Testimony

House Committee on Science and Technology

Subcommittee on Technology and Innovation

Passenger Screening R&D: Responding to President Obama's Directive to Develop and Deploy the Next Generation of Screening Technologies

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Mr. Chairman, Members of the Committee, thank you for the opportunity to testify at this important hearing to explore research and development activities aimed at improving aviation security. I am Parney Albright, Principal Associate Director for Global Security at the Lawrence Livermore National Laboratory (LLNL), one of the National Laboratories managed by the National Nuclear Security Administration (NNSA) within the Department of Energy (DOE).

My comments today will focus specifically on those efforts associated with passenger screening at the passenger checkpoint. I will begin my comments with an overview of our current efforts and where those efforts are headed in response to President Obama's directive on aviation security R&D with its specific mandate to involve the DOE National Laboratories. I will then discuss how our efforts are currently coordinated with the Department of Homeland Security, Science & Technology Directorate (DHS S&T), the Transportation Security Administration (TSA), and the National Institute of Standards and Technology (NIST). Finally, I will make some brief comments on the social science aspects of passenger screening.

Current Aviation Security Programs & Response to the President's directive

In response to the December 25, 2009 terrorist attempt to destroy Northwest Flight 253, and the President's subsequent directive, the NNSA National Laboratories (LLNL, Los Alamos National Laboratory (LANL) and Sandia National Laboratory (SNL)) continue to be fully committed to contributing their capabilities in systems analysis and engineering, explosives science and technology, high performance computing, modeling and simulation, and other resources to support the President, and work with the Department of Homeland Security (DHS) and other partner agencies to provide aviation security and combat terrorist threats.

This is a hard problem. Explosives have long presented the most prevalent threat to transportation security, to critical facilities, and to individuals. Current events show that explosives continue to be the weapon of choice for terrorists worldwide. The threat is evolving, and the increased access worldwide to the internet has provided the terrorists with information to manufacture homemade explosives (HME) using readily available chemicals. Explosives are very difficult to detect – in some cases, only trace evidence (billionths of grams) are available for sampling, and bulk quantities of explosive mater must be detected in the presence of other potentially confusing, but benign, materials. TSA officers only have a short time to detect explosives and assess the situation if they are to maintain the flow of people and goods.

Continuous and concentrated research and development is fundamental to understanding the threat and creating the tools that will give our nation the capability it needs to decrease our vulnerability. In order to provide that enduring focus on hard problems, the government created a unique type of organization to fill this gap: the Federally Funded Research and Development Center (FFRDC). Objectivity and independence are ensured by the legal structure of the FFRDC, which requires it to refrain from competition with the private sector, be free from organizational conflicts of interest, and provide full disclosure of its affairs to the primary sponsoring agency. In turn, an FFRDC has access beyond that which is common to the normal contractual relationship—to Government and supplier data, including sensitive and proprietary data. They are depended upon to effectively craft solutions to our nation's toughest problems and to anticipate and mitigate future challenges. The technical capabilities, and FFRDC status of the National Laboratories, their objectivity and independence, and the unfettered access to government data and proprietary information such as, for example, airframe structural data, is crucial to improving the security of aviation.

Current Efforts

The National Laboratories have been involved in high explosives research and development since their inception, and apply that expertise to the needs of the Defense Department, the Department of Justice, the Federal Aviation Administration, and more recently, to DHS. Laboratory researchers combine cutting edge computer simulation codes, state-of-the-art experimental diagnostics, and an environment where theory- and experiment-based chemists, physicists, engineers, and material scientists can work together to provide a detailed understanding of the science of energetic materials, their effect on aircraft structures, their impact on extant detection systems at, e.g., the passenger checkpoint, and how systems might be improved to enhance aviation security.

The National Explosives Engineering Sciences Security (NEXESS) Center, established by DHS S&T in 2006, has capitalized on the FFRDC model, utilizing the expertise of the National Laboratories to develop and implement cutting-edge engineering and science-based methods aimed at reducing the risks to aviation. The main focus of NEXESS work has been on performance characterization of homemade explosives (HME) and understanding vulnerability of aircraft to HME threats. The NEXESS Center has provided an important science base for aviation security, including:

- Evaluation and characterization of explosive formulations including, emerging (e.g. homemade) explosive threats, the determination of detonability, methods of initiation, detonation velocity, and impulse energy;
- Assessment of the catastrophic damage threshold for aircraft as a function of explosive amount, location, and flight conditions (initial work has been focused on a specific narrow body airframe) using a combination of highly sophisticated computer modeling in concert with small and large scale experiments;

- Rapid assessment of the technical performance of emerging detection systems and their application to aviation checkpoint security; including one particular example that involved working with L3 to determine the utility of active millimeter wave technology for the detection of concealed liquid explosives on a person.

