Statement for Record

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Introduction

Thank you, Madam Chairwoman and Members of the Subcommittee for this opportunity to share with you the work the Science and Technology Directorate (S&T) performs to support the Transportation Security Administration's (TSA) goal to screen 50 percent of air cargo to be transported on passenger aircraft by February, 2009 and 100 percent by August 2010.

S&T's Explosives Division develops the technical capabilities to detect, interdict, and lessen the impacts of non-nuclear explosives used in terrorist attacks against mass transit, civil aviation and critical infrastructure. This includes checkpoint, baggage, air cargo, and vehicle screening technologies; blast-resistant aircraft construction; and detection of explosive threats from a distance (standoff detection). Customer inputs and requirements from the TSA, U.S. Secret Service, U.S. Coast Guard, and first responders are used to define capability gaps, prioritize technology needs, and allocate research.

There are three, interrelated ways that S&T assists, or plans to assist, TSA in achieving the goal to screen 100 percent of air cargo by August 2010. The first way is in the conduct of the multi-year, multi-million dollar ***Air Cargo Explosives Detection Pilot Program (ACEDPP)***. This program has been carried out in full partnership with TSA as well as with the three local airport authorities and officials who have participated.

The second way is in the conduct of the multi-year, multi-million dollar ***Air Cargo Research and Development Program***. This program is also being conducted in close coordination with TSA. TSA prescribes the requirements in a Capstone Integrated Product Team process, which serves as the basis for the research program.

The third way, still in the planning stage, is S&T support to the ***TSA Certified Cargo Screening Program.*** The ***Securing the Chain of Custody*** section of this document addresses the activities that TSA requests S&T to undertake in support of the Certified Cargo Screening Program.

The sections that follow provide more detailed information on these three ways S&T is assisting TSA in achieving the goal of screening 100 percent of air cargo by August 2010.

Air Cargo Explosives Detection Pilot Program (ACEDPP) Summary and Lessons Learned

Summary

In authorizing the ACEDPP, Congress recognized the potential threat of an explosive device to be loaded onto a plane as cargo and detonated, resulting in catastrophic loss of life and significant damage to property and commerce. An additional vulnerability is related to freighter aircraft, which typically have larger cargo doors and can accept larger containers. With larger cargo containers, there is the potential for an individual to stow away in the container and take control of the plane during flight.

The ACEDPP is evaluating countermeasures to these vulnerabilities by examining alternative approaches to, and assessing the impacts of, substantially increasing air cargo screening levels for explosives and for the detection of stowaways using existing screening methods (i.e., bulk explosives detection, trace detection, canine screening and physical inspection) and TSA-qualified screening protocols. ACEDPP results will assist S&T in defining the research agenda for future cargo screening technology development to fill gaps that exist in present systems.

The ACEDPP will provide critical information about the design, operation and challenges of integrated cargo handling and screening systems, and their associated costs. The program will also collect important data about the frequency and nature of false alarms generated during screening. Such information will guide the improvement of existing screening technologies and the development of future technologies, as well as inform the development of effective Concepts of Operation (ConOps).

Key questions the ACEDPP addresses are:

- Is it feasible to screen *significantly* more air cargo (i.e., at least six times more than pre-ACEDPP levels)? What resources and ConOps are required to do so?
- What are the *costs* associated with increased screening levels, and how are these costs distributed over system and operational elements?
- To what degree does increased screening enhance security? How *effective* are technologies and protocols developed for screening passenger-checked baggage in detecting explosives in air cargo?

The ACEDPP is unique in that it has taken a systems approach to cargo screening. This approach integrates screening technologies with cargo handling systems. It also incorporates ConOps that direct specific cargo commodities to the most appropriate screening technology, based on detection sensitivities, alarm rates and other factors. ACEDPP data collection and analysis efforts are focused on evaluating the efficacy, cost, and operational impacts of increased cargo screening using high-fidelity/high-integrity, ground-truth operational data.

The ACEDPP established pilot operations at three airports: San Francisco International Airport (SFO), Cincinnati/Northern Kentucky International Airport (CVG), and Seattle-Tacoma International Airport (SEA). The objective of the pilot programs at SFO and CVG is to evaluate screening of belly-loaded cargo for explosives, while the SEA pilot evaluated the use of canines and technology to screen bulk cargo for explosives and stowaways.

