Homemade Explosives (HME) Program Overview

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The HME Threat and DHS S&T

- Numerous attempted and executed terrorist attacks involving HME have led to an urgent operational need to detect HME in the transportation infrastructure in the U.S.

- **Recent Attacks and Attempts**
  - Madrid rail bombings 2004
  - London Underground 2005
  - U.S. bound flights from the U.K. 2006
  - London theater district 2006
  - Germany (Hydrogen Peroxide) 2007

Madrid 2004

- DHS S&T's HME Program is leveraging the knowledge and experience of the Department of Energy (DOE) National Laboratories, the Department of Defense (DOD) research laboratories, the Transportation Security Laboratory (TSL), private industry, and academia to:
  - Identify, characterize, model and test HME
  - Identify and test promising HME detection and screening technologies
  - Assess the damage HME can inflict on infrastructure

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Taxonomy of Current Threat

Our customers have prioritized a list of HME threat families based on assessments of available intelligence. The HME Program has used this list as a baseline for programmatic planning and execution

Common Household Chemicals

- Liquid hydrogen peroxide/fuel formulations (HP/F) - (e.g. hydrogen peroxide with various fuels)
- Mixtures with solid oxidizers, (e.g. perchlorates and ammonium nitrate.)
- Mono-molecular mixtures, (e.g. urea nitrate, TATP, petric acids.)
- Nitrogen based explosives, (e.g. nitro glycerin, EGDN, and methyl nitrate.)
- Continuing research will identify which formulations detonate and if they do so with characteristics to cause catastrophic damage to aviation and other transportation modes

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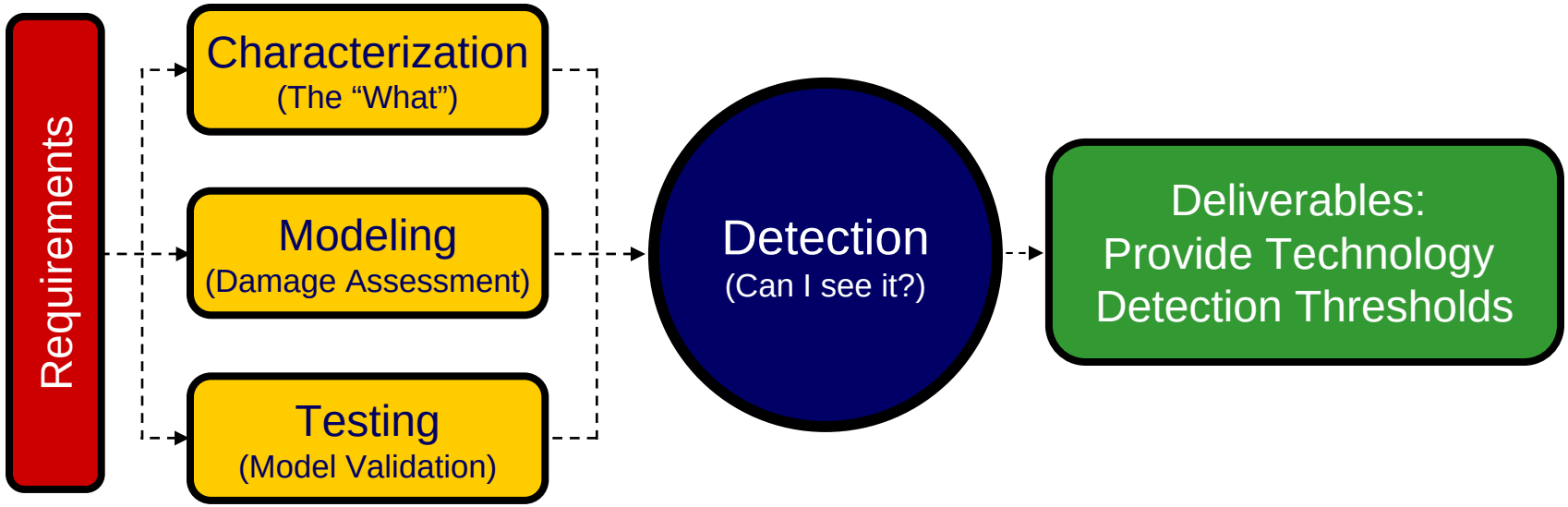
Program Structure & Process



- A capability that is comprised of several performers working in conjunction with each other to create a responsive process that allow DHS S&T to address the Capstone Requirements
- Deliverable: Determining technology detection thresholds for any explosive threats
- Readily adapt to the changing tactics and technology of our adversaries. Each program focus area drives our ability to improve detection capability

