2.4 Aviation Security Program Area Description

Mission

The Federal Aviation Administration (FAA) Aviation Security Research and Development (R&D) Division maintains responsibility for R&D programs related to civil aviation security. The division's mission of performing R&D to prevent civil aviation security incidents provides programs that accelerate and expand R&D and supports the deployment of advanced technologies. Division products lead to equipment and methods designed to counteract criminal and terrorist attacks against civil aviation. This mission includes anticipating future threats and emphasizes the need to rely less on human intervention for detection and deterrence. Well integrated, automated, aviation security systems that leverage benefits from a variety of technologies will provide better operational performance.

Intended Outcomes

The main goal for the Aviation Security R&D Program is to detect, deter, and mitigate criminal and terrorist threats to civil aviation . Accomplishing this goal promotes public confidence and directly benefits the aviation industry. The increasing extent and sophistication of terrorism demands the identification and development of practical, effective technologies appropriate for aviation security systems. These systems must be comprehensive and flexible enough to address all potential vulnerabilities at the airport as well as in loading and servicing the aircraft itself.

The Aviation Security Program conducts extensive R&D to detect explosives and weapons, as well as other more sophisticated threats, and to prevent the placement of these items on board aircraft. This program focuses on automated aviation security systems and screening protocols that are the least intrusive, most effective, and enable the highest throughput. This minimizes passenger delays and inconvenience. The Program also conducts R&D to identify methods to harden the aircraft to mitigate the damaging effects of explosives, weapons, surface-to-air missiles, and electromagnetic interference.

Program Area Outputs

Through the Aviation Security R&D Program, the FAA develops technologically improved products and procedures in explosives detection, human factors, aircraft hardening, and airport security. Program outputs include:

- Developing and fielding effective and efficient explosives detection systems.
- Developing R&D test protocols and performance criteria for the operational deployment of improved aviation security systems.
- Defining standardized methods of security screener selection, training, and performance evaluation through data collection.
- Exploring blast mitigation techniques to ensure that potentially catastrophic criminal and terrorist acts do not result in the loss of lives and aircraft.
- Developing a structured, airport security system architecture and a concept of operations for security plannering.

Aviation Security R&D products include systems, devices, technologies, specifications, analysis tools, technology integration plans, and procedures. These products are used by airports, air carriers, airframe manufacturers, and screening companies to improve civil aviation security.

Program Area Structure

The Aviation Security R&D Program is divided into four interrelated areas: Explosives and Weapons Detection; Human Factors; Aircraft Hardening; and Airport Security Technology Integration. Each program area makes a significant contribution towards achieving a safe and secure air transportation system.

The *Explosives and Weapons Detection* program focuses on developing, or improving methods and technologies of detecting explosives and weapons in checked and carry-on baggage, on passengers, or in air cargo. This program promotes pre-board screening to prevent the armed takeover of aircraft. The Explosives and Weapons Detection program develops standards and specifications for test and certification or approval of detection equipment.

The *Aviation Security Human Factors* program aims to improve the human element of the aviation security system. Two approaches are used to increase human-machine performance. The first is to improve the performance of the human operator through enhanced training. The program develops screener selection methods, evaluates screener training, and develops procedures for measuring and improving screener performance. These improvements are especially important as aviation security components merge into future integrated systems.

The second human factors approach is to improve performance of the operator by designing equipment and interfaces that maximize perceptual, cognitive, and physical abilities of users while minimizing their errors. To address this approach, the Aviation Security Human Factors Program is becoming involved in the system definition or conceptual design phase — early stages while the program is developing human-machine performance evaluation criteria. By being involved earlier in the system life cycle, significant improvements can be made to equipment without a major impact on the schedule or budget. Furthermore, early involvement increases the likelihood that the system will be easier for the user to operate.

The program also conducts usability assessments on all new aviation security equipment and training systems to ensure they are free of deficiencies and capable of effective and efficient operation by the end user. During these assessments, emphasis is placed on the capabilities and constraints of the human operators and how they influence system operation.

The *Aircraft Hardening* program conducts research to increase civil aircraft survivability in the event of an in-flight explosion. Additionally, this program identifies the type and minimum weight of an explosive that must be detected in order to prevent catastrophic damage or aircraft loss. The Aircraft Hardening program also develops methods to protect aircraft avionics and systems from the damaging effects of false electromagnetic or high-energy signal interference.

The *Airport Security Technology Integration* program focuses on airport security technology development that encompasses a broad range of security devices and models to promote enhanced security within the confines of the airport. Currently, these activities include development of access control and other physical security technologies, passenger-baggage matching technology, and passenger-baggage flow modeling. Also, vulnerability and risk assessments, threat identification, software evaluation, and operational testing are being conducted to facilitate the development of technologies to ensure a safe airport environment. Major emphasis is on the development and life cycle management of system Reliability, Maintainability and Testability (RM&T) requirements of future system designs and recommending concepts of operation while promoting operational readiness and suitability. Technology products include analytical models and simulations that analyze and predict the effects of integrating new security technologies on airport operations. This emphasis includes systems and individuals and passenger/baggage matching technologies that prevent unaccompanied baggage from being loaded on board aircraft. Testbeds that minimize the risks associated with the integration and operation of security equipment being deployed into the airport environment are also included in the program focus.

The program looks both to the present and the future. Operational readiness and suitability are never slighted while research continues into future system designs and new concepts of operation. Technology products include analytical models, state-of-the-art perimeter control, and passenger-baggage matching technologies that prevent unaccompanied baggage from being loaded aboard aircraft. Part of this technology entails the development of simulation and modeling tools. One set of tools performs airport security analysis of vulnerability, risk and blast effects. The other set seamlessly integrates, improves, and reduces operating costs for technologies developed by other programs in the Security R&D Program area.

The FAA Aviation Security R&D Program conducts six R&D projects to achieve the goals of the four Aviation Security R&D budget line items. The three R&D projects (Checked Baggage, Cargo/Mail, and Checkpoint) support the Explosives and Weapons Detection budget line item. The remaining three areas (Aircraft Hardening,

Human Factors, and Airport Security Technology Integration) each have a dedicated budget line. Any one program will not solve all the issues. Technology development has not reached a point where it can operate autonomously. The Aviation Security R&D Program embraces a systems-oriented approach that balances the application of people, procedures, and technology to each threat and vulnerability.

Customer and Stakeholder Involvement

The Aviation Security Improvement Act of 1990 (Public Law 101-604) provides direction for the FAA's System Security Technology Program. The FAA's Office of Civil Aviation Security Policy and Planning requires research in the following areas:

- Checkpoint
- Checked Baggage
- Chemical and Biological Agents
- Explosives Detection by Canines
- Human Factors
- Airport Security Technology Integration
- Aircraft Hardening

In 1996, the White House Commission on Aviation Safety and Security emphasized continued R&D in all program areas, and recommended the deployment of existing explosives detection technology. Congress funded further R&D and the FAA's purchase and installation of Explosive Detection Systems (EDS) and Explosive Detection Devices (EDD). Each year, the FAA Security Equipment Integrated Product Team (SEIPT) purchases and deploys advanced security equipment at various airports throughout the United States.

Stakeholders with a major interest in Aviation Security include the National Academy of Sciences, the Aviation Security R&D Scientific Advisory Panel, the R,E&D Advisory Committee, and the Aviation Security Advisory Committee. These groups hold periodic reviews of R&D plans and progress. Efforts also include interagency work with the Technical Support Working Group. Their recommendations include changes in the direction or emphasis of research plans.

Accomplishments

The FAA Aviation Security R&D Program has been in effect since 1974, resulting in the following significant accomplishments:

- Certified the InVision CTX 5000 and established a demonstration effort that delivered four certified CTX 5000 EDS to air carriers for operational testing. FAA certification criteria examine three performance areas including detection, false alarms and throughput requirements. Upon completion of certification, data collection and analysis took place at airports in San Francisco, Atlanta, and Manila.
- Certified the L-3 Communications eXaminer 3DX6000 EDS. During second certification testing in January 2000, the production unit met certification criteria on detection, false alarm and throughput rate requirements. This is the second company to meet the FAA certification criteria for explosives detection.
- Certified the InVision CTX 9000 DSi Galileo prototype. The first production model was certified in March 2000 using a software version modified and adjusted to improve system performance.
- Awarded five grants for the development of a low cost Explosive Detection System (ARGUS) for use at smaller airports.
- Provided critical input for the effective deployment of the SEIPT beginning in January 1997. To date, 126 EDS have been installed in airports.
- Provided support for the deployment of over 615 explosives trace detection devices to U.S. airports with more scheduled in FY 2000.
- Initiated development and evaluation of trace detection prototypes (in laboratory and airport environments) for screening personnel through use of devices such as portals and document scanners.
- Conducted explosives testing on various aircraft to provide data to validate and refine explosives detection criteria. These tests included a Boeing 747 test performed jointly with the United Kingdom, a Lockheed L1011 test performed with the manufacturing com-

munity, and vulnerability testing on DC-9, 727, and 737 aircraft.