The program has completed operations and data collection at each of the three pilot sites. The current focus is on data analysis, computer simulation, optimization modeling activities, and completion of the final report. Three interim reports have been provided to Congress as required by the statute establishing the ACEDPP. The fourth progress report is in review and will be transmitted to Congress within the month. The final report will include conclusions and recommendations that will inform evolving cargo screening policies, screening protocols and future technology development efforts. In its final report to Congress, ACEDPP will include a cost-benefit analysis to compare the high-volume/high-automation screening approach implemented at SFO-United Air Lines, the moderate-volume/high-automation approach at SFO-Northwest/Continental, and the moderate-volume/reduced-automation approach at CVG-Delta.

As a follow-on activity to ACEDPP, S&T is assisting TSA in accomplishing its air cargo screening through additional testing of different equipment that TSA wanted to test at SFO. We shall be gathering raw data and images for varied cargo from an L-3 Communications (L-3) MVT-HR unit we have on loan from L-3. S&T expects to collect about three months of data that, again, will assist in better understanding how the performance of X-ray based screening equipment might be improved (either through indicated changes in hardware or in improved algorithms). Data will be shared with L-3 and will also be analyzed at Lawrence Livermore National Laboratory. We expect to continue this data collection at SFO with a Surescan unit in the Fall, after we are through collecting other data with this unit at Tyndall AFB. These data collection efforts take on more importance as TSA evolves toward wishing to use AT technologies (in addition to CT-based technologies) as part of its strategy for screening more air cargo.

S&T will also be collecting data from the AS&E X-ray back scatter van, loaned to us by AS&E, at SFO. We shall determine its effectiveness for stowaway detection as a complement to what we have already learned at SEA from CO2 and heart-beat monitoring equipment under the ACEDPP. The back scatter unit has been effective in connection with war operations in theatre.

These data collection efforts have been in accordance with the direct requests of the Chief Technical Office at TSA.

Lessons Learned

- More than half of air cargo at some facilities (e.g., United/SFO) is currently screened by alternate methods due solely to the way it is packaged. Eliminating these alternate methods of screening will add substantially to the air carrier screening load using traditional methods.
- Screening high percentages of air cargo shipments for explosives using existing baggage screening technologies is feasible. However, breaking down and re-building Unit Loading Device (ULD) shipments for piece-level screening is very labor intensive. Moving the requirement for screening ULDs earlier in the process to Indirect Air Carriers (IACs), manufacturers, or Independent Cargo Screening Facilities (ICSFs) would be far more efficient. Alternatively, ULDs could be screened by air carriers using canines or another bulk screening method.
- The use of heart beat monitors coupled with carbon dioxide sensors for detecting stowaways in bulk cargo containers was determined to be feasible. FEMA certified search and rescue canines also showed great promise as a means to detect stowaways in freighter-bound bulk cargo.
- The cost of technology-based screening is on the order of $0.08-0.12 per pound and is dominated by cargo handling and screening labor. Canine screening is much less expensive per pound – less than $0.01 per pound for the ACEDPP pilot at SEA-TAC airport.
- Given that labor is the predominant factor in air cargo screening costs, ongoing efforts by equipment vendors to reduce false alarm rates would result in substantial future cost savings.
- Limited operational efficacy assessments for explosives detection systems (EDS) machines were conducted at SFO using simulated explosives, with very positive results. Some efficacy data for explosives trace detection (ETD) and canine screening have been reported elsewhere. There is still a need for system-level efficacy testing and analysis.
- Under the current screening regime, screening 100 percent of air cargo would have significant impacts on air carriers. Many business practices would need to be modified, such as allocation of substantial warehouse space for screening equipment, screening personnel and shipment staging, requiring some shipments to be delivered earlier, and prioritizing shipments for screening. The Certified Cargo Screening Program (CCSP), being developed by TSA (and discussed more fully in TSA's written statement), is being designed to mitigate this impact.

