Cesium Chloride:

Dispersibility or Security?

Stephen V. Musolino, PhD, CHP
Nonproliferation and National Security Department

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BROOKHAVEN NATIONAL LABORATORY

a passion for discovery

Office of Science

Backdrop

- Cesium Chloride is important to medicine and medical research
- Currently there is no alternative
- Accelerators and x-ray machines are expensive, much less reliable and more costly to maintain
  - Many operators do not want these alternatives
  - Machines typically take up to 3 times more space for chillers and associated equipment
  - Space is a premium in hospitals
  - Financial impact on medical community to switch to an alternative technology

20 Years of Radiological Dispersal Device Experiments at the Sandia National Laboratory

Material	Physical Form	# devices
Ag	Metal	17
Bi	Metal	3
Ta	Metal	1
Al	Metal	5
Stainless Steel	Metal	2
Cu	Metal	2
Co	Metal	1
Mo	Metal	1
Pb	Metal	1
U	Metal	1
Ir	Metal	3
$SrTiO_3$	Ceramic (3 densities)	8

- More than 20 materials, 600 experiments
- More than 85 device geometries
- Funded by DOE NEST, DTRA, DOE CM, DOE international, NRC, DHS

CeO2	Ceramic (2 densities)	7
Tb/Pd	Cermet	1
Co	Liquid	2
CsCl	Liquid	6
$BaSO_4$	Slurry	1
MnO_2	Ceramic Powder	4
UO_2	Ceramic Powder	1
CeO_2	Ceramic Powder	7
CeO_2	Pressed Powder	3
CsCl	Powdered salt	7
$BaSO_4$	Powdered salt	2

F. Harper, SNL

Experimental Facilities to Characterize Aerosols from a Dirty Bomb at the Sandia National Laboratories

Capacity -- 0.5 lb high explosive

Fred Harper

50 m^3 full sample recovery explosive aerosolization chamber

What if Radiological Terrorism Happens?

- If something bad happened, dispersal patters are a function of:
  - Device design
  - Quantity and physical form of the material
    - powder, ceramic, metal, etc.
  - The resulting aerosol fraction and the particle size distribution

- All this is true CsCl and <u>all other radioactive materials</u>

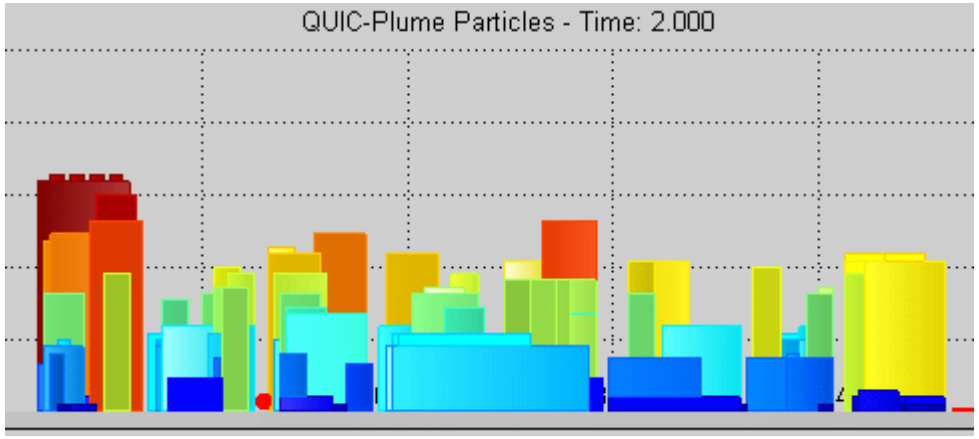
HARPER, F.T., MUSOLINO, S.V. and WENTE, W.B. (2007). “Realistic radiological dispersal device hazard boundaries and ramifications for early consequence management decisions,” Health Phys. **93**(1), 1−16.

Particle Size Effect

(Mike Brown, LANL)

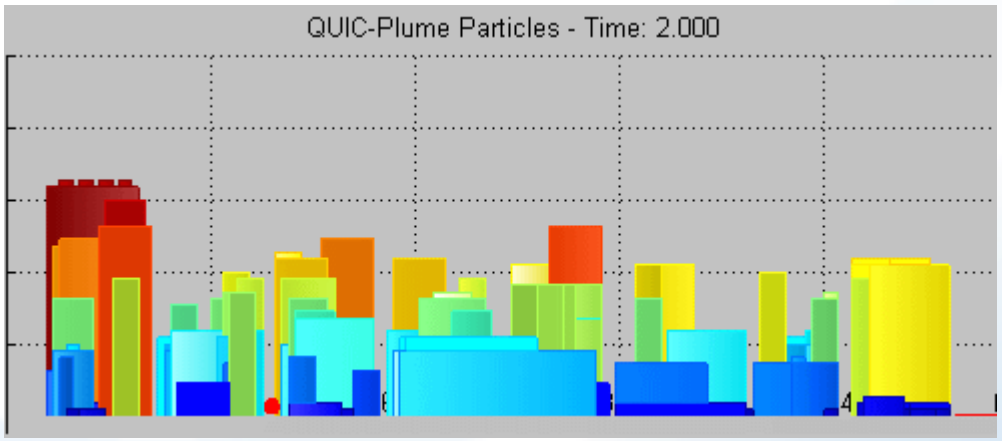
Transport & Dispersion

5 micron particles



5 micron particles lofted high into the air, 250 micron particles settle towards ground

250 micron particles



What if the Powder Form is Changed to a Solid and Insoluble Form?

- Change from soluble power to insoluble glass or mineral (pollucite) is possible (R&D needed to achieve, $$)

- Less dispersible form does not negate the risk of a potentially large cleanup and economic cost
  - Radioactive materials other than CsCl can cause large scale environmental impacts under the right conditions

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Security of Radioactive Materials

- Increased Controls have vastly reduced the risk of a terrorist incident with radioactive materials
- **Question:** Does the residual risk still justify eliminating CsCl?
- Are there cost effective ways to further improve the security of licensed materials (and reduce residual risk)?

Experience in New York City Area

- Non-regulatory assist visits to 94 licensee sites
  - 14 Licensees outside NYC in CT, NJ, NY
  - 80 NYC - IC and non-IC applications
- Objective – to share best practices and provide advice on opportunities for improvement
- Complement but not conflict with regulatory requirements

Experience in New York City Area

- Recommendations to mitigate risks covered:
  - Enhancements in physical security hardware
  - Administrative policy and procedures
  - Best Practices for Security, BNL Report 90329-2009
- Recommendations demonstrated how to make meaningful improvements, invariably at little cost to the licensee.
- Holistic approach – the facility not just the room with the radioactive material

Conclusion

- Changing physical form of Cs does not eliminate the potential impact from a dispersal
  - Re-engineering the physical form will be costly
- Significant economic impact and effects to the medical industry and medical research to replace CsCl with alternatives
  - e.g. accelerator/x-ray technologies.
- Residual risk for CsCl post-ICs is acceptable (or close to it) and opportunities exist for cost effective improvements to security