- Supported the 2000 Olympics in Sydney, Australia.
- Conducted a demonstration of hardened LD-3 baggage containers with three commercial air carriers.
- Completed a MANPAD study on the effectiveness of Infrared systems against external aircraft lighting.
- In cooperation with the U.S. Air Force Phillips Laboratory, completed a study on the vulnerability of commercial aircraft to High Powered Microwave and other directed energy weapons.
- Established criteria to limit cross-contamination of explosives used to train and certify explosives detection canine teams.
- Developed the Screener Readiness Test as part of effort to improve screener selection and performance. This government-owned test will determine when the screener has received sufficient initial training. Analyzed data to determine the appropriate cutoff score and prepared suggestions to be sent to FAA's Office of Civil Aviation Security Policy and Planning.
- Published "Checkpoint Effectiveness and Efficiency Evaluation." This report standardized the measurement of compliance with security requirements by establishing baseline performance criteria for determining the effects of interventions.
- Performed an international study of radio frequency identification tags. This technology will make positive passenger baggage matching (PPBM) cost effective and operationally feasible when deployed in the field.
- Completed the Blast/FX effects model and distributed it to over 250 Federal users in many government agencies. This model shows the structural effects of explosives on airport facilities and calculates casualties based on explosive weight and airport configuration scenarios.
- Performed an independent assessment of both the FAA and Alcohol, Tobacco, and Firearms canine explosives detection programs.
- Initiated a Quality Control Standards Development program for Trace Explosive Detectors deployed to American airports.
- Evaluated many approaches to assessing airport vulnerability and risk, adopted one approach for use by FAA agents at airports, and developed the tool and associated training for nationwide implementation.
- Facilitated completion of a signed agreement between Sandia National Laboratories and Barringer Inc. for the production of personnel portals that detect a wide range of explosives. Sandia developed the portal under an FAA contract supported by the Aviation Security R&D Systems Development Branch. The FAA anticipates the delivery of limited production models from Barringer in mid FY 2000.
- Completed standards and quality control development and testing in trace laboratory. Based on a dry transfer concept developed at the William J. Hughes Technical Center a patent is pending.
- Completed optimization and testing of a new version containing a mass spectrometer of Sandia Trace Explosives Detection Portal.
- Produced a laboratory prototype of the Interactive Terminal Interface (ITI)/Penn State Trace Explosives Detection Portal.
- Tested new and innovative explosive synthesis and identification of TATP/HMTD/NC (Triacetone Triperoxide/Hexamethylene Triperoxide Diamine/Nitrocellulose) on FAA fielded equipment.
- Completed acceptance testing for the Barringer 400B, IDS Orion, and the windows version of the Itemiser. These are all trace explosive detection devices.
- Developed Threat Image Projection (TIP) systems to measure screeners' on-the-job performance. The TIP system is now a standard requirement for all new X-ray machine deployments.
- Developed the Computer-Assisted Passenger Pre-screening System (CAPPS) to reduce the number of passengers needing special security screening.

- Developed a long-range cargo plan to evaluate new procedures and promising technologies.
- Published "Effectiveness of the Annistech PXR-1M System at Explosives Detection in Air Cargo" and "Effectiveness Testing of Checked Baggage Inspection Systems for Explosives Detection in Air Cargo: Baseline Test and Evaluation Plan."
- Assessed current EDS technology for detection of reduced threat quantities.
- Completed eighteen EDS certification tests resulting in the certification of six systems.

R&D Partnerships

Since its inception, the Aviation Security R&D Program has established productive relationships with many organizations that promote technology development for improved aviation security. These organizations include U.S. Government agencies, industry, academia, and foreign countries. Each of these partnering organizations contributes to the Aviation Security R&D mission by providing information, R&D, equipment, and/or facilities. The FAA uses these partnership agreements to enhance Aviation Security R&D project investments. Recent projects in partnering include:

- Bilateral agreements with the United Kingdom, France, Canada and Israel for exchange of information, development of new explosives detection technologies, and cooperation on joint ventures, as well as test and evaluation.
- Cost sharing agreements with manufacturers for additional sources of certified EDSs. Systems that are expected to come to market in the future, will increase the efficiency and effectiveness of available detection options while reducing cost through competition.
- Cost sharing agreements with Alaska, Northwest, Delta, and American Airlines to identify and develop methods utilizing advanced technologies to improve screener performance.
- Cost sharing agreements with Ancore, Control Screening, EG&G Astrophysics, and L-3 Communications for the development of ARGUS Explosive Detection System, a low cost system for smaller airports.
- Development and testing of hardened LD-3 containers for wide body aircraft in cooperation with the U.S. Air Force, Army, Navy, NASA, the Department of Energy, and several airlines.
- A partnership, through a U.S. Government organization and a foreign government, to investigate the practicality of developing hardened containers for use on narrow body aircraft.
- A cooperative agreement with the State of Illinois on the Security of Cargo Shipments.
- Cooperative Research and Development Agreements with Smart Approach Limited and Trainsoft Limited to complete the development of Computer-Based Training Systems for initial checkpoint screener training.

Long-Range View

The FAA envisions an integrated aviation security system for the 21st century that incorporates a variety of technologies. These technologies are continuously monitored and upgraded to respond to changes in the threat environment. This integrated system will enable aviation security professionals to perform at maximum levels of effectiveness. Major challenges are ahead for the R&D program to attain 100% EDS-level checked baggage screening to start phasing in implementation in 2009. The application of smaller, faster automated detection technologies will enhance screener performance by providing detection that is constantly vigilant and unaffected by the distractions or fatigue that affect human or canine screeners. This understanding of the aviation security system of the future provides guidance and direction for future Aviation Security R&D Program efforts and supports decisions for FAA investments.

Terrorist capabilities and techniques continue to increase and evolve. The world remains a dangerous place. The ever-changing threat requires continued R&D funding for the future of aviation security. Aviation Security R&D Program efforts will continue to focus on modifications and other technical improvements to deployed explosives detection equipment. In addition, identification

and evaluation of explosives mitigation techniques will continue to expand to include the entire aviation spectrum — airports, airplanes, and other areas of the National Airspace System.

A07a Explosives and Weapons Detection

GOALS:

Intended Outcomes: The mission of the FAA's Aviation Security Program is to develop and deploy advanced equipment capability enabling air carrier operations to comply with national security policies, meet national contingencies, and effectively enhance the security of the flying public.

This advanced capability is intended to significantly reduce, eliminate, and/or mitigate terrorist actions like the *Pan Am 103 Tragedy* through the availability of better detection and increased surveillance.

Recent studies and national security policies have led to sharply accelerated and steep requirements, such as:

- Significantly smaller quantities of explosives.
- New specific, emerging threats (explosives and weapons).
- Focused inspection sampling of passengers and bags by FY 2005.
- 100% screening of passengers and bags by FY 2010.

Agency Outputs: The FAA Aviation Security Program is the world leader in detection research and development. It leads and sponsors accelerated development of advanced technology to counter the ability of terrorists to artfully conceal improvised explosive devices and weapons in any state or form onboard aircraft. Specifically, this program:

- Develops low-cost, high throughput detection systems for inspecting passengers and their baggage for a wide diversity of civil aviation operations world wide.
- Adapts the best existing and emerging U.S. technologies to meet continually evolving threats.