- Cargo screening can provide side benefits to air carriers, such as yielding accurate weights and dimensions to maximize revenues and help balance aircraft loads.

Important legacies of the ACEDPP include an *optimization* model that permits TSA to undertake trade-off analyses between performance and comprehensive, inclusive costs. This verified and validated model, using detailed cost information collected at three airports in the process of undertaking the ACEDPP, reveals the costs of increased cargo screening, by category of cost, and is being used by TSA now in extrapolating the results of the ACEDPP to the top five air cargo carrying airports and the top ten passenger carrying airports, as required by Congress. Another legacy is the library of images from airport X-ray based detection systems. These images can be accessed by investigators to help determine what improvements in hardware and in software would be necessary to improve future detection performance – both in terms of the probability of detection and in lower false alarm rates. Since labor costs have been shown in the ACEDPP to be about 50 percent of the total costs of screening air cargo and to be a substantially greater fraction of costs than any other cost category, reduction of labor costs through reduction of false alarm rates can save substantial money. It has been estimated that each percent reduction in false alarm rate leads to a $25 million/year saving in screening costs. A final legacy is the beta-testing design of suitable material handling facilities that can reliably track air cargo from ingestion to plane delivery, route cargo to the appropriate screening technology based upon the type of commodity involved, and reduce potential injury to cargo handling personnel through ergonomically designed lifting and movement systems.

Air Cargo Research and Development Program

The overall goal of the Explosives Division's Air Cargo Research and Development Program is to research, develop, and test security systems (technologies and screener/operators) to screen all air cargo for a wide range of explosive threats while minimizing operational costs and the impact on the flow of people and commerce through the mass air transit system.

The general approach is to use, or adapt, security technologies that have been successfully employed at U.S. airports for screening checked and carry-on baggage. To reduce costs, research has focused on commercially available technologies that can be modified and enhanced from other applications (e.g., military equipment). Given gaps in the commercial technology base, the program also involves researching and developing new and emerging technologies to screen air cargo faster, more accurately, and with less reliance on the human operator.

Derived from the program's goal and approach are the following research and development (R&D) objectives:

- Aggressively pursue an innovative and forward-thinking R&D program focused on <u>automated</u> detection of explosives.
- Screen a wide range of cargo <u>commodities</u> without significantly impacting cargo operations.
- Develop technologies to screen break bulk, palletized, and containerized <u>configurations</u> of cargo.
- Apply technology to strengthen the security of the supply chain to permit <u>distributed</u> screening over time and across geography.

TSA Certified Cargo Screening Program

The *Implementing Recommendations of the 9/11 Commission Act of 2007* requires that the 50 percent screening of air cargo to be transported by passenger aircraft by February 2009 and 100 percent by August 2010 be provided at a level of security *commensurate* to that of passenger baggage. Current TSA-approved methods of air cargo screening include physical search with manifest verification, X-ray, explosives trace detection (ETD), explosives detection systems (EDS), decompression chamber, and canine screening. TSA has concluded that screening capacity at a single point in the supply chain, e.g. at the premises of air carriers in air cargo-carrying airports, is insufficient to accomplish this requirement. The large volume of air cargo (about 12 million pounds daily) that moves on passenger aircraft suggests that carrier delays, cargo backlogs and transit time increases could all occur unless the screening strategy distributes the requirement spatially and by participant. TSA intends to satisfy the requirements, in large part, by establishing a Certified Cargo Screening Program (CCSP), which will create additional screening capacity in the air cargo supply chain. TSA has already begun implementation of an Indirect Air Carrier (IAC) Screening Technology Pilot, as part of the development of the CCSP, and will issue an Interim Final Rule, as provided by the 9/11 Act, to fully implement the program.

TSA will be describing these programs in its testimony today. The S&T Directorate will continue to assist TSA in accomplishing its objectives in whatever specific ways TSA may require for both the CCSP and IAC aspects of its approach to air cargo screening.

