DHS Science & Technology R&D to Counter IEDs

Stephen Hancock
Director for Program Integration, PEO (C-IED)
Science and Technology Directorate
Department of Homeland Security

October 8-9, 2009

PARTNERING FOR A SAFER NATION

DHS S&T CIED Challenge:
From Securing Special Events to Transportation Security and Beyond
### IED Threat Domains

**Person-Borne IED (PBIED)**  
Suicide bomber or leave behind bomb

- Rail
- Public arena events
- Government Facilities
- VIP events
- Terminals
- Seaport, ships and ferries

**Vehicle-Borne IED (VBIED)**  
Parked vehicle or suicide attack

- Border crossing or vehicle raveling to high-value target
- Buildings, malls and National Monuments
- Tunnels, bridges and dams

### TERRORIST THREATS

- **Higher Likelihood of Occurrence**
  - Gov't, economy, societal instability
  - IEDs

- **Lower Likelihood of Occurrence**
  - Physical Critical Infrastructure Attack
  - Radiological

- **Higher Consequence of Occurrence**
  - Trans Nat'l Migration
  - Biological

- **Lower Consequence of Occurrence**
  - Nuclear
International Explosives Events

Bomb threats continue worldwide - 82,000 terrorist incidents between 1970 and 2007 *

Top three terrorist targets:
- Private Citizens property – 19.82%
- Government – 16.98%
- Business – 15.95%

51.34% of time terrorists tactic was bombing
- 43.69% - Explosives/Bombs/Dynamite
- 7.65% - Incendiary

Aug 2008 to Aug 2009 averaged over 600 IED attacks per month worldwide (excluding Iraq & Afghanistan)

* "Global Terrorism Trends", START presentation at the National Press Club on 14 September 2009.

Better Known Domestic IEDs

May 18, 1927. Andrew Kehoe destroys Bath Consolidated School with previously planted charges, kills self in suicide bombing.


March 17, 2003 Dwight Watson drives tractor into pond near the Washington Monument, holds Washington captive for 2 days with threat of IED. No explosives present.

April 19, 1995. Timothy McVeigh attacks Alfred P. Murrah Federal Bldg with a large VBIED.

Which of these were terrorist attacks?

- Title 18 USC Section 2331, (5)
  - (5) the term “domestic terrorism” means activities that—
  - (A) involve acts dangerous to human life that are a violation of the criminal laws of the United States or of any State;
  - (B) appear to be intended—
    - (i) to intimidate or coerce a civilian population;
    - (ii) to influence the policy of a government by intimidation or coercion; or
    - (iii) to affect the conduct of a government by mass destruction, assassination, or kidnapping; and
  - (C) occur primarily within the territorial jurisdiction of the United States.

IED: Weapon of Mass Influence

- Kehoe:
  - single attack against a local school
  - motivated by desire for retribution
- Weather Underground
  - series of attacks directed at government buildings and the economy (banks)
- McVeigh
  - single attack directed at federal government, with extensive loss of life
  - claimed the bombing was revenge for "what the U.S. government did at Waco and Ruby Ridge."
- Rudolph
  - series of attacks (Olympics, abortion clinics, night club)
  - motivated by objections to abortion, homosexuality
Domestic Explosives Threat Continues

- Bomb threats and suspicious packages cause major disruption in the U.S. almost daily – law enforcement responded to over 2,300 since 2004*
  - LaGuardia Airport, August 1, 2009 – Central terminal was evacuated and closed for 3 ½ hours after a man entered the building with a fake bomb – thousands of travel plans were disrupted and delays rippled across the country
  - Washington, DC, May 9, 2008 – Suspicious package near White House closes down 17th street near Pennsylvania Ave.

