Statement for the Record

Susan J. Hallowell, Ph.D.
Director, Transportation Security Laboratory
Science and Technology Directorate
Department of Homeland Security

Before the U.S. House of Representatives
Committee on Science and Technology
Subcommittee on Technology and Innovation

April 24, 2008

INTRODUCTION

Good Afternoon Chairman Wu, Ranking Member Gingrey, and distinguished Members of the Committee. It is an honor for me to appear before you today to provide you with information about the Transportation Security Laboratory, part of the Department of Homeland Security's (DHS) Science and Technology Directorate (S&T).

The Transportation Security Laboratory (TSL) has historically been responsible for turning aviation security applied research into prototypes and products. The Laboratory emerged from many years of work by Federal Aviation Authority (FAA) officials to increase aviation security, originally in the light of high-jacking incidents in the 1970s. The Air Transportation Security Act of 1974 (Public Law 93-366) granted the FAA authority to pursue methods aimed at preventing high-jacking, and this authority was strengthened by the 1985 International Security and Development Cooperation Act (Public Law 99-83), which led to growth and expansion of the FAA' s research and development program.

During the 1980s, threats to aviation safety began to include bombs as well as high-jacking threats, and the sorts of technology needed for detection and screening purposes started to change. Following the PanAm 103 tragedy in 1988, development of state-of-the-art technology that the FAA Administrator could certify as reliably able to detect explosive material in checked baggage was recommended. These recommendations, codified in the Aviation Security Improvement Act (Public Law 101-604) in 1992, resulted in the creation of the Aviation Security Laboratory (ASL) at the FAA William J. Hughes Technical Center, in Atlantic City, New Jersey.

The new ASL launched a multi-tiered program to develop automatic methods to detect threat amounts of explosive in checked luggage as well as develop hardened aircraft containers capable of preventing another tragedy. The ASL received direct funding by congressional line explosives detection, infrastructure protection, human factors, and aircraft hardening. The Commission's mandate also required that the FAA develop a Certification Standard that would define the performance requirements for an Explosive Detection System (EDS) in terms of probability of detection, false alarm rate, throughput rate, and detection of specific types and configuration of explosives. The EDS Certification Standard was established and published in the Federal Register in 1992, and the ASL certified the first unit, an InVision CTX 5000 System, in 1994.

Following the events of 9/11, the Aviation Security Laboratory was renamed the Transportation Security Laboratory (TSL) and joined the Transportation Security Administration (TSA); in 2003, the TSA and the TSL joined the new Department of Homeland Security, and in 2006 the TSL became part of the Department's Science and Technology Directorate. As a federal laboratory and extension of the Directorate, the TSL's domain and customer base continue to grow. In the dynamic environment in which we live, where both foreign and domestic entities pose real threats, the Transportation Security Laboratory is recognized as the foremost resource for applied research, development, integration, and validation of leading edge science and technology for the detection and mitigation of explosives and conventional weapons threats. The Laboratory is more than a research institution, however; it is committed to providing technical and procedural solutions that work in the field. This testimony provides an overview of TSL's

research, development, test and evaluation activities, its customer interactions, and its roles in technology transfer.

TSL's Role in Setting Aviation Security Research, Development, Testing and Evaluation Priorities

Although the TSL provides research and development (R&D) input, the TSL does not set priorities for this work. The TSL performs R&D at the request of the S&T Directorate, and priorities for this work are set primarily by the customer components. Under Secretary Cohen instituted the Capstone Integrated Product Team (IPT) process to set priorities for the Transition portion of the S&T Directorate's budget. Transition programs are focused on providing technology solutions to meet customer need in the 0 to 3 years timeframe. Through this process our customers identify and prioritize their capability gaps to mission performance, which allows the Directorate to respond with applicable technology solutions to fill these gaps. Aviation security efforts fall under the Transportation Security Capstone IPT managed by the S&T Directorate's Explosive Division. TSA is the customer lead for this IPT. TSL currently supports S&T Explosives Division's checked baggage, air cargo, and checkpoint program efforts. The Research portion of the Directorate's budget is not completely tied to Transition programs but aligned to provide breakthrough science to support longer-term (outside of 3 years) needs of the customer.

