U.S. DEPARTMENT OF ENERGY

Preventing Nuclear Terrorism: Does DHS have an Effective and Efficient Nuclear Detection Strategy?

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Pacific Northwest NATIONAL LABORATORY

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Introduction

Chairman Lungren, Ranking Member Clarke and other distinguished members of the committee, it is a pleasure to be here and discuss PNNL's support to DHS in formulating and executing an effective and efficient nuclear detection strategy. This is a very important issue; one that I personally consider critical and worthy of great attention, and resources that demands the collective efforts of the USG and the international community. I have devoted much of my career to combating the threat of weapons of mass destruction (WMD) with the focus ranging from developing offensive capabilities to locate, exploit and defeat WMD-related facilities to developing policies and approaches to interdict illicit transfers of WMD-related materials and technologies to combat the threat of nuclear terrorism.

Pacific Northwest National Laboratory (PNNL) has a long history of providing valuable support to numerous Federal, State, local, private and international users to protect them from and help them recover from WMD attacks. PNNL is one of ten U.S. Department of Energy (DOE) national laboratories managed by DOE's Office of Science (SC). Our support strengthens the nation's foundation for innovation, and we find solutions for not only DOE, but for DHS, the National Nuclear Security Administration (NNSA), the Department of Defense (DoD), the Intelligence Community (IC), other government agencies, universities, and industry. Our multidisciplinary technical teams are brought together to address the nation's most pressing issues in energy, environment, and national security through advances in basic and applied science.

Role of DOE Laboratories

The DOE and NNSA complex of national laboratories, which are and have been a vital centerpiece of the nation's research and development capabilities for over sixty years, continue to play a prominent role in developing and deploying technologies to protect America against evolving threats, most especially, the rad/nuc threat.

Important objectives of DOE's multi-program science laboratories are to accelerate the rate of innovation, steward unique national capabilities, and leverage the national science base for the benefit of diverse applied missions. The rad/nuc detection research programs at PNNL successfully illustrate how these objectives come together. We have scientific and engineering strengths and historic capabilities with roots dating back to the Manhattan project of the 1940s at the Hanford Site. Today, approximately half of PNNL's $1.1 billion business is centered on national security missions. Threat detection technology development and deployment is a central part of these programs and one in which science plays a particularly critical role.

Front Line Operators

It is important to note that the most critical element of the nuclear detection strategy is the brave men and women who execute this important mission day in and day out – the U.S. Customs and Border Protection officers at our ports of entry (POE), the Border Patrol (BP) agents between our POEs, the U.S.

Coast Guard (USCG) personnel monitoring our waterways, the Transportation Security Administration (TSA) officers defending transportation venues, and the State, local, and tribal first responders, and international partners. Nuclear detection is just a single aspect of one of many missions they execute each and every day, and the role of technology is to enable these tremendously capable men and women, to make the mission of interdiction of nuclear threats more efficient, more effective, and less onerous. PNNL takes great pride in the opportunities afforded it to work alongside and partner with mission personnel to understand their requirements and operational environments. We are committed and work hard to support them in the execution of all aspects of their mission and to provide them with operationally and technically effective and efficient solutions to their requirements.

To successfully detect and interdict nuclear materials requires an informed encounter. There are three elements in an informed encounter; 1) know the signature or indications of illicit nuclear trafficking, 2) place your personnel or assets in a position where they have the opportunity to sense or observe the signature of indication, and 3) accurately interpret the indications when presented. Clearly technology can play a role in this process, but there is no substitute for well-trained law enforcement personnel.

It is also important to consider all of the actions we can take to detect illicit nuclear trafficking activities. Nuclear detection technology has and will continue to play a critical role. However, this is only one source of relevant data. There are other physical sensors that could play an important role. Imagine if operators were able to determine if someone has been in the presence of nuclear materials though a simple hair sample. Additionally, operators clearly need more capable information sensors. The number and diversity of data sources continues to increase and provides a key opportunity to identify illicit trafficking activities. However, the ability to ingest and analyze the sheer quantity of data requires new solutions that will only be realized through additional research and development that is currently being undertaken at PNNL and other national laboratories.

