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on Homeland Security, House of
Representatives

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AVIATION SECURITY

Better Planning Needed to Optimize Deployment of Checked Baggage Screening Systems

Statement of Cathleen A. Berrick, Director,
Homeland Security and Justice



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Highlights

Highlights of [GAO-05-896T](#), a testimony before the Subcommittee on Economic Security, Infrastructure Protection, and Cybersecurity, Committee on Homeland Security, House of Representatives

Why GAO Did This Study

Mandated to screen all checked baggage using explosive detection systems at airports by December 31, 2003, the Transportation Security Administration (TSA) deployed two types of screening equipment: explosives detection systems (EDS), which use computer-aided tomography X-rays to recognize the characteristics of explosives, and explosives trace detection (ETD) systems, which use chemical analysis to detect traces of explosive material vapors or residues. This testimony discusses (1) TSA's deployment of EDS and ETD systems and the impact of initially deploying these systems, (2) TSA and airport actions to install EDS machines in-line with baggage conveyor systems, and the federal resources made available for this purpose, and (3) actions taken by TSA to optimally deploy checked baggage screening systems.

What GAO Recommends

In a prior report, GAO recommended that TSA systematically evaluate baggage screening needs at airports, including identifying the costs and benefits of installing in-line EDS systems or stand-alone EDS machines in lieu of ETD machines, and prioritizing those airports where TSA would benefit by such actions. DHS generally concurred with the recommendations and described its corrective actions to address the issues identified.

www.gao.gov/cgi-bin/getrpt?GAO-05-896T.

To view the full product, including the scope and methodology, click on the link above. For more information, contact Cathleen A. Berrick at (202) 512-3404 or berrickc@gao.gov.

AVIATION SECURITY

Better Planning Needed to Optimize Deployment of Checked Baggage Screening Systems

What GAO Found

TSA has made substantial progress in installing EDS and ETD systems at the nation's more than 400 airports to provide the capability to screen all checked baggage using explosive detection systems, as mandated by Congress. However, in initially deploying EDS and ETD equipment, TSA placed stand-alone ETD and the minivan-sized EDS machines—mainly in airport lobbies—that were not integrated in-line with airport baggage conveyor systems. TSA officials stated that the agency's ability to initially install in-line systems was limited because of the high costs and the time required for airport modifications. These interim lobby solutions resulted in operational inefficiencies, including requiring a greater number of screeners, as compared with using EDS machines in-line with baggage conveyor systems.

TSA and airport operators are taking actions to install in-line baggage screening systems to streamline airport and TSA operations, reduce screening costs, and enhance security. Eighty-six of the 130 airports we surveyed either have, are planning to have, or are considering installing full or partial in-line systems. However, resources have not been made available to fund these capital-intensive systems on a large-scale basis. Also, the overall costs of installing in-line baggage screening systems at each airport are unknown, the availability of future federal funding is uncertain, and perspectives differ regarding the appropriate role of the federal government, airport operators, and air carriers in funding these systems.

TSA has not conducted a systematic, prospective analysis to determine at which airports it could achieve long-term savings and enhanced efficiencies and security by installing in-line systems or, where in-line systems may not be economically justified, by making greater use of stand-alone EDS systems rather than relying on the labor-intensive and less efficient ETD screening process. However, at nine airports where TSA has agreed to help fund the installation of in-line baggage screening systems, TSA conducted a retrospective cost-benefit analysis which showed that these in-line systems could save the federal government about \$1 billion over 7 years. TSA further estimated that it could recover its initial investment in the in-line systems at these airports in a little over 1 year.

EDS and ETD Machines Used by TSA to Screen Checked Baggage



ETD machine

Uses chemical analysis to detect traces of explosive material vapors or residues.



EDS machine

Uses computerized tomography X-rays to recognize the characteristic signatures of explosives.

Source: GAO.

Mr. Chairman and Members of the Subcommittee:

I appreciate the opportunity to participate in today's hearing on leveraging technology to improve aviation security, and to discuss our work on the Transportation Security Administration's (TSA) deployment of checked baggage screening systems. After the terrorist attacks of September 11, 2001, which highlighted the vulnerability of U.S. aircraft to acts of terrorism, Congress passed and the President signed into law the Aviation and Transportation Security Act (ATSA), mandating, among other things, that all checked baggage at U.S. airports be screened using explosive detection systems by December 31, 2002.¹ To meet this requirement, the Transportation Security Administration (TSA) deployed two types of equipment to screen checked baggage for explosives: (1) explosives detection systems (EDS) that use specialized x-rays to detect characteristics of explosives that may be contained in baggage as it moves along a conveyor belt; and (2) explosive trace detection (ETD) systems, whereby an individual (i.e., a baggage screener) swabs baggage and then inserts the swab into the ETD machine, which in turn can detect chemical residues that may indicate the presence of explosives within a bag.