The Capstone process has lead to a better understanding of customer needs and how they set priorities, but it also has challenges given the large number of identified capability gaps and the expanded role of the Explosives Division beyond aviation and transportation explosives detection. As a result, the current funding for aviation security R&D for explosives detection is about what it was in 1996 (in absolute dollars).

With the use of S&T 'Core Funding' resources, TSL also performs work for customers on an as-requested basis. This involves pop-up requests from TSA, both from the TSA Office of Security Technology (OST), and from TSA field offices and airports. TSL has also done work for the U.S. Secret Service, the U.S. Coast Guard, DHS Customs and Border Protection, the Department of State, and the Department of Defense. These organizations utilize the TSL as a 'go-to' laboratory for explosives detection RDT&E. The lab conducts RDT&E evaluations of commercial off-the-shelf (COTS) and next-generation prototype detection equipment, provides laboratory and field testing standards for deployed explosives detection systems, and acts as subject matter experts to consult on a wide variety of issues involving weapons and explosives detection.

Test and evaluations activities at TSL encompass two independent functions: The Independent Test and Evaluation (IT&E) function is responsible for evaluating mature technology that may meet TSA's security requirements, suitable for piloting or deployment, and the Research and Development function has responsibilities ranging from applied research, to prototype development, to technology maturation that produces prototypes suitable for evaluation by the Independent Test and Evaluation Team. These two groups set their priorities using different methodologies.

The IT&E group has a strong relationship with the TSA's OST, in that they frequently discuss testing requirements, priorities and results of evaluations. TSL conducts three main kinds of independent verification and validation tests: certification tests, qualification tests, and laboratory assessments. These will be discussed in greater detail in the next section of my testimony, "TSL's Testing and Evaluation Procedures."

The types and frequency of independent testing at the TSL has tripled in the last two years, as acquisitions by TSA have become more diverse and more explosives and weapons detection equipment has become commercially available. The Department of Homeland Security Appropriations Bill for FY 2008 directs DHS S&T "to report on the costs and benefits of charging companies for certification of their products (at Transportation Security Laboratory (TSL)) in light of the potential to provide enhanced certification services and the capital improvement needed to safely house the ITE program." S&T has performed the review as directed and believes that TSL should be allowed to charge companies for certification of their products. Since 1992, the TSL has carried out their Congressional responsibilities while serving as the focal point for technical exchange and excellence in the field of security technology with industry, academia, other Federal and State agencies and foreign governments. Allowing TSL to charge companies for certification of their products is appropriate for this enduring and mature laboratory. The scope of investment required to meet the expanding workload of the Lab addresses infrastructure and personnel investment required.

TSL's Testing and Evaluation Procedures

Review of test and evaluation activities. There are different kinds of Test and Evaluation (T&E) activities at the TSL. Independent Test and Evaluation Activities include certification, qualification, and assessment testing, and generally speaking, are performed to determine if detection systems meet customer defined requirements. Developmental Test and Evaluation Activities (DT&E) activities are designed to verify that a prototype or near COTS system has met performance metrics established within the R&D program, such that it can proceed to the next R&D stage. Additionally, R&D may look at the science and technology issues behind the technology, along with the development of critical simulants or standards to perform laboratory or field testing of explosives.

Independent Test & Evaluation: TSL's Independent Test and Evaluation (IT&E) group conducts independent verification and validation of detection systems for transportation commerce inspection (people, goods, and baggage). Results support decisions of DHS operating elements (such as TSA) for field trials and production or deployment, as well as key program milestones, benchmarking, and investment strategy. The IT&E office judges "detection-worthiness" and product readiness. The customer sets the requirements, and TSL designs each test to determine if candidate systems meet those requirements.