In the end, all of these tools are either collecting data for or actually performing the analysis to find signatures of illicit nuclear trafficking. Signatures are not new in this business, but it is important that we continue to systematically look for new signatures. The new signatures are likely to combine disparate data or approaches to increase sensitivity and specificity. However, new signatures must be evaluated for accuracy, the cost and risk to collect them, and whether they change or evolve over time. Finally, it is crucial that we provide an integrated framework that allows the analysis and decision-making – by analysts, front line operators, and senior officials.

PNNL's Role in the Evolution of the Nuclear Detection Strategy

Initial response to the terrorist events of 9/11 included far-reaching and comprehensive strategies for technology deployment across various points or layers for possible interdiction including: the place of origin for nuclear materials or weapons, foreign border crossings and airports, ports of departure, ports of entry, between the ports of entry, and the target. In particular, PNNL has supported the deployment of radiation detection equipment for over a decade in partnership with DHS and NNSA to achieve initial

post 9/11 and SAFE Ports Act scanning goals at domestic POEs and ports of departure (POD) around the world.

Since 9/11, DHS has a more mature assessment of the nuclear threat and a deeper understanding of how to evaluate the risks through various technology insertion strategies. Coupled with the current budget realities, new strategies are emerging that balance risk reduction and total program costs, including the long-term operations and maintenance (O&M) costs associated with various technologies. As an example of how the risk analyses have matured, the new analyses more accurately recognize the fact that the presence of uniformed CBP officers and BP agents at POEs and BP checkpoints, along with the extensive range of regulatory and security functions performed by officers/agents provides for a substantial deterrent and makes the POEs a significantly less desirable entry path into the country. Hence, new, risk-based strategies for radiation detection equipment at the POEs are currently being generated.

The risk-based analyses highlight key gaps and vulnerabilities. These gaps need to be solved through a combination of material and non-material solutions. Over the last few years, DHS has implemented rigorous systematic approaches to define and address these gaps. In support of these systematic approaches, PNNL has been providing expertise and support to DHS in formulating and executing these new strategies. This support includes risk analyses, evaluation and deployment of technologies, technology pilots, O&M strategies, and impact analyses, etc.

PNNL Strategic Support to the Development and Implementation of a DHS Strategy

PNNL has been a strategic partner with DHS and its interagency partners and supported the development and implementation of the nuclear detection strategy. Those partners include CBP and BP, USCG, and TSA within DHS; NNSA; and DoD. Specific support to DNDO, responsible within DHS for the development of the GNDA, has included assisting with the development of the first GNDA Strategic Plan that was delivered to Congress in December 2010,conducting numerous architectural studies of potential threat pathways, collaborating on the development of a risk analysis model, and determining potential efforts to strengthen relationships between the GNDA and the interagency. PNNL has provided this strategic support since its initiation in 2005 and continues to this day.

One example worth noting that illustrates the unique role PNNL plays in supporting DHS architecture advancement is the development of the Rad/Nuc Risk Analysis Model (RNRAM) in collaboration with Battelle Memorial Institute. This improved RNRAM, compared to previously employed risk analysis tools, will allow DNDO to more easily and quickly determine risks associated with the GNDA and incorporate the most recent information for more timely results.

PNNL participated in several characterization surveys of the major and minor airports in metropolitan areas. These survey teams were led by CBP with representatives from DNDO and PNNL. The fact gathering at the airports, including the obtaining of extensive information on stakeholders, cargo handling procedures, and CBP's inspection and cargo release process, supported the development of an approach to study the scanning opportunities for international air cargo. PNNL conceptualized cargo movement,

captured it as stylized diagrams, and developed a matrix of conceptual rad/nuc scanning systems versus cargo encounter locations. PNNL also developed a potential volume model that makes use of commercial flight data and other open source data to quantify international air cargo movement around the airport. The model estimates the percentage of cargo volume passing various encounter locations at an airport.