Customer/Stakeholder Involvement: The Explosives and Weapons Detection program works closely with air carriers, U.S. and foreign agencies, oversight groups, special interest groups and the general public to understand and define system requirements in a team approach. The program interacts as follows with numerous private, academic, and national laboratories to focus research initiatives for "high gear" development and to ensure high quality:

- *Team Approach:* The FAA established an Integrated Product Team for Security Equipment that consists of FAA engineers, agents, human factors scientists, and senior security representatives from each of the major U.S. air carriers.
- *Tight Focus:* This program responds to congressional mandates such as Public Law 101-604, Aviation Improvement Act of 1990, White House Commission on Aviation Safety and Security, Aviation Security Advisory Committee Baseline Working Group, Guidance from the General Accounting Office, and Section 303 of the Federal Aviation Administration Reauthorization Act of 1997.
- *Quality Review:* the FAA sponsors respected special interest groups, including the National Academy of Science and the Committee on Civil Aviation Security of the National Research Council (NRC), to assess security research initiatives and to review explosives detection research priorities.

Accomplishments: Since 1991, the program has:

- Developed the world's first, detection-certified, checked bag inspection system, InVision CTX 5000, with an approximate mean effective throughput of 120 bags per hour.
- Certified an advanced user interface leading to an InVision CTX 5500 Explosives Detection System (EDS) with an approximate mean effective throughput of 160 bags per hour and a 50% lower false alarm rate. Deployed over 105 units in the U.S. Over 50 units have been purchased and deployed by International Civil Aviation Organization (ICAO) partners (abroad).
- Developed and certified two high throughput (~500 bags per hour) checked bag inspection systems: InVision CTX 9000 and L-3 Communications' Examiner 3DX6000. Deployed one unit for technology transition in the U.S. At least three units have been purchased and deployed by ICAO partners (abroad).

- Developed two prototype explosives detection walk-thru portals for screening passengers at checkpoints.
- Pioneered extensive nuclear quadrupole resonance (NQR) methods for bag and passenger inspection. Deployed two prototype units at major airports.
- Developed, produced and distributed inert, non-toxic, high fidelity, X-ray simulants (diverse primary & secondary explosives) for various agencies, foreign governments and vendors to support field testing and training. Developed prototype simulants for NQR detection methods.
- Developed two access control monitors that analyze the trace explosive residue transferred to a token or ticket.
- Evaluated over eight trace explosive detection devices and four carry-on baggage inspection devices with automated image analysis (operator assist) for acquisition and deployment decisions.
- Developed an internationally adopted, performance standard for trace detection on electronic items. Conducted an ICAO workshop on trace detection standards for electronics explosives detection.
- Deployed a suite of explosives detection equipment at five major airports to support 1996 Olympic games.
- Conducted year-long trial deployments of certified explosive detection systems for checked bag inspection at three major airports.
- Identified new potential threats to civil aviation and assessed their present detectability.
- Established test criteria and protocols for checked and carry-on baggage and cargo inspection systems.
- Held two international symposia on explosives detection. Sponsored over five additional conferences on domestic and international explosives detection.
- Developed a quality control aid to evaluate explosive trace detection systems located in airports.
- Evaluated the coordinated use of Trace and X-ray systems as an EDS alternative.
- Developed advanced image processing methods to improve detection capabilities.
- Measured background trace contamination levels on passengers' boarding passes and their bags.

The following accomplishments are expected in FY 2000:

- Enhanced performance of explosives detection canines.
- Evaluated and certified a lower cost (50% savings), lower throughput EDS, referred to as the InVision CTX 2500.
- Developed a "Directed Trace" screening protocol.
- Developed and evaluated a very high throughput (>900 bags/hour) explosives detection prototype.
- Established testbeds at five airports (four major, one minor) for checkpoint R&D and integration studies.
- Designed and field-tested at least two advanced, integrated checkpoint system designs based on commercially available equipment.
- Developed and tested at least one non-ionizing, passenger screening developmental prototype.
- Developed and evaluated an NQR wand developmental prototype.
- Developed and field-tested two portable, prototype liquid inspection devices for rapidly analyzing the contents of bottles carried in baggage.
- Evaluated commercially available screening systems for containerized/palletized cargo.
- Determined feasibility of using trace for cargo screening.
- Developed an automated cargo profiling system.
- Developed training protocols for the manual search of cargo.
- Developed and evaluated prototype systems to detect explosives within baggage and cargo, using nuclear technologies in accordance with congressional mandates.

R&D Partnerships: The explosives detection program works closely with academia, industry,

and other national laboratories. Partnerships with organizations reduce costs, where possible, by combining research initiatives that use the same technologies for slightly different purposes. More than 90 contracts, grants, Cooperative Research and Development Agreements (CRDA), and interagency agreements are in place with industry, academia, and other government agencies. R&D partnership activities include:

- Joint funding agreements, cooperative research and development agreements, and consultation agreements through which Industry and the FAA collaborate to improve and develop carry-on, checked, and cargo scanning systems.
- Many projects supported through interagency partnerships, such as with DOE laboratories, DOD facilities, U.S. Department of Agriculture (USDA), DOD's Office of Science and Technology, U.S. Customs Service, Volpe National Transportation Systems Center, U.S. Food & Drug Administration, and National Institute of Standards and Technology.
- Bilateral agreements between the FAA and several international counterparts.
- Work with the Interagency Technical Support Working Group—a body that supports explosive detection projects that can be applied to other agencies; these include document scanners, cargo screening systems, miniaturization, and performance improvement of trace detection technologies and industry collaboration with foreign governments' technology development.
- Sponsor the NRC Committee on Commercial Aviation Security—a body that regularly reviews the explosives/weapons detection program and makes recommendations supporting further developments.

MAJOR ACTIVITIES AND ANTICIPATED FY 2001 ACCOMPLISHMENTS:

Checked Baggage Screening Technology

- Developed and tested at least one low cost, low throughput (< 150 bags/hr) certified/qualified EDS for small airport applications.
- Evaluated a coherent X-ray scattering detection system.
- Explored the integration of QR and X-ray detection equipment.
- Completed optimization studies for certified EDS.

Checkpoint Technology

- Completed QR wand development.
- Developed and tested a combined alarm resolution protocol using vapor, metal, and QR detection wands for passenger screening.
- Evaluated liquid and container detection methods.
- Initiated competitive activity for concealed object detection.

Cargo Security Technology

- Completed evaluation of EDS technology for screening break bulk cargo.
- Completed guidelines for matching EDS technologies to cargo types.
- Completed training protocols for screening cargo.
- Completed threat assessment between cargo and other vectors.
- Developed guidelines for matching EDS technologies to cargo types.
- Conducted a demonstration of a dual-view x-ray, palletized cargo inspection system at Huntsville International Airport, AL.

KEY FY 2002 PRODUCTS AND MILESTONES:

Applied Research

- Optimize high sensitivity infrared spectroscopy detection systems.
- Determine detectability of newer terrorist threats including non-nitro explosives and chemical/biological warfare agents.
- Develop QR calibration aids and simulants for field testing and training.
- Develop diffraction-based simulated explosives.
- Explore advanced bulk detection methods.

Checked Baggage Screening Technology

- Evaluate trace-based automated EDS.

- Conduct operational test and evaluation of low cost low throughput, certified/qualified EDS system.
- Develop a set of functional specifications for multi-level multi-technology systems development for 100% screening.

Checkpoint Technology

- Complete field evaluation of a prototype non-invasive passenger screening portal system using available methods for a *Selectee* (<100% inspection) concept.
- Explore integrated passenger flow and information systems.
- Initiate integration of bulk object detection with molecular-specific detection techniques for passenger inspection.

Cargo Security Technology

- Enhance automated cargo profiling tool based on operational test findings.
- Complete research on enhanced security applications on ground transportation for air cargo.
- Evaluate advanced EDS systems for break-bulk cargo inspection.
- Initiate airport, airline, freight forwarder and equipment selection for integrated enhanced cargo security demonstration project.

FY 2002 PROGRAM REQUEST:

The explosives and weapons detection program has received significant policy redirection and aggressive objectives requiring substantial increases in funding. These changes include more difficult detection requirements, NAS systemwide deployment for Computer Assisted Passenger Pre-screening (CAPPS) selectees by FY 2005 for checked baggage, and 100% NAS systemwide deployment readiness by FY 2010 for checked baggage and checkpoint inspection.

Future needs, will only be met with substantial increases in research and development funding to focus leading-edge technology, such as nanotechnology, microtomography (MT), electron beam tomography EBT), micro-electro-mechanical systems (MEMS), Terahertz imaging, quadrupole resonance imaging, raman scatter spectroscopy, X-ray diffraction, advanced dielectrometry, and artificial intelligence.

