# Simulants

Harry Martz, Lawrence Livermore National Laboratory
Carl Crawford, Csuptwo

# So What? Who Cares?

- No certification/qualification testing performed in US with simulants
- While no aircraft has ever been attacked with simulants, the use of simulants for training and testing may lead to better systems than explosives alone
- Simulants are available commercially and from DHS
- Vendors have developed and used simulants
- Issues to consider
  - Are simulants needed?
  - For what purposes should simulants be used?
  - How should simulants be validated?
  - Should simulants be used instead of explosives?

# Acknowledgements

- DHS funded LLNL to validate explosives
- Science Review Panel - Developing and Validating Simulants for Commercial, Military, and Home Made Explosives, March 8, 2010
  - Mainly addressed x-ray based EDS
  - Final report may be available from DHS Explosive Division (EXD)
  - This presentation derived from the final report

# Questions - I

- What are the necessary and significant statements of requirements upon which a simulant can be developed?
- What are the specific physical measurements we want simulants to simulate?
- How should texture be addressed in the design of simulants?
- How might simulants model various kinds of heterogeneity?
- How should simulants be manufactured when seeking to represent a material with a continually variable physical criterion (e.g., density, Zeff, etc)?
- How might simulants well represent aging in materials?
- What are the categories of use for simulants (e.g., training, calibration, detection)?

# Questions - II

- What cautions should attend the use of simulants?

- How best should simulants be validated?

- What can be done to obviate the fabrication of numerous explosives so that their characteristics can be measured in order to synthesize their simulants?

- Who would be able to generate computer models of textures of explosives?

- Who would be able to manufacture simulants?

# Recommendation 1

- Simulants should be developed for several applications including to help train X-ray based explosive detection equipment.

- Simulants should not be used for Independent Test and Evaluation (IT&E, Certification).

- Simulants should be used at the user's own risk.

- The developers and providers of the simulants should not be held liable for their use.

# Recommendation 2

- The explosives and their features need to be properly specified so that simulants with appropriate features can be manufactured.

- Manufacturers of commercial explosive simulants, manufacturers of medical phantoms, and manufacturers of phantoms for non-destructive evaluation may be engaged for the development of simulants.

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# Recommendation 3

- Third-parties could be engaged to review the process of specifying, manufacturing and deploying simulants.

# Recommendation 4

- Sets of simulants should be created to span the feature space of explosives they represent.
  - This is known as matching clouds to clouds.
  - The correlations among those features of the explosives that can be measured using x-ray imaging devices should be duplicated in the set of simulants.

# Recommendation 5

- Vendors are not required to disclose how they use texture and other features either directly to the DHS or to an independent authority.

- However, voluntary disclosure of how such features are used is welcomed and could lead to simulants that are better analogs for explosives for vendor equipment.
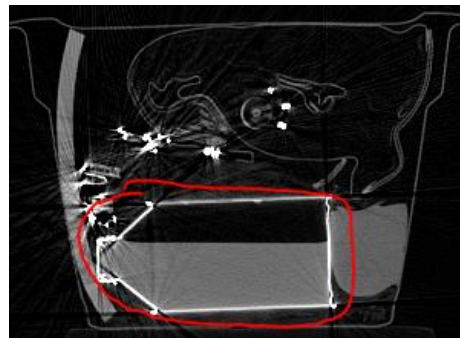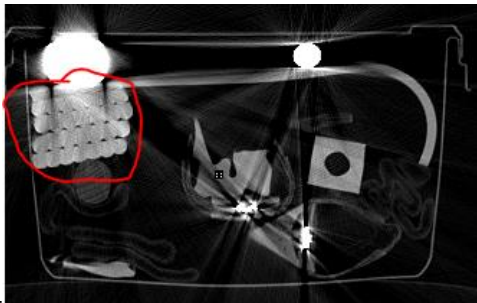
# Recommendation 6

- DHS should not recommend how texture and other features should be used.

# Recommendation 7

- Simulants should be evaluated after formulation, using a MicroCT ($\mu$CT) instrument or other scanner

# Recommendation 8

- The LLNL validation plan is a good foundation, but requires revision.

- The LLNL validation plan should be renamed to an evaluation plan.

# Recommendation 9

- Known differences between explosives and simulants should be disclosed to users and the users can make their decisions on the usefulness of the simulants.

# Recommendation 10

- It must be shown that $\mu$CT can be used to predict the values of density and effective atomic number to within ±5%.

# Additional Comments

- May be difficult to make simulants for fused systems (e.g., x-ray + neutrons)

- Simulants may need to be custom designed for each scanner

- Simulant may not be useful because scanner's PD may be < 100%
  - May need to dry lab this to get detection