PNNL managed the Puget Sound portion of DNDO's West Coast Maritime Pilot project. Activities included pilot exercise series, which began with the Concept Development Conference and ended with a full-scale exercise. The pilot agencies were eager to sustain the capability developed in the Puget Sound. Sustainment was coordinated for the region through the Puget Sound Area Maritime Security Committee, and they secured a Port Security Grant, the first of its kind for rad/nuc detection. The grant will fund the continued maintenance of detection equipment in the region, new equipment for new agency participation, and additional training.

PNNL is currently doing work for DNDO in the international rail environment by using modeling and testing to support the analysis-of-alternatives work that includes technology assessments, concept of operation development, life cycle cost estimates, deployment task definitions, port of entry site surveys, and threat definition. However, the fact remains that the operational constraints in the rail environment are quite daunting to perform rad/nuc detection efforts.

CBP does utilize imaging systems along the Mexican and Canadian border to inspect international rail traffic. PNNL has been involved in efforts to both evaluate and optimize system performance.

In the area of new detection materials, PNNL has been using its expertise in materials discovery to identify, select, and develop new materials that will improve the resolution and processing time in detecting radiological and nuclear devices. Experts now have a greater understanding of the potential materials covering the four conventional semiconductor material classes. They were able to narrow over 2,000 material compositions to a list of 245 that may have comparable performance characteristics to cadmium zinc telluride, a well-known radiation detection material. This work has drawn collaborative interests from multiple industrial and academic partners with plans to develop new detection instruments, increasing effectiveness in the field.

As DHS, the interagency, industry, and academia advance the technology and materials used in the detection of rad/nuc materials there needs to be a commensurate testing and evaluation program to ensure those systems and materials detect the types of threats we are concerned with. In addition, they should be tested in an environment that closely approximates the operational environment to ensure the systems or materials can withstand the rigors of frontline operators like CBP, USCG, or TSA.

Deployment Support to DHS and NNSA

PNNL's strategic support to the nuclear detection strategy stems from our unique understanding of the operational environment, both domestically and internationally. Over the past two decades PNNL has been a part of or managed for the U.S. Government large-scale deployment programs of rad/nuc detection systems that are an essential component of a layered defense strategy. Part of that strategy

involves securing rad/nuc materials at its source overseas. Locking down proliferation concern materials where they legally reside is critically important and much progress has been made by the various Cooperative Threat Redution (CTR) programs involved with this work. Over the years PNNL has provided strong leadership, sound programmatic recommendations, and high-value technical contributions supporting the management of projects, strategic planning, training, infrastructure development, and the overseas installation of Material Protection Control and Accounting (MPC&A) and Second Line of Defense (SLD) rad/nuc detection systems in support of the Office of International Materials Protection and Cooperation (NA-25) in NNSA. Last year alone, PNNL provided its capabilities in over 100 foreign countries through staff travel or relocation as part of these programs and NNSA's Global Threat Reduction Initiative (GTRI) which seeks to secure radiological sources in foreign countries that might be used for a radiological dispersal device (RDD), also known as a "dirty bomb."

PNNL subject matter experts in the fields of system engineering, protective forces, physical protection, material control and accounting, radiation detection, physics, materials science, training, procurement, and technically-related project management helped NNSA execute large, highly visible nuclear nonproliferation/national security projects around the globe. These same experts have been utilized by the DoD as part of its Guardian Program that seeks to deploy rad/nuc detection systems at U.S. military bases domestically and overseas.

Since 2002, PNNL has been an integral part of DHS' Radiation Portal Monitor Program (RPMP) which deploys rad/nuc detection technology to scan incoming international traffic and cargo for illicit radioactive materials at approximately 530 ports of entry into the U.S. while maintaining the uninterrupted flow of legitimate trade and travel.