Due to acquisition priorities, the NEXESS Program has recently been centered on developing system requirements for the procurement of the next generation of checked baggage screening systems. Of particular interest is the LLNL Image Database Development (IDD) Project, which aims to provide a sound basis for standards for next-generation screening equipment. The project, which is sponsored by DHS S&T, is executed in close coordination with DHS S&T, the Technical Support Working Group (TSWG), Explosive Detection System (EDS) system developers, advanced algorithm developers, the Transportation Security Laboratory (TSL), and TSA.

The IDD Project collects raw x-ray data and images for the various EDS and emerging digital radiography (DR) machines to stimulate commercial development of next-generation systems that provide the "best value" combination of performance and affordability for screening checked and carry-on baggage. Performance is measured by a number of criteria, including probability of detection, level of false alarms, signal-to-noise ratio, figure of merit, and throughput.

Compiled from both industry and government-laboratory sources, the data are stored in a common nonproprietary database located at LLNL. This information is used to assist both government and industry in developing a new performance standard for screening checked and carry-on baggage, and for determining needed modifications to future hardware and software to provide higher performance in detecting an increasing portfolio of explosives risks. Working with the NEXESS team, the IDD project is currently supporting DHS/TSA efforts to develop systems specifications and test plans for the $1-billion EDS procurement to be completed in FY 2010.

A similar activity, conducted at Sandia National Laboratory, involves the characterization of threat objects as seen by whole body imaging systems. This effort compiles the variety of images seen by various imaging systems, thus making available a library against which new detection algorithms can be developed and tested.

Los Alamos National Laboratory is investigating the use of ultra low field magnetic resonance imaging (MRI) for detecting harmful materials inside sealed containers. MagViz works by manipulating and detecting hydrogen atoms with small magnetic fields. Pattern-matching software compares the detected signature with a database of dangerous materials.

Future Efforts

Under the President's R&D initiative, the NEXESS effort plans to accelerate the evaluation and characterization of a rather long list of explosive formulations. In addition, the National Laboratories will create a "Threat Matrix" that characterizes these explosives not just in terms of their effects on aircraft, but also in the range of signatures they present to deployed and new detection technologies, thus allowing this effort to more fully inform enhancements to existing systems and the design of future ones.

As part of the vulnerability analysis, we will accelerate the assessment of the susceptibility of the full panoply of commercial aircraft airframes to the variety of explosives represented in the threat matrix, using computer analysis as well as subscale and large scale testing.

In addition, under the President's initiative, substantial efforts will be placed on the systems analysis of aviation security—understanding the various paths that might be exploited by a terrorist to create an aviation catastrophe, the points where government capabilities might be brought to bear to intervene and disrupt an incident, and the alternative architectures of capabilities that serve to mitigate the risk to aviation security. This effort, to be successful, should be focused on addressing all the contributors to risk—the people who would do us harm, the vulnerabilities they try to exploit, and the means by which they conduct the attack. Concepts developed by the National Laboratories for DHS Policy—in support of the development of planning guidance—serve as a very useful model for understanding the most productive approaches to accomplishing our goals for mitigating risk. The systems analysis effort will also consider the implications to the concept of operations of deploying new and improved screening technologies and combinations of technologies.

Furthermore, under the President's initiative, near term improvements to extant deployed systems will be examined. For example, methods for automated anomaly detection in whole body imagers will be explored and tested, perhaps allowing these systems to be deployed at the primary passenger checkpoint—due to the ability of one operator to now supervise multiple machines. Methods for automating secondary inspection—for example, the use of high frequency probes to rapidly ascertain whether or not a threat is posed by detected anomalies—present the possibility for increasing throughput and perhaps even obviating privacy concerns.

Finally, under the President's initiative, new, potentially revolutionary technologies will be vetted and tested. For instance, prospective technologies for determining whether a liquid within carry-on baggage in fact represents a threat will be assessed for use. If successful, it might allow the flying public to again carry duty-free purchases or their accustomed toiletries.