Additional infrastructure, required to support the evaluation of advanced and emerging technologies, will also increase as more systems are developed and deployed.

Other future areas of key focus include critical developments in the nanotechnology arena. Research in this area will provide future systems that work at the micron to atomic scales, providing lower cost, ease of mass production, improvements in sensitivity and selectivity, and applicability to explosive, chemical and biological detection. One type of development in this area is with novel detection systems based on MicroElectro Mechanical Systems (MEMS). This technology provides micro-sized detectors and sensors, and utilizes existing detection technologies, like Gas Chromatography (GC) and Gas Chromatography/Ion Mobility Spectrometry (GC/IMS), Mass Spectrometry (MS), Infrared (IR), microbalance (cantilevers), active surface sensors, etc. Necessary teaming with other agencies on these efforts will involve current multiagency programs with “Mass-Spec-On-The-Chip,” “Super-Sniffers,” and miniaturized GC/MS. In addition, nanotechnology will permit significant reduction in detection equipment to be ubiquitous and nonintrusive to the flying public.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2000)	$ 383,946
FY 2001 Enacted	42,512
FY 2002 Request	38,438
Out-Year Planning Levels (FY 2003-2006)	161,426
Total	$ 626,322

Budget Authority ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Contracts:					
Explosives and Weapons Detection	30,832	37,696	32,299	36,992	31,199
Personnel Costs	2,796	3,462	4,827	4,682	6,039
Other In-house Costs	572	542	479	838	1,200
Total	**34,200**	**41,700**	**37,605**	**42,512**	**38,438**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Basic	0	0	0	0	0
Applied	34,200	41,700	37,605	42,512	12,685
Development (includes prototypes)	0	0	0	0	25,753
Total	**34,200**	**41,700**	**37,605**	**42,512**	**38,438**

A07a - Explosives and Weapons Detection Product and Activities	FY 2002 Request ($000)	Program Schedule					
		FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY2006
071-110 Explosives/Weapons Detection							
Applied Research	**$10,528**						
Advanced Canine Detection and Biosensor Development		◆	◇	◇	◇	◇	◇
Test and Evaluation Chemical Engineering Support		◆	◇	◇	◇	◇	◇
Personnel Screening Equipment and Standards		◆	◇	◇	◇		
Microelectromechanical Systems Development			◇	◇	◇	◇	◇
Enhanced Infrared Detection Systems Development			◇	◇	◇	◇	
Portable mass Spectrometry Systems		◆	◇	◇	◇	◇	◇
Improved Detection for Chemical Warfare Agents			◇	◇	◇		
Bulk Research		◆	◇	◇	◇		
Checked Baggage Screening Technology	**$9,509**						
Developed Low-cost Low Throughout EDS Stations		◆	◇			◇	◇
Develop High Throughput EDS for 100% Screening		◆			◇	◇	◇
False Alarm Reduction		◆	◇		◇		◇
Alternative Technology Integration			◇	◇	◇		
Develop Trace-Based EDS		◆		◇			
Certification of EDS Upgrades		◆	◇	◇	◇	◇	◇
Test and Evaluation		◆	◇	◇	◇	◇	◇
Checkpoint Systems	**$7,530**						
Develop Trace Portals		◆	◇	◇	◇		
Develop Low-Cost Passenger Portals			◇	◇	◇	◇	
Develop Fast, Hand-held Explosive Detection Wands			◇	◇	◇	◇	
Develop Ticket Trace Scanners/Access Control		◆	◇	◇	◇		
Develop Integrated Bottle Contents Scanners		◆					
Develop Integrated Bag Inspection Systems			◇	◇	◇	◇	
Test and Evaluation and checkpoint Testbeds		◆	◇	◇	◇	◇	
Cargo Security Technology	**$3,632**						
Develop and Evaluate Automated Profiling System		◆	◇				
Investigate Matching EDS Technologies to Cargo Types		◆					
Conduct Threat Assessment of Cargo and Other Vectors		◆					
Evaluate Trace/Bulk Technologies for Cargo Screening		◆					
Complete Ground Transit Security Study		◆	◇				
Develop Training Protocols for Screening of Cargo		◆	◇				
Develop Trace Systems for Containerized Inspection		◆	◇	◇	◇	◇	◇
Develop Advanced EDS Systems for Break-Bulk Inspection		◆	◇	◇	◇	◇	◇
Enhance Cargo Security Demonstration Project				◇	◇	◇	◇
Personnel and Other In-House Costs	**$7,239**						
Total Budget Authority	**$38,438**	**$42,512**	**$38,438**	**$39,199**	**$39,901**	**$40,822**	**$41,504**

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

A07b Airport Security Technology Integration

GOALS:

Intended Outcomes: The Airport Security Technology Integration (ASTI) program supports the mission goal of security in the FAA Strategic Plan: "Prevent security incidents in the aviation system." This multi-faceted program addresses integration issues associated with a broad spectrum of current and next generation security equipment and technology in the airport environment. These issues include personnel access, physical security, intrusion detection, positive passenger bag match, and passengers and baggage throughput at the various checkpoint sensors. The intended outcome of the ASTI program is the availability of fully integrated security systems that minimally impact the movement of passengers and baggage through related airport systems.

The ASTI program aims to address integration issues through incorporating engineering disciplines—such as reliability, maintainability, availability and suitability— early in the security technologies research and development process. Through modeling and simulation of different security technologies in varying configurations, the program strives to accent a design that meets specific security requirements. Quantitative data reinforces the achievement of this design, and operational evaluations at established testbed sites ensure a smoother transition of equipment from the laboratory into the field. Overall, ASTI's goal is to reduce cost and time to develop security systems while improving quality and operability.

Agency Outputs: The ASTI program provides data and analyses of technical information, such as airport vulnerability assessments and threats to civil aviation, to aid the overall FAA rulemaking process. The program provides the civil aviation security community with improved methods and technologies. In addition, the ASTI program provides the systems engineering activities to ensure that equipment certified for detection of explosives will be more operationally suitable and transition rapidly upon certification or approval for initial airport use.

Customer/Stakeholder Involvement: The ASTI program responds to Public Law 101-604, the Aviation Security Act of 1990, the Aviation Security Advisory Committee (ASAC) recommendations, and the recommendations of the White House Commission on Aviation Safety and Security. These laws and recommendations provide impetus for the identification of security research requirements and the dissemination to industry of related research results.

The ASTI program priorities and plans are consistent with aviation security community recommendations, and they address industry needs while often involving industry participation in R,E&D efforts.

Accomplishments: Results of the ASTI program are provided to the aviation community for their use, and to the Office of Civil Aviation Security to assist in the rulemaking process. Program accomplishments include:

- Sponsored and led the government-industry committee that developed the Recommended Security Guidelines for Airport Planning, Design and Construction document.
- Developed an automated, PC-based modeling tool with analytical capability for assessing the effects of explosions on buildings and the personnel in them. Over 350 copies of the software tool Blast/FX have been distributed to requesting airport authorities and military, federal, local and state government agencies .
- Obtained critical operational performance information to support airline efforts to develop an International standard for Radio Frequency Identification (RFID) baggage tag use.
- Developed a quantitative method and tool for airport vulnerability to be used throughout the nation by airport personnel and FAA agents.
- Established operational testbed sites, through partnering with industry and academia at major U.S. airports, to improve the operational suitability of security systems and throughput of passengers and baggage at checkpoints.
- Incorporated reliability, maintainability, and availability requirements into the next generation of explosive weapons detection system specifications.

- Completed the Toxic Agent Effects Analysis Program that identified chemical and biological agent threats, including associated countermeasures. This information will drive research requirements and guide current and future research trends relative to chemical/biological threats to civil aviation.
- Completed an airport explosives security survey analysis and correlated information to identify vulnerabilities across 76 domestic airports. Information was provided back to airports on areas of concern and on appropriate corrective action.
- Published guidelines for industry on security revolving doors for use at concourse screening points.
- Performed study on the feasibility of detecting unauthorized personnel access by means of existing ground surveillance radar.

R&D Partnerships: The ASTI program activities are closely coordinated and leveraged with industry, academia, and other government agencies. This is done directly through interagency agreements, cooperative research and development agreements, university grants and Memorandums of Agreements (MOA).