As we reported in February 2004, largely because of shortages of equipment and insufficient time to modify airports to accommodate EDS machines, TSA was unable, at certain airports, to meet the 2002 congressionally established deadline to screen all checked baggage for explosives using EDS and ETD machines.² Recognizing the obstacles encountered by TSA, Congress passed, and the President signed into law, the Homeland Security Act of 2002,³ which, in effect, extended the deadline for screening all checked baggage for explosives until December 31, 2003, for airports at which TSA was unable to meet the earlier deadline established by ATSA. We also reported that TSA fell short of fully satisfying the extended 2003 mandate and continued to face challenges in deploying and leveraging screening equipment and technologies.

My testimony today discusses (1) TSA's initial deployment of EDS and ETD systems and the impact of that deployment; (2) actions taken by

¹Aviation and Transportation Security Act, Pub. L. No. 107-71, 115 Stat. 597 (2001).

²GAO, *Aviation Security: Challenges Exist in Stabilizing and Enhancing Passenger and Baggage Screening Operations*, [GAO-04-440T](#) (Washington, D.C.: February 12, 2004).

³Homeland Security Act of 2002, Pub. L. No. 107-296, 116 Stat. 2135.

airports and TSA to install automated in-line EDS baggage screening systems,⁴ and the key federal resources that have been made available to fund these systems; and (3) TSA's actions to plan for the optimal deployment of EDS and ETD equipment, including in-line checked baggage screening systems, in order to ensure the efficiency, cost effectiveness, and security of its checked baggage screening operations.

My comments are based primarily on our March 15, 2005, report on our assessment of TSA's checked baggage screening program.⁵ As part of that assessment, we reviewed available documentation on TSA's checked baggage screening program and interviewed officials from TSA, air carriers, airports, EDS and ETD equipment manufacturers, and airport industry associations to obtain information regarding TSA's efforts to improve checked baggage screening operations using EDS and ETD machines. We also visited 22 airports to observe baggage screening procedures and discuss these procedures with TSA, airport, and airline officials. In addition, we surveyed all 155 federal security directors,⁶ who oversee federal security operations at one or more airports in the United States where screening is required, to obtain their perspectives on the implementation of checked baggage screening operations at 263 airports under their supervision, and to obtain information on these airports' plans regarding the incorporation of EDS machines within the airports' baggage conveyor systems for screening checked baggage for explosives.⁷

Summary

From its creation in November 2001 through September 2004, TSA procured and placed about 1,200 EDS machines and about 6,000 ETD

⁴In-line EDS checked baggage screening systems typically involve checked baggage undergoing automated screening with EDS machines while on a conveyor belt that sorts and transports baggage to the proper location for its ultimate loading onto an aircraft.

⁵GAO, *Aviation Security: Systematic Planning Needed to Optimize the Deployment of Checked Baggage Screening Systems*, [GAO-05-365](#) (Washington D.C.: March 15, 2005).

⁶A TSA federal security director oversees federal security operations at one or more U.S. commercial airports and has operational responsibility for the screening of passengers and checked baggage.

⁷Although we could not independently verify the reliability of all of the information we obtained, we compared it with other supporting documents, when available, to determine data consistency and reasonableness. On the basis of these efforts, we believe the information we obtained is sufficiently reliable for this testimony. A detailed discussion of our scope and methodology is contained in appendix I of our March 2005 report ([GAO-05-365](#)).

machines at over 400 airports and modified airports for the installation of this equipment. Although TSA made significant progress in fielding EDS and ETD equipment to the nation's airports, TSA placed this equipment in a stand-alone mode—usually in airport lobbies—to conduct the primary screening of checked baggage for explosives, rather than integrating EDS machines in-line with airports' baggage conveyor systems. TSA officials stated that they used EDS machines in stand-alone mode and ETD machines as an interim solution in order to meet the congressional deadline for screening all checked baggage for explosives. Officials stated that they employed these interim solutions because of the significant costs required to install in-line systems and the need to reconfigure many airports' baggage conveyor systems to accommodate the equipment. These interim screening solutions led to operational inefficiencies, including requiring a greater number of screeners and screening fewer bags for explosives each hour, as compared with using EDS machines in-line with baggage conveyor systems. Performing primary screening using ETD machines, as is the case for more than 300 airports, is more labor intensive and less efficient than screening using the EDS process. TSA's placement of stand-alone EDS and ETD machines in airport lobbies also resulted in passenger crowding, which presented unsafe conditions and may have added security risks for passengers and airport workers. Certain information we obtained and analyzed regarding explosive detection technologies and their effectiveness in TSA's checked baggage screening operations are classified or are considered by TSA to be sensitive security information. Accordingly, the results of our review of this information have been removed from this testimony.⁸