The Certification Test Program is reserved for detection testing of bulk and trace explosives detection systems and equipment under statutory authority 49 U.S.C. §44913 for checked baggage. The focus is on providing laboratory certification of matured explosives detection equipment, certifying that salient performance characteristics, such as the probability of

detection of all categories of explosives with appropriate false alarm rates and throughput rates, are met. The details of types and masses of explosives and false alarm rates are classified. EDS must be certified before they can be deployed. Pub. L. 101-604 defined the requirement for certification of Explosives Detection Systems (EDS), and Pub. L. 107-71 defined the requirement for certification for Trace Explosives Detection Systems. Certification is recognized as a world standard for explosives detection. The TSL is ISO 9001:2000 registered for certification of explosive detection systems.

The certification process is clearly defined in the EDS Certification Management Plan (1993) which is available to those entities seeking systems certification. The certification test protocols were developed by a panel of experts (the National Academy of Sciences). Certification tests are performed with dedicated personnel, with the Test Director and an independent third party observer present. In the last two years, TSL has certified eleven bulk EDS and 6 trace EDS.

Qualification Tests are designed to verify that a security system meets customer-defined requirements as specified in a TSA-initiated Technical Requirements Document. This test, along with piloting (field trials) generally results in a determination of fitness-for-use. This process is modeled after the certification process, and is defined within the Qualification Management Plan. Unlike the Certification Test, the requirements of the Qualification Management Plan typically expand beyond detection functions to include operational requirements. The Qualification Test Program is conducted under statutory authority different from certification testing. Covered by 10 U.S.C. 2319, 41 U.S.C. 253(e) and FAR Subpart 9.2 Qualification Requirements, the result of Qualification Testing is a recommendation of whether candidate systems should be placed on a Qualified Products List (QPL). TSL has conducted 56 qualification tests in the last two years.

Laboratory Assessment Testing is conducted to determine the general capability of a system. These evaluations of candidate security systems are carried out in accordance with interim performance metrics, and the results drive future development efforts or operational deployment evaluations. While the IT&E group practices best scientific principles in test design, execution, and evaluation of data, assessment criteria are determined by the customer (TSA) and the customer's needs. TSL has conducted 124 such assessments in the last two years on bulk EDS and 26 on trace EDS in the last two years.

Developmental Test and Evaluation (DT&E) is performed by the R&D team at the TSL, and involves testing in a controlled environment to ensure that all system or product components meet technical specifications. These tests are designed to ensure that developmental products have met major milestones identified within the R&D project.

DT&E testing at the TSL assesses the strengths, weaknesses, and vulnerabilities of technologies as they mature and gain capability. The primary focus is to ensure that the technology is robust and ready for Certification Testing. The criteria for success are based on the operational needs of the customer and it is mainly based on technical performance and the component agency's Concept of Operations (CONOPS). Based on this key input, the customers' requirements are translated into technical requirements with testable metrics of performance. These metrics of success, and how they will be assessed, are detailed in the test plan.

The ultimate goal is to ensure that equipment that will be deployed in the field is usable, effective, reliable, and maintainable over its operational lifetime. Thus, the time spent in DT&E assures that promising research and technology development transitions smoothly to the field and the end users.

TSL's RDT&E personnel also perform testing of basic scientific principles, development of laboratory and field simulants and standards, testing of breadboard systems or components, testing of prototype systems, and testing of near-COTS or COTS systems to determine if systems meet the minimum requirements of the customer, and are ready to transfer over to TSL's IT&E testing.

Basic scientific principles are tested or measured utilizing expertise and advanced instrumentation at TSL to learn chemical or physical properties of materials (threats) or interactions with materials. This includes performing X-ray Diffraction and high energy X-ray/CT measurements on existing and home made explosives (HME) to determine the fundamental properties necessary for detection in COTS EDS systems. Similarly, ion chemistry measurements are collected to verify detection or interferences that may exist with ion mobility spectrometry (IMS) based explosives trace detection (ETD) systems.