However, an additional variation of the two approaches, above, involves establishment of Independent Cargo Screening Facilities (ICSFs). The ICSF is a “fee-for-service” business model variant that would provide screening services for varied entities, including smaller IACs and air carriers. ICSFs could be located near airports and could provide screening services for those customers (shippers or others) who do not wish to invest in security requirements and equipment to screen freight themselves. Quite importantly, the ICSFs could also receive air cargo in the form of individual break bulk parcels, screen them as such (with technologies now suited only for break bulk sizes), and assemble them into pallets for delivery to airport sites. The ACEDPP has measured the times required to break down pallets for break bulk screening in EDS equipment and then reassemble them for delivery to the air carrier point of embarkation. The times are lengthy and could threaten the orderly flow of commerce. In addition, the assembly of pallets and ULDs is a complex science that challenges the ability of screeners to reassemble pallets and ULDs expeditiously once the screening is completed. TSA has received several expressions of interest from entities who wish to explore the business opportunities presented by ICSFs. TSA would like S&T to contact these parties and design, establish and evaluate such a facility at one of the larger airports. S&T could bring the comprehensive expertise and contacts it has developed in conjunction with its ACEDPP and incorporate “lessons learned” in the design of an effective ICSF. S&T would work closely with the TSA Air Cargo team in developing an operating plan for this business model and in selecting a suitable pilot site.

S&T and TSL are also providing significant support of the CCSP by conducting the Multi-Technology Assessment (MTA) of Advanced Technology (AT) X-ray and pallet-sized X-ray systems. S&T is adjusting testing priorities to support the TSA CCSP initiative to get detection, throughput, and false alarm data to help provide guidance on how commercially available technologies can be used in the IAC Pilots.

In addition, S&T via the Independent Test and Evaluation (IT&E) Program at the TSL, is establishing a bulk/high-density break bulk air cargo qualification testing capability. This high visibility initiative is helping to establish technical requirements for commercially available cargo screening equipment. Most importantly, this effort will commence qualification testing of existing break-bulk air cargo screening equipment this Fall in direct support of the TSA CCSP.

The S&T Directorate welcomes the opportunity to participate with TSA in the multiple ways that have been described in this paper and specifically would like to work with the TSA Air Cargo Team in the design and evaluation of the new ICSF concept.

Securing the Chain of Custody

One of the challenges that must be addressed in carrying out TSA's Certified Cargo Screening Program will be how to secure the chain of custody between the points where air cargo is screened, e.g. at TSA-certified shipper sites, the IACs or at ICSFs, and final ingestion at the air carrier site at the airport. Fortunately, the S&T program supporting Customs and Border Patrol (CBP) to secure commerce in maritime transportation can provide important technologies to accomplish such chain of custody. The following S&T projects may provide results that TSA might draw upon to improve security in the chain of custody.

M-Lock - M-Lock is designed to ensure that truck cargo leaving air cargo consolidation facilities completes its intended path to designated airports throughout the U.S. with no tampering. The M-Lock configuration of the Marine Asset Tag Tracking System (MATTS) is a MATTS tag in a lock enclosure that can be used as a TSA Chain of Custody tool for reliably tracking and monitoring air cargo from a consolidation facility to an entry point at a US airport. In conjunction with TSA's Certified Shipper Program, M-Lock's will be demonstrated in an operational scenario starting in Q4 of FY 2008.

Air Cargo Composite Container – This project, which kicked off in FY 2008, expands upon the composite materials developed in association with the Hybrid Composite Container project. In order to detect tampering or intrusion, security sensors will be embedded into the walls of an air cargo Unit Load Device (ULD) fabricated using composite materials. The project's success depends on ensuring lightweight comparability to existing aluminum containers and interoperability with existing aircraft loading infrastructure.

Secure Carton – This Small Business Innovative Research (SBIR) project will develop a shipping carton with embedded security sensors. These sensors will detect tampering/opening of the carton once it has been closed and secured. The carton will communicate to an RFID reader any tamper event such as the insertion of threat material. This project provides improved supply chain visibility, chain of custody, and security closer to the point of manufacture, or stuffing, and is scalable and applicable across various shipping modalities including maritime and air cargo. The prototype development phase of this project will end in FY 2008 and testing will start in FY 2009.