Through partnership with National Safe Skies Alliance (NSSA), FAA established an operational testbed site where evaluation results are transferred to industry to ensure smoother transition of security equipment from laboratory to operational environment.

Partnerships were established with the Association of American Airline Executives (AAAE), Airport Law Enforcement Association Network (ALEAN) and Airports Council International (ACI) throughout the development and evaluation of the airport vulnerability assessment tool.

Other principal relationships include Air Transport Association (ATA) and the Regional Aircarrier Association (RAA) to focus on the economic effects of Positive Passenger Bag Match (PPBM) on the industry. A year-long cooperative study culminated with a published project report that analyzes the economic effects of PPBM on the aviation industry. The FAA continues this relationship to fulfill the requirements of the White House Commission on Aviation Safety and Security recommendations for PPBM.

The ASTI program also works with industry in the following areas:

- American Airlines at Dallas/Fort Worth International airport to study future checkpoint concepts, such as, carry-on remote bag examination and semi-automated gated portal. Measures of effectiveness (MOE) and measures of performance (MOP) are defined.
- State of Illinois for research on the security of cargo shipments in transit from the remote cargo facilities to the airlines' receiving points. Testing has determined the feasibility of a positive driver ID and cargo seal system. This project received national recognition as the leading innovative usage of technology.
- The National Center for Biometrics Testing at San Jose State University for expertise on security projects that involve positive human identity verification through the use of biometric devices (such as fingerprint, hand geometry, etc.).
- Coordination with the U.S. Air Force and the DOD Defense Special Weapons Agency related to simulation and modeling of blast effects and biological and chemical effects on aviation facilities.
- The Technical Support Working Group (TSWG) for representation on the Executive Oversight Committee for development of Automated Tools for Vulnerability Assessment and participation as task leads on specific projects.

MAJOR ACTIVITIES AND ANTICIPATED FY 2001 ACCOMPLISHMENTS:

- Developed an infrastructure to support a focus on improved integration and operational suitability of pending and next generation security equipment including testbeds, model and simulation tools, and incorporating reliability, maintainability and availability requirements early in the R&D process.
- Published results of operational performance testing of RFID baggage tag use and recommendations for international standard.

- Incorporated critical reliability, maintainability, and availability requirements early in the development life cycle of security equipment.
- Contribute to the analysis of security system effectiveness and risk estimation in support of a total security system architecture.
- Publish and distribute the airport construction guidelines document that provides guidance to airport planners, designers, and architects relative to the integration of security into facility design.
- Publish results of the feasibility study regarding the use of the Airport Surveillance Detection Equipment (ASDE3) radar as an intrusion detection sensor at airport perimeters.
- Conducted operational evaluation of advanced security components and systems at established testbed site and transferred results to acquisition team and industry.
- Defined MOEs and MOPs of advanced screener and automated portal equipment at checkpoint of the future testbed site.
- Developed an analytical model for evaluating security effectiveness of various system architectures across all airport security vectors.

KEY FY 2002 PRODUCTS AND MILESTONES:

- Obtain critical operational and performance data at operational testbed sites to aid in improving effectiveness and efficiency of next generation security equipment.
- Analyze critical reliability, maintainability and availability data at different phases of the security equipment development life cycle from conception through disposal.
- Apply the security effectiveness calculation tool to refine the analysis used to establish the second version of the security system architecture.
- Commence concept development for integrated security systems and operations to meet increased passenger and baggage checking requirements through FY 2010.
- Complete assessment of ASDE3 ground surveillance radar as airport perimeter intruder detection sensor.
- Develop new model and simulation tools for analyzing next generation equipment efficiency and effectiveness under various configurations.

FY 2002 PROGRAM REQUEST:

The FY 2002 ASTI program request covers infrastructure development activities. The development of this infrastructure supports the acheivement of fully integrated security systems with minimal operational impact to the airport system and its throughput of passengers and baggage. In addition, the FY 2002 period request utilizes that infrastructure to conduct evalulations and tests to obtain critical operational and performance data. The absence of this data creates a risk that security equipment will not be efficiently integrated into the airport environment.

Key FY 2002 program activities include:

- Operational evaluations in test-bed airports. This activity specifically supports the equipment transition activities of the Security Equipment Integrated Product Team (SEIPT), and will benefit from the lessons learned by field experience gained on SEIP- installed security equipment.
- Analyze equipment availability, reliability and maintainability with established parameters and procedures. As a result of these analyses, equipment that completes the development cycle will not only achieve the required performance levels, but also will be fully suitable operationally.
- Develop new model and simulations for improved integration and optimized operational suitability.
- Translate new concepts for integrated security systems and operations that meet increased passenger and baggage checking requirements through FY 2010 into requirements for advanced systems.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2000)	$ 25,914
FY 2001 Enacted	2,457
FY 2002 Request	2,084
Out-Year Planning Levels (FY 2003-2006)	9,024
Total	$ 39,479

Budget Authority ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Contracts:					
Airport Security Technology Integration	1,127	1,832	909	870	855
Personnel Costs	1,127	754	1,258	1,435	1,060
Other In-house Costs	231	122	118	152	169
Total	**2,485**	**2,708**	**2,285**	**2,457**	**2,084**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Basic	0	0	0	0	0
Applied	2,485	2,708	2,285	2,457	2,084
Development (includes prototypes)	0	0	0	0	0
Total	**2,485**	**2,708**	**2,285**	**2,457**	**2,084**

A07b - Airport Security Technology Integration Product and Activities	FY 2002 Request ($000)	Program Schedule					
		FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY2006
073-110 Airport Security Technology Integration							
Domestic Air Travel	**$0**						
Transferred Assessments of Radio Frequency (RF) Technology for Baggage Tracking or Positive Passenger Bag Match (PPBM) to Industry		◆	◇				
Publish Threat Analysis Report for Advanced Threats to Civil Aviation Security			◇		◇		◇
Developed a Protocol Standard for EDS to Communicate with Baggage Handling Systems to Ensure Accurate Tracking of Alarmed Bags		◆					
Airport Security	**$855**						
Develop New Simulation Tools to Analyze Security Equip Efficiency/Effectiveness Under Various Configurations		◆	◇	◇	◇	◇	◇
Validate and Verify PBFM Data with Realistic Oper.Data				◇	◇		
Plan and Conduct Airport Operational Suitability Tests on Development–Proven Equipment		◆	◇	◇	◇	◇	◇
Developed Advanced Airport Vulnerability and Risk Assessment Tools and Methods		◆		◇	◇	◇	
Developed Internal FAA Capability for Airport Assess		◆					
Establish Testbed Policies and Procedures for Operational Evaluations		◆	◇	◇			
Construct/Refine Oper.Testbed Infrastructure at Selected Airports and Tech Center's Security Operations Center		◆	◇	◇	◇	◇	
Define Measures of Effectiveness and Measures of Performance of Advanced Screener and Automated Portal Equipment at Checkpoint of the Future Testbed Site		◆	◇	◇			
Continuously Evaluate EDS and Other Security Vulnerability Countermeasures in Operational Testbeds		◆		◇	◇	◇	◇
Revise and Update Airport Security Construction Guidelines			◇		◇		◇
Establish a Reliability-Engineering Program to Influence and Supplement Security Sensor Development		◆					
Incorporated Reliability, Maintainability and Availability Requirements into Security Equipment Development Phases		◆	◇	◇	◇	◇	
Analyzed Reliability, Maintainability and Availability Parameters Throughout Development Phases of Next Generation Security Equipment		◆	◇	◇	◇	◇	◇
Completed Assessment of ASDE3 Ground Surveillance Radar as Airport Perimeter Intruder Detection Sensor			◇				
Test Emerging Intrusion Detection Sensors and Systems for Low-cost Performance				◇	◇	◇	◇
Commence Concept Development for Integrated Security Systems and Operations to Meet Increased Passenger and Baggage Checking Requirements Through 2010				◇			
Personnel and Other In-House Costs	**$1,229**						
Total Budget Authority	**$2,084**	**$2,457**	**$2,084**	**$2,151**	**$2,218**	**$2,293**	**$2,363**

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

A07c Aviation Security Human Factors

GOALS:

Intended Outcomes: The Aviation Security Human Factors program strives to optimize human operator capabilities and performance to ensure that advanced security technologies and procedures are maximally effective tools to combat terrorist threats. The program applies human-centered design principles to , leverage human abilities and avoid security personnel limitations in the development and integration of technologies and procedures for checkpoint, checked baggage, and cargo security. The program's efforts directly support the FAA's Strategic Plan security goal to improve the detection of explosives and weapons within the NAS. Specifically, the program focuses upon establishing the baseline level of security and addressing related vulnerabilities.

