Written Statement

of

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Keeping America Secure: The Science Supporting the Development of Threat Detection Technologies

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Good morning Chairman Hall, Ranking Member Johnson, and distinguished Members of the Committee. As Acting Director of the Department of Homeland Security's (DHS) Domestic Nuclear Detection Office (DNDO), I am pleased to testify today with my distinguished colleagues to discuss ongoing research and development of nuclear detection technologies.

DNDO is a unique interagency organization with staff expertise in technical, law enforcement, military, and interagency issues focused exclusively on preventing nuclear terrorism. Countering nuclear terrorism is a whole-of-government challenge, and DNDO works with Federal, state, local, tribal, territorial, international, and private sector partners to fulfill this mission. Working with partners from across the U.S. government (USG), including the Departments of Energy (DOE), State (DOS), Defense (DOD), Justice, the Intelligence Community, and the Nuclear Regulatory Commission, DNDO coordinates the development of the global nuclear detection architecture (GNDA) and implements the domestic portion of the architecture. DNDO also works with its partners to coordinate interagency efforts to develop technical nuclear detection capabilities, measure detector system performance, ensure effective response to detection alarms, integrate USG nuclear forensics efforts, and conduct transformational research and development for advanced detection and forensics technologies. We coordinate and collaborate efforts through shared review of Broad Area Announcements, Requests for Proposals, and through interagency portfolio reviews. Additionally, we interact and exchange technical information for research and development efforts under a Memorandum of Understanding with relevant parties.

Detecting Nuclear Threats

Along with intelligence and law enforcement, technology is fundamental in our ability to detect nuclear threats. In recent years, there have been dramatic advancements in nuclear detection technology. Thirty years ago, identification of detected nuclear material required laboratory specialists and large, complicated equipment. Now, however, newer detection materials that can be integrated into mobile and human-portable devices, coupled with advanced algorithms, allow for significantly improved operations. As a result, frontline responders and law enforcement officials now regularly use detection equipment to search for, find, and identify nuclear materials in the field. Technological advances in computing, communications, software, and hardware have also contributed to this revolution in nuclear detection technology.

Despite these advancements, however, developing nuclear detection technology for homeland security applications is an inherently difficult technical task. The fundamental technical challenge for nuclear detection is one of distinguishing signal from noise. Sensors can detect radiation, but detection is limited by several factors, including speed, distance, shielding, and source strength. Compounding these challenges is the difficulty in distinguishing ever-present background radiation from radiation that poses a threat.. Additionally, to mitigate risk across all pathways in the GNDA, detection technologies must be capable of operations in challenging environments, such as on the water and in rugged terrain between ports of entry.

Current Nuclear Detection Systems

Currently, there are several types of passive detection systems deployed across the GNDA by federal, state, and local entities. For example:

- Personal Radiation Detectors (PRDs) are generally small, pocket-sized devices used as scanning tools to search for and detect nuclear and radiological materials.
- Hand-held Radioisotope Identification Devices (RIIDs) are designed to identify the radionuclides present in radioactive materials and sources and are used by law enforcement officers and technical experts during routine operations.
- Radiation Portal Monitors (RPMs) are large, usually fixed, detectors typically composed of polyvinyl toluene (PVT) for gamma detection andhelium-3 tubes for neutron detection, and are often used to scan vehicles or cargo at fixed chokepoints such as ports of entry and weigh stations.
- Mobile and Transportable Detectors, are mounted in a ship, vehicle, or trailer and used for area surveillance, search, or temporary checkpoint deployments.
- Backpack Based Radiation Detection systems - are used in mobile or checkpoint operations to search for nuclear threat materials.

To further improve operational nuclear detection capability, DNDO led the development of a next-generation RIID. We worked closely with U.S. Customs and Border Protection (CBP), the United States Coast Guard (USCG), the Transportation Security Administration (TSA), and state and local operators, to identify key operational requirements that drove the design of the new system. Based on an enhanced detection material, lanthanum bromide, and improved algorithms, this new handheld technology is easy-to-use, lightweight, and more reliable, and because it has built in calibration and diagnostics, has a much lower annual maintenance cost.