Secure Wrap – This SBIR project, which kicked off in FY 2008, is developing a more flexible and secure tamper-indicative wrapping material. This wrap is suitable for palletized cargo shipped through the international supply chain and across the various shipping modalities (e.g. air, maritime, land). Secure wrapping material will have the capability to detect tampering through the material and will be deployable with minimal impact to current supply chain logistics and processes.

CanScan – This project will develop enhancements to existing secondary non-intrusive inspection (NII) capabilities to detect or identify terrorist contraband items (e.g., drugs, money, illegal firearms) or humans. These system enhancements will provide increases in penetration, resolution, and throughput when compared to existing NII systems. Future Automatic Target Recognition (ATR) capability will be integrated into the CanScan system. This project addresses the Cargo Security Capstone IPT's highest capability gap to enhance cargo screening and examination systems through advanced non-intrusive inspection. The capabilities developed will screen air cargo in unit load devices (ULD), on pallets, or break-bulk configurations. This effort is planned to begin in FY 2009.

Automatic Target Recognition (ATR) - The project will develop an automated imagery detection capability for anomalous content (e.g. persons, hidden compartments, contraband) for use in existing and future Non-Intrusive Inspection (NII) systems. This ATR capability is applicable to scanning and imaging systems used by CBP and TSA by applying an operator-assisted decision aid that provides target discrimination. This project is planned to begin in FY 2010.

Air Cargo Data Exchange System - This project establishes a system architecture and prototype implementation to ensure that security data and tracking information from various tamper evident devices are communicated reliably and securely to TSA. This prototype implementation will be interfaced to TSA's targeting capability. The effort is planned to begin in FY 2014.

Customer Output Focused

Input from customers is key to defining capability gaps, prioritizing technology needs, and effectively allocating research. This input has been gathered through the DHS S&T Capstone Integrated Product Team (IPT) and the Air Cargo Product IPT processes. The Capstone IPT has identified capability gaps for technology development, operations and oversight, and detection of stowaways. The explosives detection IPT calls for technologies for screening break bulk, palletized, and containerized air cargo for explosives and weapons.

One of the highest priorities of TSA is to develop requirements and to qualify commercially available technologies to screen air cargo. Congress directed that by February 2009, 50 percent of air cargo transported on passenger aircraft be screened and to increase that percentage to 100 percent of air cargo by August 2010. The Explosives Air Cargo Program will work with TSA to assist TSA in meeting this goal.

Goals for Air Cargo Explosives Detection R&D. The short, mid, and long term research goals for effective air cargo screening of explosive threats are identified below. These goals are based on the program mission, the investment approach, operational objectives, and customer input.

Short Term Goals (0-2 years)

- Development of cargo-optimized EDS systems for break bulk cargo screening.
- Continued industry outreach to pursue private sector innovations and approaches.
- Tools to assess operator performance and to regulate/oversee screening effectiveness. Cargo screening is currently a regulated function.
- Evaluation of current capabilities and TSA approved screening methods.
- Detection of non-explosive components of air cargo threats.

Mid Term Goals (3-5 years)

- Development of advanced technologies to screen larger cargo configurations without causing logistical burdens on the industry.
- Development of advanced technologies to screen dense and exception cargo commodities.

- Mitigation of insider threats by ensuring cargo integrity throughout the supply chain.

Long Term goals (>5 years)

- Next Generation ETD and EDS development to permit automated, fast, accurate inspection of a wide range of commodities and cargo configurations.

The specific FY 2008 and FY 2009 goals are:

- Conduct testing of cargo-optimized technologies, based on checked luggage equipment, for break bulk cargo screening.
- Conduct testing of a metal detection technology to detect the components of an Improvised Explosive Device (IED), such as wires, batteries, and timers, rather than identification of the explosive. This will be used for non-metallic cargo commodities.
- Complete development of a prototype technology that ruins the electronics of an IED and renders it safe. This will be used for non-electronic cargo commodities.
- Conduct testing (Technology Readiness Evaluation) of commercially available technologies to screen containerized cargo made of low-density commodities (e.g., fresh flowers, produce, and seafood).
- Develop and pilot test a selection test to identify and hire the best air cargo screeners.
- Begin development and validation of standardized training for all of the approved air cargo screening technologies.
- Begin development and validation of a certification test to assess the performance (i.e., operator proficiency) of air cargo screeners.