This program leverages funding for equipment development to improve aviation security system performance through the following means:

- Optimizse human performance contributions through better operator selection, training, and performance monitoring for the various detection technologies.
- Improves the design and person/machine interfaces of security technologies through usability assessment, laboratory testing, and airport testbed operational evaluation.
- Maximizes security system effectiveness by increasing operator threat detection performance while improving coordination, integration, and throughput by applying human-systems analysis.
- Create better security machine interfaces and integration by merging individual detection technologies into a combined system with optimized human performance contributions.
- **Agency Outputs:** The FAA establishes standards for security activities. This program contributes to satisfying this agency resposibility by conducting R&D for technical input essential to:
- Reduce security costs as a result of automation.
- Reduce vulnerability to terrorist threats.
- Decrease risk of catastrophic financial loss resulting from sabotage of an airplane.
- Increase public confidence in the safety of air travel.
- Increase global U.S. industrial competitiveness.
- Improve security screener certification.

Customer/Stakeholder Involvement:

The Aviation Security Human Factors program:

- Supports the Office of the Associate Administrator for Civil Aviation Security as mandated by the Aviation Security Improvement Act of 1990 (PL 101-604).
- Responds to requirements from the Aviation Security Improvement Act of 1990, the White House Commission on Aviation Safety and Security, the Baseline Working Group on Aviation Security, and the General Accounting Office (GAO).
- Partners with multiple airlines to test and evaluate equipment, personnel, and procedures.

Accomplishments: The following results of Aviation Security Human Factors research were provided to the Office of Civil Aviation Security to assist them in their rulemaking process:

- Developed functional requirements for the Screener Proficiency Evaluation and Reporting System (SPEARS) components of screener selection, training, and performance monitoring.
- Measured baseline checkpoint security X-ray threat detection performance.
- Developed screener selection tests for estimating future performance to interpret both conventional X-ray and computed topography (CTX 5000) images.
- Developed computer-based training (CBT) for both checkpoint operations and checked baggage evaluation using the InVision CTX 5000 Explosives Detection System (EDS).
- Developed Threat Image Projection (TIP) for both conventional X-ray machines and the InVision CTX 5000.

- Developed and validated a computer-based test of screener initial training mastery, the Screener Readiness Test (SRT), in support of rulemaking to certify screening companies.
- Developed a Computer-Assisted Passenger Pre-Screening (CAPPS) system.
- Evaluated TIP-ready X-ray machines (TRX) for adherence to FAA functional requirements in support of FAA Security Equipment Integrated Product Team (SEIPT) procurement and nationwide deployment. Developed human-centered functional requirements to guide industry development of networked X-ray TIP.

R&D Partnerships: This program works closely with various agencies and groups, such as:

- The International Aviation Security Human Factors Technical Advisory Group, to ensure effective international communication of research results to avoid duplication of efforts.
- Lawrence Livermore National Laboratory — through an inter-agency agreement.
- Frontline International and International Consultants on Targeted Security/Trainsoft — through Cooperative Research Development Agreements (CRDA) with the FAA.
- The United Kingdom (U.K.) Defense Evaluation Research Agency (DERA), the U.K. Department of the Environment, Transport, and the Regions (DETR), and Canada'sTransport Canada —through Memorandums of Cooperation (MOC) with the FAA.
- The National Research Council (NRC) Committee on Commercial Aviation Security — through this body's regular review of the FAA human factors program and its recommendations regarding focus and initiatives.
- Domestic airlines and research organizations including:
  - – Alaska Airlines
  - – Delta Airlines
  - – Perkins-Elmer / EG&G Astrophysics
  - – Northwest Airlines
  - – American Airlines
  - – Public Computer Systems (Safe Passage)
  - – Frontline
  - – Heimann Systems Corporation
  - – Rapiscan Security Products
- Airport testbeds for human factors research and development:
  - – Atlanta Hartsfield International Airport (ATL)
  - – Dallas/Ft. Worth International Airport (DFW)
  - – Detroit Metropolitan Wayne County Airport (DTW)
  - – Seattle-Tacoma International Airport (SEA)

MAJOR ACTIVITIES AND ANTICIPATED FY 2001 ACCOMPLISHMENTS:

Enhance Human Operator Performance

- Improved screener selection, screener machine interfaces, CBT multimedia training, and performance monitoring systems for emerging detection technologies.
- Developed performance criteria, Instructional Systems Design (ISD), pedagogical approach, and subject matter content for cargo screener Improvised Explosives Device (IED) identification training.
- Performed a multiple vendor assessment (i.e., shoot-off test) of security screener computer-based training systems to determine effectiveness to train critical knowledge, skills, and abilities.
- Completed training protocols for manual search of cargo.
- Developed the ISD for a team training approach for checkpoint security screeners to enhance coordination, threat detection, and passenger processing/throughput.

Improve Security Technology Usability and Effectiveness

- Provided input to further enhance training, demonstration images, selection, testing, and the threat resolution protocol to optimize operator field performance on the InVision's CTX 9000 EDS.
- Evaluated the initial person/machine interface and operator training package for the L-3 Communications' Examiner 3DX6000 EDS.

- Developed human factor design input and criteria for the design and development of a low cost, low throughput ARGUS EDS.

Human Systems Integration (HSI)

- Developed functional requirements for the integration and networking of multiple X-ray machines with TIP capability.
- Conducted an extensive laboratory evaluation of human factors considerations, throughput, and effectiveness of the Directed Trace procedure. This evaluation assessed the efficacy of a human operator using an X-ray machine and an Explosives Trace Detector (ETD) to meet FAA EDS performance standards.
- Developed the design guidelines and criteria for an Elevated Podium of Integrated Checkpoint Security Supervision (EPICSS), in conjunction with Alaska Airlines, to enhance supervision and coordination at security checkpoints.
- Evaluated checkpoint effectiveness and throughput, focusing on person-machine integration, to determine baseline checkpoint performance at testbed sites.
- Integrated new and emerging detection technologies into the operational environment.
- Convened an ongoing panel of industry, academia, military, and government subject matter experts to develop human factors functional design guidelines for security checkpoints to further enhance threat detection performance and passenger throughput.

KEY FY 2002 PRODUCTS AND MILESTONES:

Enhance Human Operator Performance

- Establish criteria and data for rulemaking on screener selection, training, and proficiency assessment.
- Develop and validate certification standards for security personnel to support rulemaking.
- Enhance the predictive validity of psychometric tests to further improve industry accuracy to select job candidates with aptitudes for successful threat detection performance. This work will continue to support the rulemaking for certification of screening companies by providing selection tools to the security industry.
- Evaluate security screener effectiveness in threat detection, passenger processing, and checkpoint procedures to determine baseline performance in an ongoing longitudinal evaluation using four major airport testbeds.
- Develop valid, reliable, non-biased cargo screener IED identification training.
- Perform assessment of advanced security screener computer based training systems to determine its effectiveness on enhancing critical knowledge, skills, and abilities.
- Develop an interactive computer based test to assess screener mastery of on-the-job training (OJT) skill acquisition.
- Develop the Instructional Systems Design for a team training approach for checkpoint security screeners to enhance coordination, threat detection, and passenger processing/throughput.

Improve Security Technology Usability and Effectiveness.

- Determine knowledge, skills, and abilities required for screeners to use advanced threat detection technologies (e.g., X-ray personnel screening devices).
- Evaluate advanced checkpoint personnel screening passenger portals for training design, maintainability, effective throughput, usability, operability, and person-machine performance.
- Determine conformance of additional vendor's TIP equipped X-ray systems to FAA functional requirements for design, usability, and effectiveness.
- Provide continued input to further enhance training, demonstration images, selection, testing, and the threat resolution protocol to optimize operator field performance on InVision's CTX 9000 EDS.
- Conduct a field evaluation of the person-machine interface and operator training package for the L-3 Communications' Examiner 3DX6000 EDS.