- Bombs are exploding in U.S. Cities
  - New York, NY, 25 May 2009 A homemade bomb exploded outside an upper East Side Starbucks, shattering the store’s windows
  - Seattle, WA, Oct 2, 2008 – Bomb squad investigating blast at garage at Second Avenue and Union

- Terrorists continue planning explosives attacks in the U.S.
  - Dallas, TX, Sep 23 - 24 2009 – Two Islamic extremists were arrested for unrelated plots to conduct vehicle improvised explosives device attacks against prominent buildings.
  - New York, Sep 18, 2009 – A terror plot that came to light this week following raids in New York may have been targeting a major transportation center – investigations continuing

“Use of a conventional explosive continues to be the most probable al-Qa’ida (domestic) attack scenario” said Director of National Intelligence to Congress Intelligence Committee, January 2007

* ATF Bomb Data Center


On February 12, 2007, President Bush signed HSPD-19, which addresses the threat of terrorist use of explosives and IEDs in the United States

- Establishes a national policy on the prevention and detection of, protection against, and response to terrorist use of explosives (and IEDs) in the United States; and

- Calls for the development of a Report to the President comprised of 11 specific requirements that yield a “national strategy and recommendations.”
HSPD-19 Assigns DHS as Lead Agency for Research, Development, Testing, and Evaluation (RDT&E) Projects Relating to Combating Terrorist Use of Explosives and IEDs in the Homeland

- HSPD-19 Section 9:
  - The Secretary of Homeland Security, in coordination with the Attorney General, the Secretary of Defense, and the Director of the Office of Science and Technology Policy, shall coordinate Federal Government research, development, testing, and evaluation activities relating to the detection and prevention of, protection against, and response to explosive attacks and the development of explosives render-safe tools and technologies. The heads of all other agencies that conduct such activities shall cooperate with the Secretary of Homeland Security in carrying out such responsibility.

- The HSPD-19 Report was approved by the President on December 20, 2007
- The Obama Administration has reviewed and retained HSPD-19

Coordination with Other Government Agencies

NSTC Subcommittee on Domestic IEDs
- Co-chaired by DHS S&T, TSWG, OSTP
- Published C-IED Research Challenges
- Undertaking coordinated investment plan
- Members from:
  - DoD
  - DOE
  - DHHS
  - DHS
  - DOJ
  - DOS
  - DOT
  - EPA
  - IC
  - TSWG

HSPD-19 Joint Program Office
- Mandated by HSPD-19 Implementation Plan
- Administered by FBI for DOJ
- Organization:
  - Director appointed by DOJ
  - Deputy Director representing DHS
  - Executive Board
- Works with DHS S&T to coordinate RDT&E
Needs Prioritization

Critical Needs

- C-IED Network Attack and Analysis
- Detection of Homemade Explosives
- Standoff Rapid Detection of Person Borne IEDs
- Vehicle-borne IED Detection
- IED Access and Defeat
- Radio Controlled IED Countermeasures
- IED Assessment and Diagnostics
- Waterborne IED Detect and Defeat Systems
- IED Warnings
- IED Threat Characterization and Signatures

http://www.ostp.gov/cs/nstc/documents_reports
Terrorist IED Attack Cycle

1. Decide to attack
2. Plan the Attack
3. Obtain Resources
4. Prepare for Attack
5. Conduct the Attack
6. BOOM
7. Observe Consequences
8. Attribute Responsibility

DHS C-IED Investment Emphasis

- Identify indicators of radicalization in the U.S.
- Prevent & Predict
  - Evaluate programs to counter violent extremism
  - Track suspicious behaviors and prioritize likely targets, staging areas, and ISR assets
- Detect
  - Detect, isolate, and inert/defuse IEDs without detonation
  - Protect population, infrastructure
- Defeat
  - Damaged structure stabilization
  - Community resilience
- Mitigate
- BOOM
- Observe Consequences
- Attribute Responsibility
Technology Development Cycle

Requirements → Research & Development → First Responder Community → Deployment

Future Requirements

Immediate Goals & Objectives (0-1 year)
- Utilize current knowledge, tools, and equipment

Near Term Goals & Objectives (1-3 years)
- Currently under development

Far term Goals & Objectives (3-10 years)
- Concepts and Innovative solutions
- Basic Research vs. Applied Research
S&T Countering Domestic Explosive Threats Program

**Prevent/Deter**
- Actionable Indicators & Countermeasures
  - Community Characteristics
  - Group Characteristics
  - Pre-incident Behaviors & Rhetoric
  - Integrated Framework
  - Countermeasure Evaluation