These immediate activities will assist TSA in meeting the requirements to screen 50 percent of air cargo transported on passenger aircraft by February 2009 and to increase that percentage to 100 percent of air cargo by August 2010.

Air Cargo Screening Challenges

There are currently six approved methods for the screening of air cargo: physical search with manifest verification, canines, X-ray, decompression chamber, Explosives Trace Detection (ETD), and Explosive Detection Systems (EDS). None of these methods were designed for cargo inspection, and their use in the cargo environment has resulted in limited performance in terms of detection, nuisance alarms, throughput, operation/logistics, and costs. A dedicated near, mid, and long-term R&D program is described to optimize current (checked baggage and checkpoint) inspection technologies for cargo and to develop equipment and systems to expeditiously and effectively screen cargo. Challenges an R&D program must address are:

Commodities – The greatest challenge in screening air cargo is the tremendous range and - configuration of commodities. Many of the common cargo commodities (e.g., machine parts) are very dense and present significant challenges for inspection technologies. In addition, many commodities are exceptional, such as cargo that is live (e.g., tropical fish) or requires great care and sensitivity (e.g., human remains) (refer to Table 3). The time-sensitive nature of air cargo requires fast screening and resolution. Further, there is wide seasonal, temporal, and geographic fluctuation in commodities shipped by air. Lastly, approximately fifteen percent of the cargo is unique or unusual (e.g., race cars, marble statues) and can present tremendous screening challenges.

Configurations and Packaging – Another challenge in screening air cargo is the wide range of packaging and configurations. Cargo can be presented in individual boxes, on pallets, and in a wide range of containers (i.e., Unit Load Devices or ULDs). In general, break bulk cargo is considered to be individual boxes less than one cubic meter (3ft X 3 ft X 3 ft). Containerized cargo includes shrink wrapped pallets, cookie sheets, and ULDs. These configurations are generally 4ft by 4ft by 8 ft, but can also be much larger. Currently, there is no inspection technology to inspect the larger cargo configurations automatically (i.e., without operator intervention). In addition, cargo is packaged in a diverse range of material including cardboard, metal, wood, and plastics and a large range of weights that can exceed current equipment capabilities.

Operational Constraints and Environment – The context of air cargo in the U.S. has a profound impact on its safe and expeditious screening. Numerous and diverse stakeholders are involved with air cargo: air carriers, logistics companies, indirect air carriers, freight forwarders, shippers (both known and unknown), industry groups, screening companies, and government agencies. Stakeholders have competing views and demands that may be strenuous. The TSA's oversight of cargo screening is from a regulatory perspective. Thus, TSA does not directly screen air cargo, nor does it procure, deploy, maintain, or operate cargo screening equipment. Key operational constraints to screening air cargo include:

- Diverse and Numerous Stakeholders
- Regulatory Oversight / Approach from Government
- Percentage of Cargo Screened
- Operational Need for Speed and Efficiency
- Economic Impact of Screening
- Alarm Resolution is Critical
- Insider Threats
- Theft
- Public Concern
- Political Interest

There is strong pressure to inspect more cargo and to reduce the current type and number of exemptions. In FY 2006, Congress directed DHS S&T to conduct three Air Cargo Explosive Detection Pilot Programs (ACEDPP) to examine the feasibility of screening six times more air cargo in a break bulk configuration. A final report to Congress, with key findings regarding this challenge, will be presented in January 2009.

The Technology Base – The technologies that have been used, or proposed, to screen air cargo were developed for checked for carry-on baggage. As a result, each technology and approach has limitations in terms of detection, throughput, sensitivity, automation, and operational costs. Several screening methods and technologies exist for the type of commodity and configuration that are acceptable for screening low density commodities in small configurations. Performance gets progressively worse as the density increases, the configuration gets larger, and the packaging becomes more complex. The ultimate goal of the Explosives Air Cargo Program is to provide effective and acceptable technologies for all types of commodities and configurations.