PNNL support to RPMP also includes tapping into our scientific expertise to tackle such technical issues as supporting efforts to transition the nation's portal monitoring activities away from the current neutron detection standard, which is based on the now highly constrained helium-3 (He-3) commodity, toward more sustainable solutions. Several DOE labs, in conjunction with industry, the DNDO, and NNSA, played critical roles in driving innovation and evaluating technology so that today's detection system needs are met with commercial instrumentation that does not consume precious He-3. In the longer run, improved detection systems will require more rapid discovery of new materials with advanced capabilities. To this end, laboratories such as PNNL have focused on the fundamental science necessary to understand how and why radiation detection materials function as they do.

Another example of PNNL work involves improving the capability of currently deployed RPMs via advanced algorithms. RPMs operate via algorithms that allow the technology to detect radiation from threatening materials, but these algorithms sometimes result in a large number of alarms from naturally occurring radioactive materials (NORM) as well. The current data provided by the RPMs make it difficult to directly distinguish between the two, thus requiring a referral to secondary inspection. PNNL is adapting its anomaly detection algorithms to improve the detection of illicit rad/nuc materials. In addition, PNNL also continues to make significant progress on the DNDO-sponsored Energy Window Optimization Initiative. The initial results indicate a potential for modest reduction of alarms due to NORM on deployed RPMs while holding the threat detection probability constant through optimization of existing system settings.

Sustainment of Current Domestic Architecture

When deployment started in 2002 as part of RPMP, the RPMs were estimated to have a 10-year life cycle. However, the deployment of RPMs across U.S. POEs is the first of its kind on this scale. While regular maintenance is part of RPM sustainment, the goals of upgrading for improved performance, controlling costs, eventual replacement of aged systems, and maintaining configuration commonality are fundamentally in conflict. Thus, the best approach to sustaining and replacing these systems is still being developed. PNNL is analyzing the anticipated life cycle for an RPM and proposing sustainment strategies to extend their life cycle and understand the associated costs.

PNNL has also used its expertise in RPM technology to support CBP operations across a full range of engineering work including maintaining and upgrading individual pieces of hardware and software to managing the service of entire systems. Two of PNNL's key support functions are trouble call handling and calibration. For example, PNNL provided subject matter expertise via phone support to CBP's Enforcement Technology Program as needed regarding preventive maintenance, repairs, and improvements to ensure installed systems remain fully operational. PNNL staff also calibrate systems annually to prevent long-term drift or degradation, minimizing the effects of the recalibration process on port operations. PNNL is also assisting CBP's Enforcement Technology Program in sustaining fully transitioned RPM equipment and related systems within CBP so that all systems continue to operate as planned in detecting threats.

PNNL also plays a key role in the management and execution of the sustainability strategy under NNSA's SLD program. Maintaining the operational effectiveness of foreign deployed rad/nuc detection systems is critically important and PNNL operates a help desk that provides as-needed troubleshooting assistance to foreign partners. Implementing robust preventative maintenance programs, tracking system performance, developing partner country training capabilities and providing assistance in the creation on national alarm response plans are all activities that PNNL leads on behalf of NNSA to help ensure long-term risk reduction is achieved.

Considerations for Next Steps

Although significant progress has been made across the last decade to protect the U.S. from the threat of nuclear terrorism, there is still work to be done. Much of that work involves developing and executing strategies associated with all pathways into the country that are risk-based and highly integrated with all security programs in DHS and throughout the USG.