Testing and development of Simulants and Standards are critical to the T&E of explosives detection systems both in the laboratory and field. TSL has developed many sets of bulk explosives simulants (for X-ray and CT systems) that allow testing of EDS systems without the need for the presence of dangerous bulk explosives, permitting systems to be tested in laboratory settings and for testing in the field for government customers. TSL has also developed a number of trace explosives standards for TSA, such as standards that are used for quality control (QC) checks on lab and fielded ETDs, trace particle standards to contaminate surfaces (baggage, laptops, vehicles, etc.) to verify proficiency of both the screener and ETD as a system, and a number of verification standards that other government performers or industry utilize to measure the efficiency of their ETD system.

Breadboard EDS systems, which are developed either at TSL, industry, academia, or a government laboratory, are tested or evaluated by TSL as part of a product developmental cycle. This testing allows TSL to utilize explosives threats to measure the technology's feasibility to meet the customers' defined requirements, or in some cases, general requirements to develop technology for S&T without specific agency requirements, but with minimum technology specifications. Often, Human Factors evaluations or assistance are brought into the process to provide early guidance with the end-users requirements for usability, interface, and suitability.

Prototype testing encompasses early developmental systems, which are typically provided by industry, academia, or government laboratories. Prototypes undergo testing to learn about detection capabilities and gaps, in order to improve and transfer the systems to the final production stage.

R&D Assessment of production stage prototypes is where TSL determines if a system is ready to be transferred over to IT&E for critical customer evaluation. This testing looks at the

minimum detection requirements of the evaluated system, the human factors considerations for field use, issues with false alarms, interferences, and systems engineering requirements. Often this is where industry will get a chance to perform final product modifications to meet the intended customer's needs.

Certification Readiness Testing is a DT&E test conducted to provide quantitative evidence that a system meets (or fails to meet) the performance requirements prior to certification testing. This test is conducted in stages, in order to grow the candidate equipment performance so that it will be robust enough to have a good probability of passing the certification test. While certification may take only a few weeks to administer, Certification Readiness testing may take several months to a year of hard lab work with the industry partner to mature the candidate explosives detection system. Typically, the TSL presents increasingly harder Improvised Explosives Device (IED) concealments to candidate explosive screening equipment, and the vendor must, in turn, refine hardware and software to achieve detection of explosives with high levels of detection and low false alarm rates.

The results of all of the above RDT&E activities normally end up in technical documents which, along with oral debriefings, are provided to the customer. This provides them with clear and concise test plans, T&E data, summaries, comments and conclusions. With CRDAs, similar non-sensitive reports and debriefs are provided to the industrial partner to ensure they have gained the insight necessary to bring their product to the next step in the developmental process.

Coordination with other DHS components. TSL works closely with TSA in the translation of customer requirements into TSA technical requirements that have performance metrics of success, so that requirements are testable. The IT&E group provides the customer with high quality test data that guides decisions concerning operational robustness and detection capability of available systems. The IT&E group also regularly convenes working groups, contributes to IPT meetings, and produces rapid assessments to support TSA's efforts. The TSL has also shared its expertise with other DHS components, including the U.S. Coast Guard and U.S. Secret Service.

The TSL looks forward to contributing our expertise to the University Centers of Excellence (CoEs) in the areas of transportation and explosives. TSL personnel are working with the S&T Explosives Division to identify and evaluate potential research projects of interest, and TSL will be part of the proposal review chain. TSL has welcomed assorted undergraduate and graduate students as part of the DHS Scholars and Fellows program over the years. It should be noted that, prior to the establishment of the DHS CoEs, TSL has had a long and fruitful relationship with academia, via the Grants and Cooperative Agreement programs (FAA Grants Program). With these funding mechanisms, TSL has been able to work with academia to develop and perform RDT&E on novel next-generation explosives detection systems.