TSA and airport operators are taking actions to install in-line EDS baggage screening systems—to streamline airport and TSA operations, reduce screening costs, and enhance security—but resources have not been made available to fund these systems on a large-scale basis. Most airports that have installed or are planning to install these capital-intensive in-line systems have relied on or plan to rely on some form of federal funding to help install the systems. Although TSA and airports operators are taking

⁸We issued two additional reports detailing the results of our review, which discuss results deemed to be classified or sensitive security information. The report that contains classified and sensitive security information is GAO, *Aviation Security: Systematic Planning Needed to Optimize the Deployment of Checked Baggage Screening Systems*, GAO-05-135C (Washington D.C.: February 4, 2005). The report containing sensitive security information but not the classified information is GAO, *Aviation Security: Systematic Planning Needed to Optimize the Deployment of Checked Baggage Screening Systems*, GAO-05-302SU (Washington D.C.: February 4, 2005).

actions to install in-line EDS baggage screening systems, identifying the resources to fund the systems on a large-scale basis continues to be a challenge. The issuance of letter of intent (LOI) agreements—TSA’s primary method for funding in-line systems—has been limited to nine airports. An LOI, though not a binding commitment of federal funding, represents an intent by TSA to provide funds in future years if they are appropriated by Congress. This in turn enables an airport to proceed with a project, such as installing in-line baggage screening systems, because the airport and investors are aware that allowable costs will likely be reimbursed. However, TSA has not determined the total cost of installing in-line EDS baggage screening systems at airports determined to need these systems, the availability of funding for in-line systems is uncertain, and perspectives differ regarding the appropriate role of the federal government and airport operators in funding these systems.

At the time of our March 2005 report,⁹ TSA had not yet completed a systematic analyses needed to plan for optimally deploying EDS and ETD equipment—including installing in-line EDS baggage screening systems or replacing ETD machines with stand-alone EDS machines—at the nation’s more than 400 airports to enhance security and reduce TSA staffing requirements and long-term costs. Specifically, TSA had not completed a prospective analysis to determine at which airports it could achieve long-term savings and improved security benefits by installing in-line baggage screening systems rather than continuing to rely on labor-intensive stand-alone EDS and ETD machines to screen checked baggage for explosives. TSA’s retrospective cost-benefit analysis conducted on the nine airports with signed LOI agreements to install in-line screening systems found that significant savings and other benefits, including reduced screener staffing requirements and increased baggage throughput, may be achieved through the installation of in-line systems. Also, for airports where in-line systems may not be economically justified because of the high cost of installing these systems, TSA has not conducted an analysis to determine whether it could achieve savings and other benefits by making greater use of stand-alone EDS systems rather than relying on the use of less efficient and more labor-intensive ETD machines at these airports.

Background

With the passage of ATSA in November 2001, TSA assumed from the Federal Aviation Administration (FAA) the majority of the responsibility

⁹[GAO-05-365](#).

for securing the commercial aviation system. Under ATSA, TSA is responsible for ensuring that all baggage is properly screened for explosives at airports in the United States where screening is required, and for the procurement, installation, and maintenance of explosive detection systems used to screen checked baggage for explosives. ATSA required that TSA screen 100 percent of checked baggage using explosive detection systems by December 31, 2002. As it became apparent that certain airports would not meet the December 2002 deadline to screen 100 percent of checked baggage for explosives, the Homeland Security Act of 2002 in effect extended the deadline to December 31, 2003, for noncompliant airports.¹⁰ Prior to the passage of ATSA in November 2001, only limited screening of checked baggage for explosives occurred. When this screening took place, air carriers had operational responsibility for conducting the screening, while FAA maintained oversight responsibility. With the passage of ATSA, TSA assumed operational responsibility from air carriers for screening checked baggage for explosives. Airport operators and air carriers continued to be responsible for processing and transporting passenger checked baggage from the check-in counter to the airplane.