In order to discuss next steps associated with an effective strategy to combat the threat of nuclear terrorism, it is important to summarize some high level views of the significant progress that has been made to date that PNNL has directly supported:

- On the international front, the SLD program is increasing its focus on both the sustainment of deployed radiation detection systems and expanding the provision of mobile "surge" radiation detection technologies to special law enforcement agencies

- Implementation at the POEs, in the maritime vector, for general aviation, and within cities:

    - Scanning over 99% of all incoming cargo at land and sea ports of entry
    - Preliminary pre-clearance of international general aviation aircraft at foreign airports
    - Successful maritime pilot demonstration and sustained program in the Puget Sound to protect against the small maritime vessel threat
    - On-going Securing the Cities program in the New York City region and an expansion to a second city expected in 2013
    - Acquisition and deployment of the next generation handheld radiation detection system to enhance CBP's field operations
    - Successful equipping of the USCG boarding teams and TSA Visible Intermodal Prevention and Response (VIPR) teams with radiation detection capabilities.

Despite these successes there are still areas of the DHS detection strategy that will continue to evolve including:

- General aviation and commercial air cargo
- Small maritime vessels
- Areas between POEs
- Protection of major urban areas
- Next-generation detection and imaging technology.

PNNL stands poised to continue to support DHS in further developing and executing these evolving strategies.

Closing

Mr. Chairman and members of the committee, protecting the Nation from a nuclear attack has been at the top of U.S. Government priorities for at least the last 11 years and PNNL has been honored to provide essential support to U.S.G. strategy formulation and implementation of nuclear counterterrorism efforts around the globe and stands ready and prepared to continue its support. There is still much work left to be done. Advanced risk analyses and highly integrated strategies need to emerge to ensure capabilities are not eroded but actually improve, despite current fiscal realities since, unfortunately, the threat of nuclear terrorism has not diminished. I thank you for the chance to appear before you today and welcome any questions you might have.

About the Speaker

Vayl S. Oxford is the National Security Executive Policy Advisor at the Pacific Northwest National Laboratory (PNNL) where he is responsible for working with the National Security Directorate (NSD) and PNNL leadership to guide the strategic direction and vision for National Security issues. Specifically, he works with the NSD Sector, Project Management Office, Division, and Account leads to help focus NSD initiatives based on national-level priorities, and to create opportunities for NSD to provide thought leadership at the national-level.

Prior to joining PNNL, Mr. Oxford spent a short time in private industry after 35 years of public service that combined time in the military and as a government civilian employee. His career highlights include serving at the Department of Homeland Security (DHS) from October 2003 to January 2009, where he held the positions of Policy Advisor to the Under Secretary of Science &Technology, Acting Director of the Homeland Security Advanced Research Projects Agency, and as the first Director of the Domestic Nuclear Detection Office (DNDO).

About PNNL

Located in Richland, Washington, PNNL is one among ten U.S. Department of Energy (DOE) national laboratories managed by DOE's Office of Science. Our research strengthens the U.S. foundation for innovation, and we help find solutions for not only DOE, but for the U.S. Department of Homeland Security, the National Nuclear Security Administration, other government agencies, universities and industry. Unlike others, our multidisciplinary scientific teams are brought together to address their problems. More specifically, at PNNL we

- provide the facilities, unique scientific equipment, and world-renowned scientists and engineers to strengthen U.S. scientific foundations through fundamental research and innovation
- prevent and counter acts of terrorism through applied research in information analysis, cyber security, and the non-proliferation of weapons of mass destruction
- increase U.S. energy capacity and reduce dependence on imported oil through research of hydrogen and biomass-based fuels
- reduce the effects of energy generation and use on the environment.

Today, approximately 4,700 are employed at PNNL; our business volume is more than $1.1 billion. Our Richland campus includes unique laboratories and specialized equipment as well as the William R. Wiley Environmental Molecular Sciences Laboratory, a DOE Office of Science national scientific user facility. In addition to the Richland campus, we operate a marine research facility in Sequim, Washington; and satellite offices in Seattle and Tacoma, Washington; Portland, Oregon; and Washington, D.C.

Battelle—the world's largest independent scientific research and technology development organization—has operated PNNL for DOE and its predecessors since 1965. One unique feature of Battelle's contract with DOE allows research to be conducted for private industry.

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