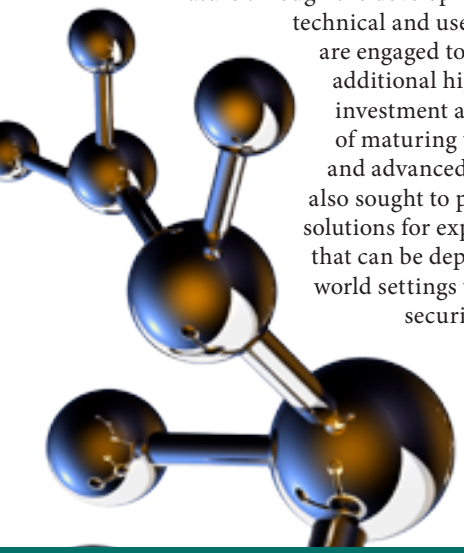
System of Systems for Explosives Detection

Because there is no single perfect detection technology for use in a variety of situations, fusing complementary or orthogonal detection methods can significantly increase the overall detection system capabilities. Staff at PNNL are developing effective integrated systems for explosives detection, addressing such key issues as the identification of appropriate combinations of technologies and development of suitable algorithms for rapid and accurate combinatorial processing of multiple information sources.

What It's All About

This Initiative moves promising science and emerging technologies toward application. As technologies mature through the development process, technical and user communities are engaged to help identify additional high-value research investment areas. Integration of maturing technologies and advanced algorithms is also sought to provide effective solutions for explosives detection that can be deployed in real-world settings to increase the security of our nation.



Pacific Northwest National Laboratory

Pacific Northwest National Laboratory is a U.S. Department of Energy (DOE) Office of Science research facility that delivers breakthroughs in the areas of national security, environment, energy, fundamental science and health. Battelle, based in Columbus, Ohio, has operated PNNL since 1965.

PNNL's long record of partnering with industry for early deployment of technologies enables the Laboratory to leverage DOE's vast resources. The Laboratory is also involved in research and development supporting mission objectives for both the U.S. Department of Defense and the U.S. Department of Homeland Security.

PNNL is located in Richland, Washington. Additional web resources are at:

http://www.pnl.gov/nationalsecurity/explosives.detection/

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PNNL-SA-54590

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

Initiative for Explosives Detection

Delivering Science-Based Solutions

What We're All About

The illicit use of explosives has become a daily event in the modern world. For terrorist organizations and insurgents, the Improvised Explosive Device (IED) has become a weapon of choice. These devices are being used to kill or harm civilians and military personnel as well as destroy vital infrastructure and assets. Because they can take different forms and be delivered to their targets in a variety of ways, these devices are proving difficult to defeat.

Advances in technology for the detection of explosives, explosive devices, or components of such devices can improve our ability to counter their use and resulting impacts. Pacific Northwest National Laboratory (PNNL) is addressing this crucial need by investing in the Initiative for Explosives Detection, a Laboratory-wide effort to develop science-based solutions that can be effectively deployed and used in a variety of real-world settings.

Explosives detection research crosses boundaries of physics, chemistry, materials and electronics. PNNL's science-based, computational and sociological capabilities reach across a strong, multi-disciplinary staff and infrastructure, providing tangible solutions through the application of a range of techniques, including:

- Novel materials for collection, preconcentration and detection
- Trace chemical analysis instrumentation
- Laser-based measurement methods
- High-frequency interrogation
- X-ray and neutron methods
- Electronics and systems development
- Statistical data analysis, information visualization and data fusion.

Timely and Effective Solutions

Technology experts at PNNL are taking an accelerated approach to address shortcomings in discovering and identifying explosives and explosive devices—*the ability to detect the array of explosives or IED components and assembled devices in a variety of forms across a range of venues and environments.*

Besides creating new capabilities and enhancing existing ones, a major goal of the Initiative is to integrate relevant capabilities to provide a more cohesive and comprehensive approach to explosives detection.

The projects within the Initiative are currently selected to address science and technology development. They are integrated from four major focus areas and funneled to create the system of systems for explosives detection.

Enhanced Trace Detection

Trace detection is a proven method for detecting explosives and is widely used as an explosives detection solution—such as in aviation security systems in most airports. Among the significant challenges to trace detection are selectivity, sensitivity and low vapor pressures associated with some explosives, as well as the need to adapt technologies to detect emerging explosive threats. The large installed base of trace detection systems provides strong incentives to find improvements that can be implemented on these existing systems rather than requiring much larger investments in replacement systems.

Sampling and Preconcentration

Sampling and preconcentration can provide improved sensitivity and selectivity for detection of explosives, breakdown products and precursors without significantly impacting analysis time or cost. These improvements can complement and extend the capabilities of the existing trace detection systems. The potential benefits of improved sampling techniques and preconcentration systems include obtaining larger samples of low vapor pressure explosives and "sticky" explosives particles, while at the same time decreasing background interferences and false alarms. The ultimate goal would be to allow for direct vapor detection of explosives.

Stand-off Detection

The objective of standoff detection is to enable detection to take place further away from people and vital assets and to reduce the potential for severe damage. Some stand-off methods are focused on chemical identification (to detect explosives, breakdown products, and/or precursors) while others are based on the detection of suspicious packages, wire, fragmentation materials and other physical attributes of IEDs. Key challenges include extending distances at which effective screening can be conducted, reducing the impacts of various interferences and backgrounds (e.g., atmospheric and environmental), and effective screening of more than one potential threat at a time while in motion.

Highly Concealed Bulk Explosives Detection

This focus area emphasizes the detection of explosives or IEDs hidden in vehicles, buildings or various types of containers. Many of the enclosing materials are metal, which makes it difficult to penetrate with most forms of electromagnetic radiation, or to detect with currently fielded technologies. Approaches to improving detection of highly concealed explosives include the development of enhanced energy sources, improved electronics and more sophisticated signal and image-processing techniques. A significant challenge for this focus area is the development of more compact equipment for practical field deployment.