In addition to the aforementioned passive detectors, radiography imaging systems are used to help identify threats or anomalies in cargo and conveyances. These systems employ x-rays or gamma rays to image conveyances. The images generated by currently-deployed technologies must be reviewed by trained and skilled operators to ascertain anomalies that might indicate threat materials- a time-consuming process. DNDO is presently developing algorithms to automatically detect nuclear threats and shielding that may be used to conceal these materials.

Our ongoing collaboration with CBP to facilitate container security has resulted in the radiological and nuclear scanning of over 99 percent of all incoming containerized cargo transported via truck at land border crossings and at our seaports, utilizing RPMs. DNDO has procured thousands of PRDs, RIIDs, and backpack detectors for CBP, USCG, TSA, as well as for state, local, and tribal law enforcement across the country to scan people and their effects, cars, trucks, and other conveyances for the presence of radiological and nuclear materials. In addition, all TSA Visible Intermodal Prevention and Response teams and USCG boarding teams are now equipped with radiation detection capabilities. Additionally, to ensure the detection systems are used effectively, DNDO has made available radiological and nuclear detection training to over 23,000 state and local law enforcement officers and first responders.

Recognizing the important contributions and innovations of private industry, national laboratories, and academia, DNDO has evolved its acquisition focus from one that is predominantly fueled by a government-funded, government-managed development process to one that relies upon industry-led development. As such, all DNDO technology development programs now proceed with a "commercial first" approach – engaging first with the private sector for solutions and only moving to a government-sponsored and managed development effort if necessary. This approach takes advantage of industry's innate flexibility and ability to rapidly improve technologies, leveraging industry-led innovation.

This transition will also include a new approach at the systems level, in which strategic interfaces will be clearly defined in the detector/system architecture, allowing system upgrades without wholesale changes. We have shared the DNDO Acquisition and Commercial Engagement Strategy with industry through DHS's Private Sector Office to ensure the commercial sector remains aligned with DNDO's current development and acquisition approach. In some cases, shifting to commercial-based acquisitions will reduce the total time to test, acquire, and field technology.

Next Generation Nuclear Detection Systems

While DNDO's work to develop, evaluate, and deploy systems supports the ongoing enhancement of the GNDA, significant technical challenges remain. These challenges include:

- Cost effective equipment with sufficient technical performance to ensure widespread deployment;
- Enhanced wide area search capabilities in a variety of scenarios to include urban and highly cluttered environments;
- Monitoring along challenging GNDA pathways, to include scanning of general aviation and small maritime vessels, and searching for nuclear threats between ports of entry; and
- Detection of nuclear threats even when heavily shielded.

Additionally, our programs must be able to reach out to operators for user requirements and to balance both "technology push" and "technology pull" efforts, as appropriate. For the former, the technology developer is pushing a new concept out for examination by the operator. These systems may be otherwise unknown to operators, and are often state-of-the-art with enhanced or dramatically improved threat detection capabilities and may further allow for simplified operational use. Technology pull refers to equipment and programs where operators have identified new concepts of operation and/or features that they need in order to achieve their missions. The operators are constantly pulling the technologies in directions that guide our development of detection systems.

DNDO works to address these challenges through a robust, long term, multi-faceted transformational and applied research and development (R&D) program. I would like to highlight a few of the projects in our transformational R&D portfolio that are showing significant progress and promise.

Helium-3 Alternatives

Helium-3 has been widely used as a neutron detection component for radiation detection devices, such as RPMs. However, in recent years, our country has faced a helium-3 shortage. Years before the recent helium-3 shortage, DNDO and the DoD Defense Threat Reduction Agency (DTRA) were already exploring options for better, more cost-effective, alternatives for neutron detection. DNDO's transformational and applied research efforts included fourteen different technologies that could be used instead of helium-3 tubes, including those based on boron or lithium.

Once the shortage was identified, DNDO accelerated this progress and led an interagency working group to address the use of alternate neutron detection technologies. DNDO also queried the commercial marketplace for available systems. At a recently-completed test, present and next generation alternatives from the interagency research and development portfolio and the private sector were evaluated and multiple systems proved to have sufficient performance to replace helium-3 in RPMs. As a result of our efforts, alternative neutron detection technologies are now commercially available and large quantities of helium-3 will no longer be necessary for use in RPMs. Importantly, due to a collaborative, USG-wide effort to address the shortfall, our U.S. strategic reserve of helium-3 has increased by 40% since 2009.

