# CRITICAL RESEARCH/INNOVATION FOCUS AREA DOCUMENT

# Detection of Homemade Explosives (HMEs)

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**U.S. Department of Homeland Security, Science and Technology (S&T) Directorate**

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*Please note that as more details are available, DHS will post updated research/innovation focus area overviews on the FutureTECH website. This is a pre-decisional draft document of the NSTC Subcommittee on Domestic IEDs. Please contact Dr. Ruth Doherty, ruth.doherty@dhs.gov for more information.*

# Who?

*Identify any DHS component stakeholders that contain or represent potential end users. Also name any Capstone IPT(refer to http://www.dhs.gov/xres/programs/gc_1234200779149.shtm and the article entitled "Making it Easier to Work with DHS"), if any, which identified a capability gap related to this research/innovation focus area.*

The U.S. Department of Homeland Security (DHS) leads for counter improvised explosive devices (CIEDs) are the Office for Bombing Prevention and United States Secret Service (USSS). The corresponding DHS Science and Technology (S&T) Capstone IPT that identified capability gaps related to this focus area is entitled "Counter-IED."

# What?

*Describe a required technology/capability. Describe how a technology will provide the capabilities and functional improvements needed to address the DHS need. Do not describe a specific technical solution. Instead, describe a conceptual technology for illustrative purposes. Define typical missions that the proposed technology could be utilized to accomplish.*

Sampling and detection methods are needed that are able to screen at a fast rate (nominally <5 seconds) while maintaining a low false alarm rate (false positives) and a high enough rate of detection (true positives) to deter terrorist use of HMEs.

Ideally, the sampling and detection methods should be useable in various venues with an emphasis on transportation (air) checkpoints (most critical due to the small amount of explosive needed to create catastrophic damage), but also for screening at large crowd venues such as sports events. It would be preferable to have both a fixed and portable version of the equipment with real time response for screening people and baggage.

The introduction of the technological solution should enable the end user to maintain current tactics, techniques and procedures without major changes to their current practices. The deliverable sought for this requirement should include the following: 1) underlying science for the sampling and detection of HMEs and their precursors that are applicable under a wide range of environmental conditions at stand-off and screening checkpoints; 2) systems architecture capable of addressing the known HME threats and extendable to new materials and/or classes of HMEs in the future; 3) comprehensive characterization data on the relevant characteristics of vapor and surface contamination from known or expected HMEs to enable development of the sampling and detection methods; and 4) listing of materials and chemical classes the technological solution addresses and could be expanded to in the future.

References

a. HSPD-19: Sections 4b and 5e.
b. National Strategic Plan for U.S. Bomb Squads, December 2007, National Bomb Squad Commanders' Advisory Board, page 19, Section 7
c. Containing the Threat from Illegal Bombings: An Integrated National Strategy for Marking, Tagging, Rendering Inert, and Licensing Explosives and Their Precursors, National Academies Press 1998.

# Why?



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*Describe the analysis and rationale for requiring a new technology/capability. Describe why existing technologies cannot meet current or projected requirements. Describe what new technologies/capabilities are needed to address the gap between current capabilities and required capabilities.*

The terrorist threat facing our nation's critical infrastructure can take many forms including HMEs. In fact, for over 20 years terrorists have used HMEs to target U.S. interests with notable success and devastating consequences. Considering likely events based on available intelligence and past experiences, HMEs will continue to be used by terrorist groups against U.S. interests due primarily to the wide availability of improvised bomb making materials, the ability to conceal large amounts of explosives, the ease of getting the IED to the target, the proliferation of bomb making instructions, and the history of success, which increases repetition and imitation.

The diversity of materials that can potentially be used to devise HMEs and their normal presence in streams of commerce make detection of these materials particularly challenging. Improvised explosive devices (IEDs) can be constructed from bottles of liquid medical essentials, flammables, industrial gases, explosives or reactive/energetic chemicals. The main challenge for finding a solution to the detection problem is that the only common thread for these materials may be their energetic/reactive nature.

While DHS, the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), and the Federal Bureau of Investigation (FBI) have agreed on nine explosives chemical precursors as having the largest quantities in unregulated distribution as well as the highest destructive potential, the detection of HME and their precursors cannot be limited to this set.

The detection of the wide range of materials that can be used in constructing HMEs is challenging and a successful solution may require multiple technologies. The integration of multiple technologies into a system that can give comprehensive coverage against known threats and be adaptable to cover new threats as they emerge will require a strong systems architecture approach from the start.

The term HME has been used to cover a wide range of materials from pure explosive compounds, such as triacetone triperoxide (TATP), that can be synthesized from readily available articles of commerce to home-made variants of explosives, such as ammonium nitrate (ANFO), that are used in very large commercial blasting operations. The former is a very sensitive material and so ordinarily is not made in large quantities. The latter is relatively insensitive and can be made in very large quantities. In non-transportation applications, the detection of the precursors of the explosives in a way that allows discrimination between legitimate use of those precursors and illegal use to make explosives is extremely challenging.

At this time there is no stand-off or remote detection of classes of liquid explosives or flammables for use in screening and portal environments. There is also a need in security and operational law enforcement environments to detect explosives, including HMEs, from a safe standoff distance for a given quantity of explosives.

# When?

*If a technology/capability is intended as a countermeasure to a threat, summarize the threat to be countered and how the technology could be used (i.e., concept of operations). If applicable,*

*provide a schedule/timeframe to capture when the technology/capability is needed in order to address the DHS gap.*

The need is immediate with the ability for adaptability to meet potential emerging threats of the future.

# Where?

*Describe the projected threat environment in which the technology/capability may be potentially deployed.*

The solution must provide a capability to detect HMEs and their precursors in a variety of venues and situations. The solution will be utilized at a security checkpoint where inspection of persons is conducted and the envisioned users will be security personnel who are non-scientists so the technology must be adaptable for use by people who have not been technically trained.

The need for HME detection goes far beyond screening in a transportation venue. There is also the need to detect HME precursors and their relative quantities in other environments in such a way as to allow a decision to be made regarding what action should be taken to protect the first responders and others in the vicinity. In particular, transportation (air) checkpoints, but also for screening at large crowd venues.