Additional Security Challenges – Other challenges to screening air cargo include the need for operational speed and efficiency. This is particularly important given the corporate and national economic benefits of air cargo commerce. Furthermore, a very low nuisance alarm rate is required of any technology that will be operationally acceptable, especially given the high costs and difficulty in opening and resolving alarms in carefully packaged break bulk and containerized configurations. In addition, the open nature of the air cargo system has made it vulnerable to threats from insiders and to theft, which is estimated at 3 percent annually and is accepted by the industry as a "cost of doing business." Theft of cargo indicates that there are vulnerabilities in the system that could be exploited to insert a threat.

The Opportunities: Proposed Systems Approach for Screening Air Cargo

The Explosives Air Cargo Program is also guided by a vision of an integrated system of people, technologies, and procedures to effectively and expeditiously screen air cargo. This vision is based on the idea that any effective and optimized system for screening should include at least the following seven components.

- Tested and Qualified Products – by Commodity/Configuration
- Detection, Identification, and Disruption
- Site-Specific customization
- Distributed System
- Protection and Inspection Approaches
- Human Engineering
- Rigorous Oversight and Audit for Quality Assurance

Candidate Technology List. Working in collaboration with TSA, a draft performance specification has been developed that presents the detection and processing requirements for break bulk and containerized air cargo screening technologies. This performance specification, analogous to a Qualified Products List, will facilitate the selection of suitable solutions for air cargo screening. To the extent practicable, technologies should be automated to aid the human operator in the interpretation of complex images and information. It is foreseen that technologies for the proposed air cargo system will be approved or qualified by configuration (i.e., break bulk or containerized) and by eight major cargo commodities.

Explosive Detection, Device Identification, and Threat Disruption. For checkpoints and checked baggage the focus has been on detection of explosive substances. Given the nature of air cargo, an entire, intact explosive device is the threat that will almost certainly be presented. This provides the opportunity to identify the non-explosive components of the device (i.e., metals) in non-metallic air cargo. There is also the opportunity to disable/disrupt the intact device in non-electronic cargo to render it harmless to the aircraft. The proposed systems approach to air cargo screening should be multi-faceted and include explosives detection, as well as innovative approaches for device identification, and threat disabling/disruption.

Site-Specific Customization. Given the wide variation in the types and configurations of air cargo by airport (e.g., Miami has a high percentage of fresh flowers) it is likely that specific technologies should be mapped onto the operational needs of each airport and/or operation. For the state of Alaska, which relies on air cargo rather than roadways, the customization and flexibility of the cargo screening will be critical. Thus, it is foreseen that an effective cargo security system will be a customized "patchwork" of technologies, procedures, and human operators who are designed to optimize the detection and minimize the operational costs of air cargo inspection at each site.

Distributed System. The current air cargo system involves numerous stakeholders (e.g., shippers, consolidators, handlers) who have facilities and equipment off-site from the airport. There is opportunity to take advantage of the distributed nature of air cargo over geography and time. To the extent that cargo can be effectively screened by trusted entities and that the supply-chain is secure, it will be possible to design a system that is flexible and does not create "cargo checkpoints" or bottlenecks at the airport. Improved supply chain integrity will reduce thefts. The proposed systems approach should include supply chain integrity to permit distributed screening over time and geography.

Protection and Inspection. Protection refers to hardening the aircraft or its subsystems so that it has enhanced capability to withstand the effects of an explosive device. To the extent that protection approaches are viable and successful, terrorists are forced to use larger threats to cause catastrophic damage. Larger threats are easier to identify via inspection and thus the performance demands on detection technologies can be better optimized. The proposed systems approach should employ protection technologies to ensure a more robust capability to mitigate explosive threats via air cargo.

Human Engineering. Even with significantly automated technologies, it will ultimately be the decision of a human operator whether or not a cargo item represents a threat. The human operator is a necessary and key component of an effective security system. Thus, there should be a dedicated focus on human factors and the performance of individuals screening cargo through R&D on selection, training, equipment interfaces, standardization, development of procedures, and mitigations of insider threats.

Oversight and Audit. A significant challenge for a complex socio-technical system with diverse people, entities, locations, procedures, technologies is to maintain strict vigilance. The goal is to maintain high and consistent levels of performance over time. Technologies and interventions, such as Threat Image Projection, can be incorporated to maintain vigilance, provide training to operators, and monitor performance to determine person-machine effectiveness. The proposed air cargo security system should be designed with oversight and quality assurance as a key goal.