Advanced Radiation Monitoring Device (ARMD)

Our Advanced Radiation Monitoring Device (ARMD) project focuses on enhancing our ability to distinguish benign radiological and nuclear materials, from those that potentially pose a threat. The ARMD project capitalizes on the efficiency and energy resolution of emerging detector crystals, such as strontium iodide (SrI_2) and cesium lithium yttrium chloride, or "CLYC", to develop smaller, more capable detection systems. The detector materials have sufficiently matured to the point where they are now commercially available – the direct result of a coordinated interagency effort between DNDO, DTRA, and DOE. New handheld detector systems using these crystals are being designed, built, and will soon be ready for formal evaluation by DNDO.

Long Range Radiation Detection (LRRD) Project

Our Long Range Radiation Detection (LRRD) project has the potential to have broad operational impact by significantly improving the range of detectors. Through the LRRD project, DNDO has been developing advanced technologies to detect, identify, and precisely locate radiation sources at stand-off distances, through passive gamma-ray imaging technology. We have focused on two systems: Stand-Off Radiation Detection Systems, which uses a mobile system to locate stationary sources; and the Road Side Tracker, which is a rapidly re-locatable monitoring system capable of identifying and tracking threats in moving vehicles across multiple lanes of traffic. Recent LRRD demonstrations included interagency partners from the technical and law enforcement communities, utilizing a "technology push" to allow operators to use the prototype systems in simulated and operational environments. DNDO is assessing the potential for further development based upon operator feedback and evaluations obtained during the demonstrations.

Networked Detectors

To address nuclear detection in challenging operational environments, DNDO is working on networked detectors. These detectors, being developed in the Intelligent Radiation Sensor System (IRSS) project, are intended to facilitate situational awareness and improve capabilities to detect, identify, locate, and track threats across distributed sensors. The IRSS integrates data from across multiple portable detectors with the goal of improving overall system performance compared to a non-networked system. This technology will support operations where scanning for nuclear threats by routing traffic through checkpoints is not tenable. These operations include nuclear searches at some special security events, between ports of entry along the land border, or scanning general aviation or small maritime vessels for illicit radiological or nuclear materials.

Detecting Shielded Nuclear Threats

Nuclear threats may be shielded or masked, increasing the challenge for passive detection techniques. To address shielded nuclear threats, DNDO has several important projects. The Shielded Nuclear Alarm Resolution (SNAR) project seeks to develop and characterize advanced active interrogation systems with improved ability to uniquely detect special nuclear material and to resolve alarms with confidence, even in the presence of significant countermeasures (such as shielding). The scanner systems generate X-rays and/or neutrons, which pass through the cargo container and interact with the materials inside. These interactions can produce high-resolution images that reveal the shapes of objects inside the container. The scanner systems can also produce physical signatures, which uniquely identify materials inside, including those that can be used to make nuclear weapons or shield nuclear materials from detection.

This technology may substantially reduce the number of manual inspections required to resolve alarms, while increasing the probability of nuclear threat detection even when heavily shielded. Technologies under review include induced fission, high energy backscatter, and nuclear resonance fluorescence. Characterization activities for all SNAR systems will conclude in late 2012.

Recent advancements in the commercial sector have also resulted in technologies that combine the merits of passive and active technologies into a single system through either muon tomography or by integrating radiation detectors into x-ray radiography systems. In theory, these systems should be able to automatically detect nuclear threats, regardless of the shielding level, while providing an image for detecting other anomalies. In order to characterize the full performance capability of these technologies, DNDO recently solicited proposals for our Nuclear and Radiological Imaging Platform Advanced Technology Demonstration. This project will characterize imaging systems for scanning conveyances and identifying possible shielded threats. Results from this demonstration will be available in 2014.

Testing, Evaluation, and Standards for Nuclear Detection Technologies

Over the years, DNDO's test program has grown and matured. To date, DNDO has conducted more than 70 test and evaluation campaigns at over 20 experimental and operational venues. These test campaigns were planned and executed with interagency partners using rigorous, reproducible, peer-reviewed processes. The interagency involvement in these tests is underscored by DNDO's use of a DTRA test director for the DNDO Dolphin test campaign. Tested nuclear detection systems include pagers, handhelds, portals, backpacks, and vehicle-, boat- and spreader bar-mounted detectors, as well as next-generation radiography technologies. The results from DNDO's test campaigns have informed federal, state, local and tribal operational users on the technical and operational performance of nuclear detection systems, allowing them to select the most suitable equipment and implement effective concepts of operations to detect nuclear threats.