**Predict**
- Predictive Screening
  - Behavior Analysis
  - Video Tracking
  - Video Identification & Alert
- Risk Prediction
  - Target Prediction
  - Staging Area Prediction

**Detect**
- Person Borne IED
  - Suicide Bomber
  - Leave-behind
- Vehicle Borne IED
  - Integration
  - Demonstration
  - Canine

**Defeat**
- Bomb Access & Diagnostics
  - Type of Explosive
  - Device Triggers
- Render Safe
  - Electronic
  - Countermeasures
  - Inerting
  - Robotics

**Mitigate**
- Blast Mitigation
  - Blast resistant materials
  - Protective countermeasures
  - Stabilize damaged structures
- Urban blast effects
  - Predictive models
  - Effective Risk Communications

Cross Cutting:
- Standards; Outreach; Technology Demonstration/ System Integration, Integration of Public Perception Data, Community Resilience
- Intel Data Sharing (Intel Community); Technology resource & Test sharing (DoJ, DoD, DoE)

---

**Counter-IED Investment Areas**

- Social and behavioral science to identify potential IED threats
  - Real-time, automated video-based identification of suspicious behaviors
  - Framework integrating social and behavioral science indicators of radicalization
- Strategies to prevent potential IED attacks before they occur
  - Tested, effective strategies to counter violent extremism in domestic context

A human factors portfolio focused on identifying and preventing potential IED threats
Counter-IED Investment Areas

• Improved detection capabilities for known and emerging IED threats
  – Imaging technologies
  – Spectroscopic and trace detection technologies

• Improved probability of detection by screening for IEDs more efficiently to while minimizing effect on flow of people and commerce
  – Non-contact interrogation
  – Enhanced algorithms for automation

• Improved first responders’ ability to react to and defeat discovered IED threats
  – IED identification and defeat tools
  – Radio frequency jamming equipment

Diversified investment portfolio to maximize potential for success

Counter-IED Investment Areas

• Enhanced blast resistance
  – Advanced blast-resistant materials
  – Models for assessing damage from blast

• Mitigation of effects
  – Rapidly deployable means to stabilize damaged structures

• Community resilience
  – Communication of clear, understandable, credible warnings in the event of an IED threat
  – Recovery in the aftermath of an attack

Preventive measures to reduce effects of an event, help for recovery afterwards
C-IED Achievements and Deliverables

**Infrastructure & Geophysical Division**
- Stabilization of buildings workshop (08/09)
- Non-destructive experiments on Waldo-Hancock Bridge began October 2008.
- Series of urban canyon Computational Fluid Dynamic (CFD) analyses performed
- Extended the Financial District model / conducted calculations for flow through urban cityscape

**Explosives Division**
- Backscatter x-ray based system
- Mass Spectrometry based walkthrough portal
- Single Sided X-Ray Backscatter System Deployment
- 10 ECM systems distributed to bomb squads
- STIDP large public event setting field test:
  - Infrared cameras systems
  - Millimeter wave radar systems

**Human Factors/Behavioral Sciences Division**
- Pilot interviews with suicide bombing subject matter experts
- Alpha level testing on the geo-behavioral pattern extraction technology
- Workshop on Coding Methodologies for Case Studies
- Report on trends in sympathy and support for jihadist terrorism within the United States
- Report on de-radicalization programs in five countries and their domestic applicability

Interagency Collaborations

**Department of Defense**

**Intelligence Community**

**Department of Justice**

**Department of Energy**

**Other Federal Agencies**
Coordination Activities

- National Science and Technology Council
  - Subcommittee on Domestic Improvised Explosives Devices
  - Subcommittee on Infrastructure
  - Subcommittee on Human Factors
- Countering Violent Extremism Interagency Coordination Group
- Combating Terrorism Technical Support Office
  - Technical Support Working Group – National Interagency R&D Program for Combating Terrorism
  - Subgroups DHS supports
    - Blast Effects & Mitigation
    - Explosives Detection
    - Improvised Device Defeat
- National Infrastructure Protection Program Cross-Sector R&D Committee
- National Bomb Squad Commanders Advisory Board
- Program-level coordination and collaborations across agencies