TSL and Technology Transfer

While the TSL performs testing and certification of technologies, it is the responsibility of TSA to define and judge readiness for deployment. Technologies passing certification are demonstrated to have efficacy, but do not necessarily demonstrate operational robustness.

Deployment decisions are, in part, based on unique laboratory tests conducted at TSL that cannot be conducted in the field, along with operational utility evaluations conducted by TSA. If TSA encounters operational issues with a piloted or deployed system, TSL stands ready to provide subject matter expertise to understand the issue and assist in corrective action. Several examples of TSL's assistance in these situations are described with other technologies we have transferred below. Occasionally, TSL has taken the initiative to develop product support systems (e.g., the Image Quality phantom and trace quality control aids) to improve operational performance.

In terms of technology transfer, in addition to the clear technology transfer milestones that equipment certification and qualification play, the TSL offers continuous, daily support to enable this process. Some efforts are obvious, such as subject matter expert support for TSA programs, and some are more nuanced, such as refinements to federal security officer's training for explosives recognition, or training concerning use of an explosives detection system.

In addition to testing and certification, TSL continues to work with TSA as they plan for deployment. The Lab helps TSA develop appropriate training modules for newly deployed technologies. The TSL also continues to work with the TSA to aid in the monitoring and oversight of the configuration of each piloted or deployed system. As systems are upgraded to become more operationally robust, the TSL assesses the extent and nature of system changes, and occasionally calls for system recertification if changes may affect the performance criteria of the system. Finally, the deployment of explosives detection systems to the airports has created a secondary industry at the TSL: We have created high fidelity explosive simulants, test articles, quality control aides and other diagnostic tools that TSA uses to validate that the equipment or screeners are performing at the appropriate high standards.

TSL/TSA Transition Activities

TSL has worked with TSA to transition many programs that could improve transportation security. Examples of ongoing work include:

- TSL has been actively pursuing R&D relative to improving detection by **bomb sniffing dogs**, and provide training tools for canine handlers, training aids for canines and canine performance assessments for canines to TSA's National Explosives Detection Canine Training Program.

- TSL has a strong tradition of **Human Factors** expertise, and TSL's Human Factors group is currently involved with a number of projects in support of TSA. These efforts are critical to ensure that sophisticated equipment can be easily, safely, and effectively used by thousands of screeners in the field. Past activities included the creation of a selection test for X-ray screeners for TSA's Office of Human Capital; this was transitioned to TSA in 2001 and it has been used to hire all TSA screeners since then. Currently, the TSL Human Factors team are:

    - Providing a formal analysis of the so-called "re-screening problem" for a joint U.S. – Canadian Working Group, and looking at possible alternatives to re-screening of checked bags of Canadian origin at US airports.

- Working on the development of On-Screen Alarm Resolution (OSARP) procedures for Cargo, which presents new and different challenges to screeners using EDS.

- Participating in a TSA pilot on the development of Cargo screening procedures for privately operated independent air carriers that acquire X-ray, Advanced Technology (AT) and Explosives Trace Detection (ETD) equipment.

- Participating in TSA's Passenger Screening Program workgroup to develop measures of screening effectiveness. TSL also supports research on screener performance, screener attention focusing techniques, screener fatigue, and optimizing screener interfaces, which efforts are expected to contribute to TSA processes in the future.

- Providing support to the TSL's Independent Test & Evaluation (IT&E) group assessments of Whole Body Imagers (WBI) for TSA. In the last year, Human Factors staff supported TSA with 14 separate WBI assessments examining the effects of multiple technologies, passenger poses, privacy settings, and threat sizes on threat detection capabilities.