Air Cargo R&D Strategic Map

Given the challenges, opportunities, operational constraints, and technology approaches, the Explosives Air Cargo Program has developed a high-level strategic map to guide the sequencing and priority of R&D based on the cargo configuration, commodity characteristics, and the applicable technology approach.

The strategic R&D map indicates that technologies will be developed individually for break bulks, palletized, and containerized cargo configurations. These are in order of difficulty, but the ultimate goal is one integrated technology solution that can screen all three configuration types. Within each configuration, technologies will be specialized for low density, high density, and exceptional commodities. Six technology approaches will be developed, enhanced, and tested to yield air cargo screening systems:

- Trace Explosives Detection is based on chemistry and it involves technologies that can identify minute particles or vapors from explosives. In this area, the R&D focus is to get the sample into the technology, to get more accurate analysis (sensors), and to increase automation so there is less reliance on a human operator.

- Bulk Explosives Detection is based on physics and involves electromagnetic energy and ionizing radiation (such as X-rays) to penetrate cargo, collect data (e.g,, mass and density), and present an image. In this area the R&D focus is to increase automation so there is less reliance on a human operator, increase detection of explosives, reduce nuisance alarms, increase speed and throughput, increase power to screen larger and more dense cargo, increase reliability, and reduce annual operational costs.

- Device Component Detection is based on technologies that detect or disrupt the non-explosive components of an IED. In air cargo the threat is an intact IED that is a complete circuit with a power source, initiator, explosive, and switch/timer. In this R&D area the focus is to increase sensitivity (e.g., find very small amounts of metal in produce), increase throughput, ensure safety, increase speed and throughput, and reduce reliance on a human operator.

  This work is based on commercially available technologies or the integration of mature components. A dedicated basic research effort is not required since the effort involved leveraging work conducted by other government agencies (e.g., DoD, NASA) through the Technical Support Working Group (TSWG).

- Human Engineering is concerned with getting the best performance from the human operator and to ensure that technology is designed for ease-of-use (ergonomics). The R&D focus is to select, train, and monitor the performance of human operators who are screening air cargo. Another key R&D challenge is to evaluate the automation of screening technologies and determine the most effective way for humans to interpret data and resolve alarms.

- Canine Explosives Detection is concerned with the use of dogs to screen air cargo for explosives and the scent of threats. The challenge for R&D is to breed the best dogs, increase training tools, develop better ways to get a scent (sample) to the dogs, improve detection performance, increase consistency of the dogs, and reduce operational costs.

- Mitigation and Hardening is focused to develop bomb-resistant systems to complement and back-up explosive detection technologies. Existing inspection systems may not always find explosives at weights that can, under some circumstances, cause catastrophic failure. Selective use of hardening technology in conjunction with inspection may result in a more practical and cost effective means of ensuring aircraft safety than inspection alone.

In addition, as technologies mature, a concerted effort will be undertaken to integrate and fuse the technologies to take full advantage of their orthogonal capabilities. It is envisioned that the “final” fused solution will take advantage of multiple technology layers in an integrated system of systems (technology, people, and procedures).

Conclusion

The threat of explosives to air cargo remains considerable. The key challenge is that there exists a very limited current technology base. There is currently no technology that can cost-effectively, efficiently, accurately, and quickly screen the diverse range of cargo commodities, configurations, and packaging.

The DHS S&T Explosives Division is committed to a balanced strategic approach to developing air cargo screening technologies by leveraging research and development in chemistry and physics-based detection, IED component detection, human engineering, canine olfaction, and explosives mitigation. Research and development in the air cargo explosives detection area will ensure that technology products are available to be deployed to ensure the safety and security of the traveling public.

Members of the Committee, I thank you for the opportunity to meet with you today to discuss how the S&T Directorate is assisting TSA in meeting the goal of screening 100 percent Air Cargo by 2010. As we move ahead, I look forward to working with the Committee to improve our Nation's capabilities in the area of securing air cargo.