DNDO has also supported the development, publication and adoption of national consensus standards for radiation detection equipment. Several such standards now exist for use in homeland security. DNDO collaborated with the National Institute of Standards and Technology (NIST) to conduct a review of all national and international consensus standards for nuclear detection systems, and formed an interagency working group to draft government-unique technical capability standards (TCS). Earlier this year, we finalized the first TCS for handheld systems.

The success of the nuclear detection mission is contingent on timely information exchanges.. To this end, DNDO successfully collaborated with the NIST to create a major update of the Data Format Standard for Radiation Detectors used for Homeland Security. This standard facilitates the exchange of detection information by ensuring that the systems create and distribute data in a specified format to enable interoperability. Through the International Electrotechnical Commission (IEC) and the American National Standard Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE), this significantly improved standard (ANSI/IEEE N42.42 and IEC 62755) is now internationally accepted. IEC 62755 was approved in late February 2012.

The DNDO Graduated Radiological/Nuclear Detector Evaluation and Reporting (GRaDER^SM) Program builds upon these standards to determine if commercially-available nuclear detection equipment complies with established standards. DNDO created the infrastructure for voluntary, vendor testing of commercial nuclear detection technologies by independent, National Voluntary Laboratory Accredidation Program (NVLAP) accredited laboratories against national consensus standards and government-unique TCS. This program encourages vendors to develop better nuclear detection and identification systems that meet evolving Homeland Security requirements.

With the maturation of our test and evaluation program, DNDO's collaboration with interagency partners, such as DOE and DOD, and international partners, such as the United Kingdom, Canada, Israel, the European Union (EU), and the International Atomic Energy Agency (IAEA)), has increased significantly. For example, our close partnership with the DOE Second Line of Defense program, EU, and the IAEA for the Illicit Trafficking Radiation Assessment Program+10 (ITRAP+10) will result in a comprehensive evaluation of the performance of nearly one hundred commercially-available radiation detection systems against national and international standards. ITRAP+10 will allow for the refinement of nuclear detection standards and promote greater homogeneity in US and international detection standards. The test program will conclude in the spring of 2013.

Academic Research

In recent years, statistics have indicated a frailty in the expertise pipeline for fields important to national security—especially those that impact DNDO's mission spaces for nuclear detection and technical nuclear forensics. In recognition of this important need, DNDO seeks to support students and programs that address nuclear detection and forensics related work. Underlying DNDO's R&D efforts is our Academic Research Initiative (ARI), a program executed in partnership with the National Science Foundation that seeks to ensure a continued pipeline for national human capital development. Since its inception in 2007, 57 grants have been awarded to over 45 academic institutions across the country. In fiscal year (FY) 2011, the ARI program supported 39 grants and over 150 students. Currently, the ARI has awards with 25 universities through 32 grants supporting 80 students. DNDO has worked hard to maintain ARI, despite significant fiscal constraints in FY 2012. The FY 2013 President's Budget Request includes funding for sustainment of the ARI program, with the potential for additional grantees.

The ARI projects and research support the technological breakthroughs that allow us to better accomplish our mission. ARI grantees are addressing fundamental research for passive and active detection, as well as nuclear forensics activities. The priorities being addressed through ARI projects include: advanced materials research; neutron detector alternatives to helium-3; advanced algorithms for a range of applications; detector modeling; research to support non-destructive inspection and active interrogation; and investigating novel techniques for detection, localization, identification, and characterization of radiological and nuclear sources. Many of these projects provide the early applied research necessary to support future capabilities needed to implement the GNDA.

Conclusion

DNDO has come a long way since its creation in 2005. With our integrated approach to GNDA planning, testing and assessments, research and development, and operational support, we continue to strengthen the nation's capabilities to detect and interdict nuclear threats. We appreciate your continued support as we work with our partners to develop and deploy the necessary systems to implement a nuclear detection architecture that can effectively respond to credible intelligence and threat information. In addition, we appreciate your continued support as we continue to research and develop technologies that meet the operational requirements of our end users.

Thank you for this opportunity to discuss our research and development of nuclear threat detection technologies. I would be happy to answer any questions from the Committee.