- Through a long-term research grant with the University of Central Florida, TSL's Human Factors experts have created a new and highly effective method for training TSA screeners to detect threats in carry-on bags. This new method has been shown to produce significant increases in threat detection in lab studies, and an initial pilot showed improved IED detection for screeners with this new training method. A comprehensive pilot study is being planned with TSA's Office of Technology Training to test 300 screeners across at least 20 different US airports.

- TSL also has a tradition of supporting **mitigation efforts** and has assisted TSA's Office of Security Technologies with mitigation-related technology. In the late 1990's, TSL successfully blast-tested two hardened aircraft luggage container prototypes **(HULD**'s), which were subsequently certified to existing FAA airworthiness requirements. In 2006, the TSA's Office of Security Technology implemented the HULD Pilot Program in response to 9/11 Commission recommendations, the objective of which was to determine operational impact (security benefits, durability, maintenance, training impact, and cost) of any subsequent HULD implementation. During the course of the HULD Pilot, TSA placed a total of 25 HULD's into operational service trials; to date, 20 HULD's have been removed from service at predetermined intervals (between 100-350 flights), and TSL has blast-tested these in order to determine the effects of operational service on continued HULD blast resistance. Over the next 6 months, TSL will complete explosive testing on the HULD's remaining in operational service.

Other Examples of Technology Transfer

TSL also provides technology transfer through its **Communications and Radio Frequency Identification** (RFID) group**.** These activities include:

- Cockpit-Crew Emergency Communications System Flight Tests. TSL provides expertise and flight tests to support TSA's Federal Air Marshals (FAMS) development of the FAMS Air-to-Ground Communications Architecture.

- Cargo RFID Seals Project. TSL is providing recommendations and test bed support for TSA's efforts to have a Cargo Screening System using RFID seals in place for 100% of all cargo shipments by August 2010.

- Canine Mass Transit Remote Sensor Project. This project is providing a pilot of a Canine Stand-off Situational Assessment for First Responders and was initiated by the TSA Deputy Administrator.

- Regional Maritime Security Coalition/Cargo Information Action Center. TSL contributed subject matter expertise and assistance with transference of Command, Control, Communications and Intelligence Network technology to Pacific Northwest Airports and Columbia River Seaports, linking TSA Federal Security Directors at Portland International and feeder airports with the US Coast Guard, Customs and Border Patrol, FBI and State and Local Port Authorities and Emergency Management Centers.

- Atlantic City International Airport Testbed. TSL is working with the South Jersey Transportation Authority for in-situ RDT&E site for airport-related security technologies and systems.

Another major role that TSL plays in technology transfer is working with industry via **Cooperative Research and Development Awards** (CRDAs). The CRDA mechanism allows industry to mature their technology in partnership with the US Government. TSL provides industry with a unique opportunity to perform RDT&E (laboratory evaluation) of its products with real explosive threats that are not typically available to the private sector, while at the same time providing industry with subject matter expertise to assist in the final development and maturation of technology. This allows Industry a path to mature technology that will meet performance standards required for DHS applications. To date, these activities have been limited due to lack of government funding and infrastructure/laboratory constraints.

Conclusion

In conclusion, the primary focus of the R&D and the test and evaluation at the TSL is to develop, mature, and transition technology to detect explosives. TSL combines a profound awareness of terrorist capabilities with penetrating insight about the operational environment. The Laboratory's close relationship with its customers allows us to fully understand customer needs and incorporate operational considerations into our R&D. By applying fundamental

understandings of science, systems engineering, and test and evaluation protocols, the Laboratory is a unique national asset that is perfectly positioned to continue providing effective technology solutions for national security. The TSL stands proudly behind the fact that every piece of security technology presently deployed in the nation's airports has at some point traveled through our doors. Whether it is during development, qualification, or certification, the hands and minds of the TSL team have played a role in all of today's technological solutions for the detection of explosives and conventional weapons in transportation security. Chairman Wu, Ranking Member Gingrey, and distinguished Members of the Committee, I want to thank you for giving me the opportunity to provide this testimony today.