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Characterization

Strategic Goal: Systematically, determine the physical and chemical properties of HME threats, largely non-ideal explosives

HME explosive performance evaluation test

- Identify HME mixtures for future detection technology and define the properties of terrorist explosive materials.
- Define the physical and chemical signatures from threat materials in relation to detection methods under development or currently deployed
- Undertake all work using safe and reproducible mixing and handling procedures for large quantities of HME
- Assess detonation and blast characteristics

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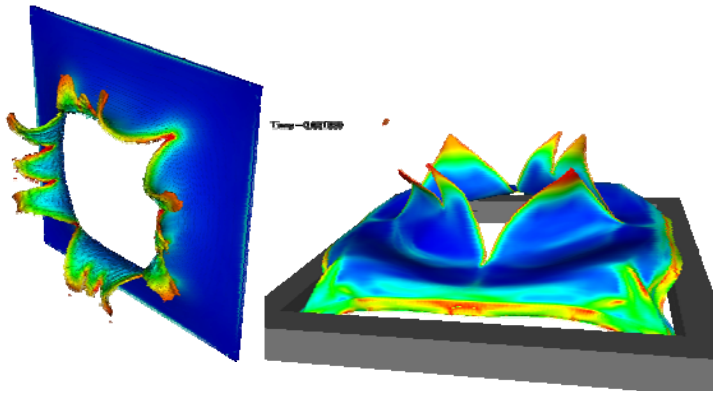
Modeling

Strategic Goal: Develop, verify and validate models that will assess damage non-ideal HME would cause to key U.S. infrastructure



Hydrodynamic and structural effect analyses

- Couple explosive models and equations of state with finite element representation of key infrastructure
- Improve and further develop predictive explosive modeling tools
  - Kinetic-Cheetah
  - Hydrodynamic code
  - Finite Element Analysis
- Verify and validate predictive tools with data from blast damage assessments

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Testing

Strategic Goal: Determine key explosive properties of HME and their actual damage potential

Full-scale blast testing of wide-body commercial aircraft

- Arena testing of explosives to establish blast propagation characteristics
- Testing of flat and curved panels that are representative of an actual aircraft's structure, with gradual scaling up to full pressurized aircraft and to validate models
- Determine levels of fugitive emissions and trace amounts detection equipment bust be able to detect
- Use results to validate modeling and simulation

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Detection

Strategic Goal: Evaluate technologies against homemade explosive threats and determine their detection capabilities

Operational assessments of aviation checkpoint explosive detection technology

- Establish performance requirements for detection equipment
- Provide recommendations that will address threshold limits of detection for HME threats
- Identify HME detection systems with the capability to screen liquid HME in containers with clutter
- Collect and analyze threat data to improve both detection hardware and software algorithm performance

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Program Outputs

- Reports, assessments and recommendations covering:
  - Which materials require boosters or are cap sensitive
  - The range of materials (including composition & concentration) which detonate
  - Damage equivalency of materials
  - HME model validation
  - Unique HME physical properties that may be exploited for detection
  - Predicted damage to key infrastructure as a function of weight and configurations of the explosive and clutter
- DHS S&T will provide recommendations on policy requirements for HME detection and defeat equipment to our customers
- DHS S&T solicitations of industry will be used to identify specific commercial off the shelf items that can be procured or improved to address the customers' specific HME detection concerns

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Customer Payoffs

- Customers receive the threshold limits of detection for HME formulations, which allows them and DHS S&T to work with vendors to improve detection hardware and software for use in baggage screening

- The data collected and analyzed by DHS S&T helps vendors improve the overall performance of detection equipment
  - Improves screening of:
    - Laptops
    - Liquid bottle containers
    - Shoes

- Current improvement to detection algorithms in equipment as well as evaluations of COTS Technology have already been made to look at liquids in glass and plastic bottles

Smith 6040aTix

L3 ACX 6.4

Rapiscan 522DV

Smith 6040i

Rapiscan 520B

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Path Forward – Where are we going?

- Once the analysis of the prioritized list HME Threats is completed, the next set of emerging threats as they are identified will go through the process of characterization, modeling, testing and detection. The next set of threats will be determined by the primary customer.

- The Program is currently focused on air transportation, but can be readily adapted for rail car and other modes of transportation

- A future program goal is to utilize the recently established Explosives Centers of Excellence (COE)s to conduct long-term research projects as well as using their findings as a feeder to the main HME Program

- Performance standards for next generation of checked baggage explosives detection equipment (Manhattan II)

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