- Conduct laboratory evaluations of usability, interoperability, effectiveness, and throughput of a low cost, low throughput ARGUS EDS.
- Develop and evaluate a prototype, integrated network of multiple vendor X-ray machines with TIP capability. This effort supports information requirements in the rulemaking for certification of screening companies.
- Construct and evaluate an Elevated Podium for Integrated Checkpoint Security Supervision prototype system. The EPICSS will be constructed in conjunction with Alaska Airlines at SEA to enhance supervision and coordination at security checkpoints.

Human Systems Integration (HSI) to Optimize Security System Effectiveness and Throughput

- Integrate new and emerging detection technologies into the operational environment by developing human factors functional requirements to integrate persons and machines at the checkpoint.
- Provide evaluations on the manpower, personnel, training, human factors engineering, health, and safety aspects of security systems, especially those involving EDS and weapons detection technologies.
- Evaluate checkpoint effectiveness and throughput, focusing on person-machine integration, to determine baseline checkpoint performance in an ongoing longitudinal evaluation using four major airport testbeds.
- Conduct additional field studies to determine the optimal presentation rate of TIP fictional threats to maximize operator threat detection performance at middle to low volume airports.
- Convene an ongoing panel of industry, academia, military, and government subject matter experts to develop human factors functional design guidelines for security checkpoints to further enhance threat detection performance and passenger throughput.

Long Term Human Factors Research to Improve Threat Detection

- Conduct laboratory and field research to evaluate human perceptual abilities for threat and target identification.

FY 2002 PROGRAM REQUEST:

The Aviation Security Human Factors program emphasizes R&D within the areas of enhancing human operator performance, improving security technology usability and effectiveness, and human systems integration.

This research provides the basis for establishing criteria and data for rulemaking. It evaluates detection systems involving advanced technologies (e.g., InVision's CTX 9000, L-3 Communications' Examiner 3DX6000, ARGUS, Trace Portals) for checkpoint, cargo, and checked baggage security system. The program also optimizes detection technologies through component integration within futuristic screener stations and integrates new and emerging detection technologies into the operational environment. Consideration of human factors is essential to meet FAA strategic security initiatives for 100% screening of selectees at checkpoints by FY 2005, and 100% hold baggage inspection by FY 2010. Finally, it provides Human Systems Integration evaluations on the manpower, personnel, training, ergonomics, health, and safety aspects of security systems, especially those involving EDS and weapons detection technologies.

The human operator continues to be a critical component of current and advanced technologies to counter the threat of terrorism. The human operator contributes flexibility and adaptability to the aviation security system; however, a mismatch between the person and the machine often results in sub-optimal detection performance. This performance decrement is increasingly important given reduced threat masses and increasing cognitive demands placed on the operator as security equipment increases in complexity.

As the number of air travelers increases, an integrated person-machine security system is the key to efficiently and expeditiously processing passengers. Human factors research addresses person-machine performance concerns for checkpoint, checked baggage, and cargo security systems (i.e., technology, people, procedures, and organizations). The results of this research should increase the probability of detection and decrease the false alarm rates over current levels.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2000)	$ 30,586
FY 2001 Enacted	5,134
FY 2002 Request	5,163
Out-Year Planning Levels (FY 2003-2006)	21,736
Total	$ 62,619

Budget Authority ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Contracts:					
Aviation Security Human Factors	4,723	4,078	4,114	4,106	4,029
Personnel Costs	679	1,064	1,032	921	955
Other In-house Costs	138	140	110	107	179
Total	**5,540**	**5,282**	**5,256**	**5,134**	**5,163**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Basic	0	0	0	0	0
Applied	5,540	5,282	5,256	5,134	5,163
Development (includes prototypes)	0	0	0	0	0
Total	**5,540**	**5,282**	**5,256**	**5,134**	**5,163**

A07c - Aviation Security Human Factors Product and Activities	FY 2002 Request ($000)	Program Schedule					
		FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY2006
076-110 Aviation Security Human Factors							
Enhance Human Operator Performance	$856						
Establish Criteria and Data for 2005 Checkpoint Selectee Rulemaking regarding Screener Selection, Training, Testing, Certification, and Proficiency Assessment		◆	◇	◇	◇		
Establish Criteria and Data for 2010 Rulemaking for 100% Checked Baggage Screening Regarding Screener Selection, Training, Testing, Certification, and Proficiency Assessment		◆	◇	◇	◇	◇	◇
Develop IED Identification Training, Testing, Performance Monitoring, and Certification Program for Cargo Screeners		◆	◇	◇	◇	◇	◇
Establish Criteria and Data to Support Rulemaking for Screening Company Certification		◆	◇	◇	◇		
Develop Equipment-Based Type Rating System for Screener Certification		◆	◇	◇	◇	◇	◇
Improve Security Technology Usability and Effectiveness	$1,505						
Improve Screener Selection, Screener-Machine Interfaces, CBT Multimedia Training, and Performance Monitoring Systems for Advanced Explosives Detection Systems (EDS) Technologies		◆	◇	◇	◇	◇	◇
Evaluate Adv. Detection Systems for Checked Baggage Screening-Low Cost EDS for Low Throughout Stations (ARGUS)		◆	◇	◇	◇	◇	
Eval. Advanced Detection Systems for Checked Baggage Screening-L-3 Communication's Examiner 3DX6000		◆	◇	◇	◇	◇	
Optimize Screener Checked Baggage Field Performance-InVisions CTX 9000 EDS System		◆	◇	◇	◇	◇	
Human Systems Integration (HSI)	$1,588						
Provide HSI Evaluations on Manpower, Personnel, Training Human Factors Engineering, Health and Safety Aspects of Security Systems		◆	◇	◇	◇	◇	◇
Human Factors Performance Improvement of Deployed Checked Baggage, Checkpoint, and Cargo Security Systems to Reduce False Alarms and Increase Detection		◆	◇	◇	◇	◇	◇
Evaluate Advanced Trace Systems for Checkpoint Screening – Trace Portals, Passenger Portals, Ticket Scanners, Trace Wands			◇	◇	◇	◇	◇
Assess TRX Systems for Conformance to FAA Requirements in Support of SEIPT Deployment		◆	◇	◇	◇	◇	◇
Human Factors Airport Test Beds (ATL, DFW, DTW, ATL)		◆	◇	◇	◇	◇	◇
Integrate New and Emerging Technologies into Op. Envir.		◆	◇	◇	◇	◇	◇
Optimize Combined Detection Technologies through Component Integration within Futuristic Screener Stations		◆	◇	◇	◇	◇	◇
Develop Enhanced, Adaptive, Networked Threat Image Projection for X-Ray Detection Systems to Support Checkpoint Integration			◇	◇	◇	◇	◇
Long Term Human Factors Research to Improve Threat Detection	$80						
Laboratory and Field Research to Assess the Effects of Operator Fatigue on Visual Perception, Detection Performances, and Decision-making			◇				
Personnel and Other In-House Costs	$1,134						
Total Budget Authority	**$5,163**	**$5,134**	**$5,163**	**$5,270**	**$5,370**	**$5,499**	**$5,597**

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

A07d Aircraft Hardening

GOALS:

Intended Outcomes: In accordance with the strategic FAA goal of preventing security incidents in the aviation system, the overriding goal of the Aircraft Hardening program is to protect commercial aircraft from catastrophic structural or critical system failure due to an in-flight explosion. Secondary objectives are to investigate vulnerability from spurious electromagnetic or high energy signal interference with aircraft electronic systems, and to assess the threat presented by manually operated, highly mobile, surface-to-air missiles.

The program is designed to determine and identify:

- Minimum size/type of threats that would result in aircraft loss.
- Methods and techniques that can be applied to the current and future fleet of commercial aircraft to decrease the level of vulnerability to explosive effects.
- Threats to aircraft from electromagnetic (EM), projected energy, surface-to-air missiles, and other emerging lethal threats and practical countermeasures.

Agency Outputs: The program is tasked with delivering documented vulnerability data to the explosive detection community and, depending on research results, providing recommendations for rulemaking relative to mitigation techniques. In the area of other threats, the program provides reports to the staff of the Associate Administrator for Civil Aviation Security characterizing specific commercial aircraft vulnerability to threats as well as possible countermeasures. In order to meet these requirements, the program is divided into the following separate emphases:

- Threat vulnerability identification.
- Aircraft design related/procedural mitigation techniques.