While the NNSA National Laboratories have a long history of combining science and systems analysis with innovation and engineering, they do not create production lines and manufacturing facilities. Hence, over the years, the National Laboratories have worked closely with our government sponsors and with industry to commercialize those innovations, including explosive detection capabilities for aviation security. The currently deployed millimeter wave (mmW) whole body imaging technology uses a licensed technology from Pacific Northwest National Laboratory (PNNL). LLNL has commercialized first generation colorimetric devices, such as the Easy Livermore Inspection Test for Explosives (ELITE), which is sensitive to more than 30 different explosives and provides immediate results. The National Laboratories continue to work on advanced algorithms to simultaneously address false alarms, enhance sensitivity to the expanding panoply of threats, and protect individual privacy.

Coordination with DHS S&T, TSA, and NIST

The primary source of funding for Aviation Security Programs at the National Laboratories is DHS S&T and TSA. In addition to our regular interactions with the DHS and TSA program managers and routine peer reviews conducted at the National Laboratories (by academic and industry experts), the NEXESS program has also established a Blue Ribbon Panel chaired by TSA and includes members from DHS S&T, TSL, the private sector, and academia. This panel provides assistance in evaluating and redefining the explosives detection and certification standards for a range of automated screening systems.

The National Laboratories also support the DHS Explosive Standards Working Group (ESWG), which is chaired by DHS S&T, and includes broad membership across the DHS Components, the NIST and other federal agencies. LLNL and other National Laboratories are members of the National Electrical Manufacturers Association (NEMA) team, which has been chartered by DHS to write a new standard for airport security called Digital Communication in Security (DICOS). The standard will enable prevention, detection, and response to explosive attacks by standardizing the screening of checked bags as well as other threat risk detection attributes at airports and other security areas. While, the current focus is on x-ray equipment, there are plans for future work in whole body imaging technologies.

Over the last 10 years, the National Laboratories have broadly engaged the scientific community in aviation security. LANL, LLNL, and SNL scientists have participated in numerous National Academy studies and co-authored several reports, including a report entitled, Airline Passenger Screening, New Technologies and Implementation Issues.

Social Science Impact of New Technologies

Commercial deployment of new and improved technologies to meet the threats of today as well as anticipated future threats will require a robust scientific research program to meet the required technical performance and effectiveness. However, we must be mindful that successful deployment of these technologies requires the acceptance of the people required to use it (e.g., airport screeners) and people affected by it (e.g., passengers and crews). Public concern related to passenger screening technologies has been persistent over time and includes health, legal, operational, privacy and convenience issues.

It is my firm belief that the acceptance of a technology—such as whole body screening—will be strongly influenced by the public's perception of the benefits in relation to the loss of privacy. These trades are made all the time by the public, and in the absence of a clearly defined benefit (in terms of enhanced security), the lack of public support should surprise no one. If government regulators mandate such an approach (or an optional full body "pat down" in lieu of the image) without defining in clear terms the benefits to the public in terms of security, or perhaps convenience (e.g. coat removal is no longer required), and in a manner that does not pay due respect to the cultural sensitivities and social concerns of society, then the public will resist. Hence, along with the development of new technical means, it is important to research the social science issues associated with a technology that may be deemed necessary due to the evolution of the threat or the improvement of capability. Such social science efforts should address the multicultural issues surrounding modern air travel—and address questions like why a socially conservative country like Saudi Arabia accepts full body imaging, while the US public is seemingly less inclined.

There is much work to do in this area. Understanding the complex interaction between threat and defense requires system-level modeling and analysis across the entirety of the problem. When dealing with the public in such a direct manner on a 24/7/365 basis, the traditional technical performance metrics, cost effectiveness, and the integration issues must stand alongside an appreciation of the human factors associated with deployment. The National Laboratories have extensive experience in conducting this type of analysis for a broad range of national security applications.

Conclusion

As I have demonstrated through a number of examples, the NNSA National Laboratories have long engaged in a wide range of Aviation Security Programs to prevent terrorist use of high explosives. Lawrence Livermore, Sandia, and Los Alamos National Laboratories have worked with DHS since 2006 in aviation security, working closely with DHS S&T and TSA. The President's directive on Aviation Security specifically challenged the Department of Energy, and in particular it's National Laboratories, to respond to the need for innovation in this arena. We look forward to accepting the President's challenge, and applying the full power of these laboratories—multi-disciplinary science and engineering, high performance computing, and (importantly) the core mission to serve the Nation without any real or perceived conflict of interest, as a partner to the government in the context of our special relationship as an FFRDC— to secure our Nation's aviation and our freedoms. In pursuing this effort, we will work closely with DHS, which has been the primary funding source of many of our aviation security projects, and other partner agencies to meet this vitally important challenge to national security.