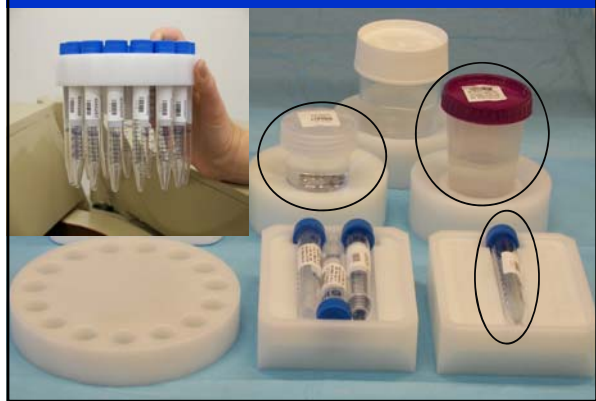


Gamma Emitters in Urine (HPGe)

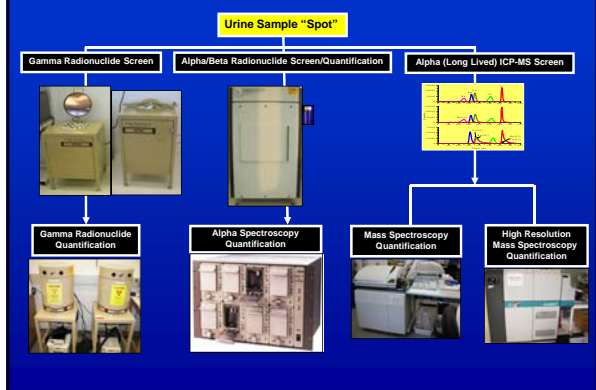
Some radionuclides likely to be used in a dirty bomb



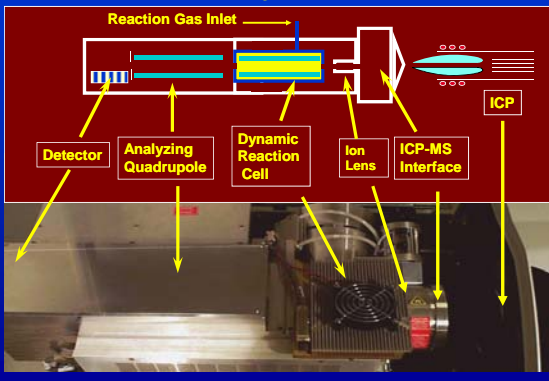
All Sample Geometry Holders



CDC's Urine Radionuclide Screen



Schematic and Layout of ICP-DRC-MS



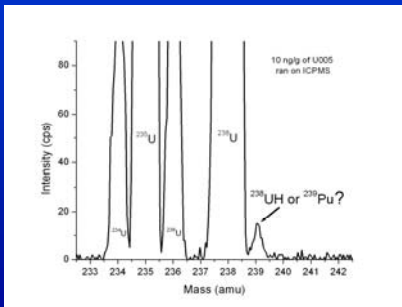
Actinides by ICP-MS: The issues

Polyatomic ions

^{236}UH and ^{237}Np
 ^{237}NpH and ^{238}U
 ^{238}UH and ^{239}Pu
 ^{240}PuH and ^{241}Am
 ^{242}PuH and ^{243}Am

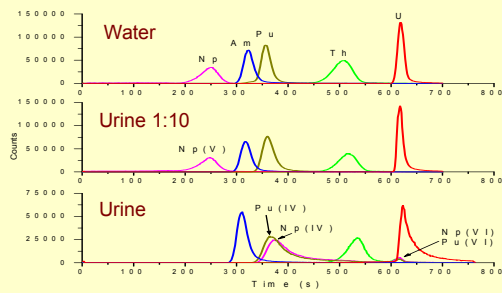
Isobars

^{238}U and ^{238}Np
 ^{238}U and ^{238}Pu
 ^{241}Pu and ^{241}Am



Actinides by IC-ICP-MS

Wei Hang, Wenwan Zhong, Luwang Zhu, Cynthia Mahan
 Los Alamos National Laboratory
 2004 Winter Conference on Plasma Spectrometry

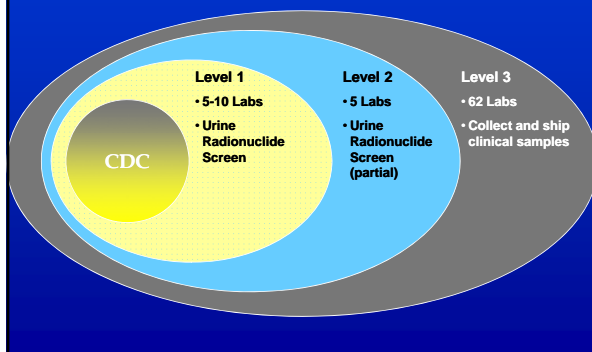


LRN-C and Radionuclides

LRN-C: Inorganic Analytical Toxicology labs can perform measurements on selected radionuclides

- Inductively Coupled Plasma – Mass Spec (ICP-MS)
 - ^{238}U , $^{235/238}\text{U}$ Isotope Ratio
- Magnetic Sector (MS-ICP-MS)
 - ^{238}U , $^{235/238}\text{U}$ Isotope Ratio, ^{239}Pu , ^{232}Th

Radiological - Laboratory Response Network (Proposed)



“LRN-R”: Future Goals

- To rapidly (≤ 30 minutes) analyze urine for selected radionuclides
- To be able to achieve the analytical goals using a volume of ≤ 50 mL of urine
- To analyze the priority radionuclides (e.g. ^{60}Co , ^{137}Cs , ^{241}Am , etc.)
- To provide accurate and precise results in a short amount of time (>2000 /day)
- CLIA'88 compliant

Coordination with other Laboratories

- Environmental Protection Agency
- Food and Drug Administration
- Department of Homeland Security
- Department of Defense
- Department of Commerce
- Federal Bureau of Investigation
- Department of Energy
- States, Cities, Other Agencies
- **Integrated Consortium of Lab Networks**

Summary

- RDD is likely to be used to:
 - ◆ Contaminate places where people live and work.
 - ◆ Increase rate of cancer in targeted populations.
 - ◆ Cause major anxiety.
- Radiation Laboratory Methods: rapidly identify and quantify specific radionuclides in people potentially exposed to a radiological event.
- Radiological analytical methods (bioassays) are radionuclide specific.

Acknowledgements

- Kathleen Caldwell, PhD
- Jennifer Hartel
- Olga Piraner, PhD
- Ge Xiao, PhD

- Los Alamos National Labs
- Sandia National Labs
- Savannah River National Labs
- FDA, EPA, NIST, DOD

Questions
Discussions

Contact Info
Robert L. Jones, PhD

Centers for Disease Control and Prevention
4770 Buford Hwy
Mailstop F-50
Atlanta, GA 30341

RLJones@cdc.gov

"The findings and conclusions in this presentation have not been formally disseminated by the Centers for Disease Control and Prevention/the Agency for Toxic Substances and Disease Registry and should not be construed to represent any agency determination or policy."