Explosive detection systems include EDS and ETD machines. EDS machines, which cost approximately \$1 million each, use computer-aided tomography X-rays adapted from the medical field to automatically recognize the characteristic signatures of threat explosives. By taking the equivalent of hundreds of X-ray pictures of a bag from different angles, the EDS machine examines the objects inside of the baggage to identify characteristic signatures of threat explosives. TSA certified, procured, and deployed EDS machines manufactured by two companies, and has recently certified a smaller, less costly EDS machine, which is currently being operationally tested. ETD machines, which cost approximately \$40,000 each, work by detecting vapors and residues of explosives. Because human operators collect samples by rubbing bags with swabs, which are then chemically analyzed in the ETD machines to identify any traces of explosive materials, the use of ETD is more labor-intensive and subject to more human error than the automated process of using EDS machines. ETD is used both for primary, or the initial, screening of

¹⁰ ATSA also authorized the use of alternative means to screen checked baggage, such as positive passenger bag match (i.e., air carriers determining whether the passenger is on the same aircraft as the checked baggage), canine searches, and searches of bags by hand for time periods when airports were not able to screen 100 percent of checked baggage using explosive detection equipment.

checked baggage, as well as secondary screening, which resolves alarms from EDS machines that indicate the possible presence of explosives inside a bag. TSA has certified, procured, and deployed ETD machines from three manufacturers.

As we reported in February 2004, to initially deploy EDS and ETD equipment to screen 100 percent of checked baggage for explosives, TSA implemented interim airport lobby solutions and in-line EDS baggage screening systems.¹¹ The interim lobby solutions involved placing stand-alone EDS and ETD machines in the nation's airports, most often in airport lobbies or baggage makeup areas where baggage is sorted for loading onto aircraft. For EDS in a stand-alone mode (not integrated with airport's or air carrier's baggage conveyor system) and ETD, TSA screeners are responsible for obtaining the passengers' checked baggage from either the passenger or the air carrier, lifting the bags onto and off of EDS machines or ETD tables, using TSA protocols to appropriately screen the bags, and returning the cleared bags to the air carriers to be loaded onto departing aircraft. In addition to installing stand-alone EDS and ETD machines in airport lobbies and baggage makeup areas, TSA collaborated with some airport operators and air carriers to install integrated in-line EDS baggage screening systems within their baggage conveyor systems.

¹¹[GAO-04-440T](#).

TSA Equipped More than 400 Airports to Screen Checked Baggage for Explosives, but the Initial Deployment Led to Operational Inefficiencies, and Additional Security Risks

Since its inception in November 2001 through September 2004, TSA used its funds to procure and install about 1,200 EDS machines and about 6,000 ETD machines to screen checked baggage for explosives at over 400 airports and to modify airport facilities to accommodate this equipment. For the most part, TSA deployed EDS machines at larger airports and ETD machines at smaller airports, resulting in primary screening being conducted solely with ETD machines at over 300 airports. Table 1 summarizes the location of EDS and ETD equipment at the nation’s airports by airport category,¹² based on a June 2004 TSA inventory listing. The number of machines shown in table 1 includes EDS and ETD machines procured by both TSA and FAA prior to and during the establishment of TSA.

Table 1: EDS and ETD Machines Deployed at U.S. Airports as of June 2004

Airport category	Number		
	Airports	EDS machines	ETD machines
X	21	679	2,833
I	61	467	2,401
II	50	71	695
III	124	9	744
IV	190	2	473
Total	446	1,228	7,146

Source: GAO analysis of TSA data.

Although TSA made significant progress in fielding this equipment, TSA used most of its fiscal years 2002 through 2004 funds for its checked baggage screening program to design, develop, and deploy interim lobby screening solutions rather than install more permanent in-line EDS baggage screening systems. During our site visits to 22 category X, I, and II airports, we observed that in most cases, TSA used stand-alone EDS machines and ETD machines as the primary method for screening checked baggage.¹³ Generally, this equipment was located in airport lobbies and in baggage makeup areas. In addition, in our survey of 155 federal security directors, we asked the directors to estimate, for the 263 airports included

¹²TSA classifies the over 400 airports in the United States into one of five categories—X, I, II, III, and IV. Generally, category X airports have the largest number of passenger boardings, and category IV airports have the smallest number.