Leverage Points/Collaborations

- Explosive detection system – leveraging JIEDDO* funded project Fido
  - DHS ruggedizing Fido for USCG use in the sea environment
  - Joint DHS/DOD
- Hardened Explosives Trace Detection System - leveraging JIEDDO project
  - JIEDDO funded development of 3 systems through TSWG**
  - DHS evaluating systems for domestic applications
- Single-sided imager for PBIED – collaboration with TSWG
  - DHS developed system to detect devices on a moving person (Rapiscan)
  - Technical Support Working Group (TSWG) modified ruggedizing for the military theatre
- Standoff dual-energy x-ray VBIED detection – collaboration with TSWG
  - TSWG developed a system (Carscan) for small slowly moving vehicles
  - DHS is modifying algorithms for detection of explosives on larger and higher speed vehicles
- Electronic Countermeasures (ECM) - leveraging JIEDDO project
  - DHS adapt military ECM technology for broader range of RF triggering devices that must be considered in domestic threats
- Disruption Tool Characterization - collaboration with TSWG
  - Joint test and evaluation of emerging VBIED disruptors for domestic Bomb Squads
- Single-sided imager for VBIED diagnostics – collaboration with TSWG
  - DHS and TSWG co-funding developing (ASAE system) for dual use
- Video extraction technology - collaboration with NIST***
  - Leveraging video extraction technology testing infrastructure
- Geo-spatial technology – collaboration with National Geospatial Agency, Office of Naval Research, and OSD/Rapid Reaction Technology Office
  - Leveraging geo-spatial technology testing infrastructure (data and test bed)

* Joint Improvised Explosive Device Defeat Organization
** Technical Support Working Group
*** National Institute of Standards & Technology
“The art of war teaches us to rely not on the likelihood of the enemy's not coming, but on our own readiness to receive him; not on the chance of his not attacking, but on the fact that we have made our position unassailable.”

Sun Tzu (544–496 B.C.), The Art of War
### C-IED: Contrasts in Environments

<table>
<thead>
<tr>
<th>DoD: Deployed Environment</th>
<th>DHS: Domestic Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Broad leeway for countermeasures</td>
<td>- Severe legal and social constraints</td>
</tr>
<tr>
<td>- Unified US/Allied Command</td>
<td>- Multiple independent authorities</td>
</tr>
<tr>
<td>- Higher joint training and funding capability</td>
<td>- Limited training and funding capabilities</td>
</tr>
<tr>
<td>- Abundant data on enemy TTPs</td>
<td>- Little data on enemy TTPs</td>
</tr>
<tr>
<td>- Tactical Targets (e.g., roadside bombs)</td>
<td>- Strategic Targets (e.g., critical infrastructure)</td>
</tr>
<tr>
<td>- Operatives plentiful</td>
<td>- Few operatives</td>
</tr>
<tr>
<td>- Terrorist support in population</td>
<td>- Non-supportive population</td>
</tr>
<tr>
<td>- Military explosives readily available</td>
<td>- Military explosives used sparingly</td>
</tr>
<tr>
<td>- Attacks largely part of insurgency</td>
<td>- Motivations behind attacks vary</td>
</tr>
<tr>
<td>- Data on attacks plentiful</td>
<td>- Data on attacks scarce due to low base-rate and privacy constraints</td>
</tr>
</tbody>
</table>
DoD C-IED Investment Emphasis

Wealth of data = improved predictive capability

Protect military convoys by:
- Pre-detonation of devices prior to vehicles entering the danger zone
- Improved vehicle armoring
- Jamming radio-controlled IEDs

Many detection systems designed to find IEDs in non-urban settings – route clearance

Protection of national infrastructure OCONUS is not primary mission

Decide to attack

Deter & Predict

Plan the Attack

Obtain Resources

Prepare for Attack

Conduct the Attack

Defeat

Mitigate

Observ Consequences

Attribute Responsibility

Obtain Resources

Detect

Wealth of data = improved predictive capability

DoD C-IED Investment Emphasis

Many detection systems designed to find IEDs in non-urban settings – route clearance

Protection of national infrastructure OCONUS is not primary mission