Customer/Stakeholder Involvement: The aircraft hardening program was initiated in 1990 in response to the directives of the President's Commission on Aviation Safety and Security and the mandates set forth in the Aviation Security Improvement Act of 1990. The program was endorsed by the White House Commission on Aviation Safety and Security in 1996. The program is continually submitted to close scrutiny by by the Aviation Security Subcommittee of the R,E&D Advisory Committee. The General Accounting Office also assesses the program. The content of the program is in direct support of the customer, the Assistant Administrator for Civil Aviation Security, and complies with the aviation security requirements directives from the Office of Civil Aviation Security. Additionally, the program is required to periodically report technical progress directly to Congress.

Accomplishments: The Aircraft Hardening program has:

- Validated current detection standards for both checked and carry-on luggage through analysis and explosive testing on the minimum size, type, and location of explosives that could result in catastrophic failure of both wide and narrow body commercial aircraft.
- Proved the feasibility of and determined the standards for explosive resistant luggage containers used in wide body aircraft. Prototype containers were provided to the airlines to complete an operational assessment of the cost and improved security effectiveness of implementing hardened containers.
- Initiated research on the development and practicality of protective units for use in the baggage compartments of narrow body aircraft.
- Developed a process to assess the vulnerability of commercial aircraft to terrorist induced electronic and mobile missile threats with the Department of Defense and other government agencies.

R&D Partnerships: From the onset, the program has used expertise from the U.S. Air Force, U.S. Army, and U.S. Navy as well as consulted with various Department of Energy laboratories and NASA. Relationships also have been established with the U.S. aircraft and container manufacturing industries. Research efforts have been coordinated with the United Kingdom, Israel and France. The program uses the services of many defense and aircraft related industries. The prime

program objective is the collection of data in support of rulemaking. As the program utilizes a wide spectrum of industry experts, all developed technologies have been or will be directly transferred to the appropriate private market.

MAJOR ACTIVITIES AND ANTICIPATED FY 2001 ACCOMPLISHMENTS:

Threat Vulnerability Assessments

- Validated, through explosive testing of DC-9, 727, 737, 747, and A-300 aircraft, the blast effects of a variety of different explosives and/or locations for the purpose of refining detection criteria.
- Determined the vulnerability of commercial aircraft to terrorist-induced electromagnetic projected energy threats.
- Refined the vulnerability of commercial aircraft to Man Portable Air Defense (MANPAD) Systems.

Threat Mitigation Techniques

- Continued testing of hardened container concepts developed through private industry investment.
- Completed operational assessment of LD-3 hardened containers with airlines.
- In concert with the International Civil Aviation Organization (ICAO) partners, identified methods of protecting aircraft cockpits from intruders.
- Initiated the development of specifications for other size standard containers (LD-2, LD-4, LD-6, etc.) used by the airline industry.
- Developed the specifications and tested protective luggage units for use on narrow body aircraft.
- Initiated an operational assessment on the cost and effectiveness of using hardened units on narrow body aircraft.
- Demonstrated the utility of protecting overhead compartments from explosive effects in both narrow and wide body aircraft.
- Transitioned container technologies to private industry.
- Identified possible mitigation techniques to counter projected energy and other threats.
- Developed MANPAD procedures/rules.

KEY FY 2002 PRODUCTS AND MILESTONES:

Threat Vulnerability Assessments

- Assess security implications associated with the introduction of new passenger aircraft designs.
- Assess commercial aircraft vulnerability to incendiaries, innovative explosives, hazardous materials and other emerging threats as identified through intelligence estimates.
- Assess aircraft design implications relative to chemical/biological threats.

Threat Mitigation Techniques

- Determine specifications, operational impacts and costs of explosive resistant luggage units on narrow body aircraft.
- Complete the development of specifications for other than LD-3 size standard containers.
- With the aircraft manufacturing industry, develop and validate specifications to harden overhead and cargo compartments to mitigate explosive effects.
- Develop procedures/rules to counter the threat from electromagnetic and projected energy sources.
- With DOD, determine costs and methodology for implementing countermeasures to the MANPAD threat to commercial aviation through leveraging DOD investments in the Civil Reserve Air Fleet (CRAF).
- Develop procedures/rules for chemical/biological threat.

FY 2002 PROGRAM REQUEST:

In FY 2002, the program continues to focus on the areas listed at the beginning of the GOALS section above. As the vulnerability assessments from the various threats evolve, ideas to mitigate threats either through retrofitting the current fleet, revising procedures, or instituting new design techniques and materials are being identified. These ideas and concepts, which include lining cargo bays and overhead compartments, are analyzed and tested in concert with our partners in industry (Boeing) and government (DOD and NASA) as well as ICAO and the Government of Israel. The recommendations for new

specifications are made as required. In addition, analysis is underway to identify vulnerability of commercial aircraft to new and emerging threats.

These research efforts are primarily investigative and involve both analytical and empirical assessments. This research will provide security alternatives that could help meet the difficult technical challenges and costs facing the detection community as it strives to meet a FY 2010 goal of 100% screening. By reducing aircraft vulnerabilities to explosives and other terrorist threats, detection standards could be eased thus reducing technical risks and costs.

APPROPRIATION SUMMARY

	Amount ($000)
Appropriated (FY 1982-2000)	$ 39,478
FY 2001 Enacted	4,297
FY 2002 Request	4,640
Out-Year Planning Levels (FY 2003-2006)	19,626
Total	$ 68,041

Budget Authority ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Contracts:					
Aircraft Hardening	1,393	1,139	3,371	3,415	3,338
Personnel Costs	504	754	1,497	801	1,089
Other In-house Costs	103	107	133	81	213
Total	**2,000**	**2,000**	**5,001**	**4,297**	**4,640**

OMB Circular A-11, Conduct of Research and Development ($000)	FY 1998 Enacted	FY 1999 Enacted	FY 2000 Enacted	FY 2001 Enacted	FY 2002 Request
Basic	0	0	0	0	0
Applied	2,000	2,000	5,001	4,297	4,640
Development (includes prototypes)	0	0	0	0	0
Total	**2,000**	**2,000**	**5,001**	**4,297**	**4,640**

A07d - Aircraft Hardening Product and Activities	FY 2002 Request ($000)	Program Schedule					
		FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	FY2006
075-110 Aircraft Hardening							
Threat Vulnerability Assessment	**$835**						
Validated Through Explosive Testing, the Blast Effects of a Variety of Different Explosives for the Purpose of Refining Detection Criteria		◆					
Assess Security Implications Associated with the Introduction of New Passenger Aircraft Designs			◇	◇			
Assess Commercial Aircraft Vulnerability to Incendiaries, Innovative Explosives, Hazardous Materials and Other Emerging Threats as Identified through Intelligence Estimates		◆	◇	◇	◇	◇	◇
Assess Aircraft Design Implications Relative to Chemical/Biological Threats		◆	◇	◇	◇	◇	◇
Threat Mitigation Techniques	**$2,503**						
Completed Operational Assessment of LD-3 Hardened Containers with Airlines		◆					
Publish Specifications for Other Than LD-3 Size Standard Containers		◆	◇	◇			
Identify and Test Methods for Protecting Aircraft Cockpits from Intruders		◆	◇				
Determine Specifications, Operational Impacts and Costs of Explosive Resistant Luggage Units on Narrow Body Aircraft		◆	◇				
Develop Rules for Narrow Body Protective Units			◇	◇			
With the Aircraft Manufacturing Industry, Develop Specifications to Harden Overhead and Cargo Compartments to Mitigate Explosive Effects		◆	◇	◇	◇	◇	
Transition Container Technologies to Private Industry		◆	◇	◇			
Develop Procedures/Rules to Counter the Threat from Electromagnetic and Projected Energy Sources		◆	◇	◇			
With DOD, Determine Costs and Methodology for Implementing Countermeasures to the MANPAD Threat to Commercial Aviation through Leveraging DOD Investments in the Civil Reserve Air Fleet (CRAF)			◇	◇	◇		
Develop New Aircraft Certification Criteria		◆	◇	◇	◇	◇	◇
Develop Procedures/Rules for Chemical/Biological Threat			◇	◇	◇	◇	◇
Personnel and Other In-House Costs	**$1,302**						
Total Budget Authority	**$4,640**	**$4,297**	**$4,640**	**$4,745**	**$4,844**	**$4,969**	**$5,068**

Note: Out year numbers are for planning purposes only. Actual funding needs will be determined through the annual budget process.

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