¹³The 22 airports included 12 category X, 9 category I, and 1 category II airports.

in the survey, the approximate percentage of checked baggage that was screened on or around February 29, 2004, using EDS, ETD, or other approved alternatives for screening baggage such as positive passenger bag match or canine searches. As shown in table 2, the directors reported that for 130 large to medium-sized airports in our survey (21, 60, and 49 category X, I, and II airports, respectively), most of the checked baggage was screened using stand-alone EDS or ETD machines. The average percentage of checked baggage reported as screened using EDS machines at airports with partial or full in-line EDS capability ranged from 4 percent for category II airports to 11 percent for category X airports. In addition, the directors reported that ETD machines were used to screen checked baggage 93 to 99 percent of the time at category III and IV airports, respectively.

Table 2: Average Percentage of Checked Baggage Reported as Screened Using EDS, ETD, or Other Approved Method at 263 Airports on or around February 29, 2004

Airport category	X	I	II	III	IV	Total
Number of airports	21	60	49	73	60	263
Percentage of checked baggage screened using:						
EDS (at airports with no in-line EDS capability)	59	59	27	6	0	25
EDS (at airports with partial or airportwide in-line EDS capability)	11	8	4	0	0	3
Total^a EDS	70	67	32	6	0	28
ETD	18	33	66	93	99	69
Total^a EDS and ETD	88	99	98	99	99	98
Other approved method	12	1	2	2	1	2
Total^a	100	100	100	100	100	100

Source: Analysis of GAO federal security director survey data.

^aPercentages in totals may not add to 100 percent because of rounding.

Stand-alone EDS and ETD machines are both labor- and time-intensive to operate since each bag must be physically carried to an EDS or ETD machine for screening and then moved back to the baggage conveyor system prior to being loaded onto an aircraft. With an in-line EDS system, checked baggage is screened within an airport's baggage conveyor system, eliminating the need for a baggage screener or other personnel to physically transport the baggage from the check-in point to the EDS machine for screening and then to the airport baggage conveyor system. Further, according to TSA officials, ETD machines and stand-alone EDS machines are less efficient in the number of checked bags that can be screened per hour per machine than are EDS machines that are integrated in-line with the airport baggage conveyor systems. As shown in table 3, as of October 2003, TSA estimated that the number of checked bags screened per hour could more than double when EDS machines were placed in-line versus being used in a stand-alone mode.¹⁴

¹⁴According to a senior TSA official in the Office of Security Technology, these throughput numbers could change as TSA gains greater operational experience. However, this data did not change between October 2003 and May 2005.

Table 3: Bags Per Hour Screened by Stand-alone and In-line EDS Machines and ETD Machines

Type of equipment	Bags per hour	
	Stand-alone	In-line
EDS machines		
CTX 2500—stand-alone only	120	NA
CTX 5500	180	250
CTX 9000—in-line only	NA	425
L3 6000	180	425
ETD machines—stand-alone only	36	NA

Source: TSA.

NA: Not applicable.

In January 2004, TSA, in support of its planning, budgeting, and acquisition of security screening equipment, reported to the Office of Management and Budget (OMB) that the efficiency benefits of in-line rather than stand-alone EDS are significant, particularly with regard to bags per hour screened and the number of TSA screeners required to operate the equipment. According to TSA officials, at that time, a typical lobby-based screening unit consisting of a stand-alone EDS machine with three ETD machines had a baggage throughput of 376 bags per hour with a staffing requirement of 19 screeners. In contrast, TSA estimated that approximately 425 bags per hour could be screened by in-line EDS machines with a staffing requirement of 4.25 screeners.

In order to achieve the higher throughput rates and reduce the number of screener staff needed to operate in-line baggage screening systems, TSA (1) uses a screening procedure known as “on-screen alarm resolution” and (2) networks multiple in-line EDS machines together, referred to as “multiplexing,” so that the computer-generated images of bags from these machines are sent to a central location where TSA screeners can monitor the images of suspect bags centrally from several machines using the on-screen alarm resolution procedure. When an EDS machine alarms, indicating the possibility that explosive material may be contained in the bag, the on-screen alarm resolution procedure allows screeners to examine computer-generated images of the inside of a bag to determine if suspect items identified by the EDS machines are in fact suspicious. If a screener, by viewing these images, is able to determine that the suspect item or items identified by the EDS machine are in fact harmless, the screener is allowed to clear the bag, and it is sent to the airline baggage makeup area for loading onto the aircraft. If the screener is not able to

make the determination that the bag does not contain suspicious objects, the bag is sent to a secondary screening room where the bag is further examined by a screener. In secondary screening, the screener opens the bag and examines the suspect item or items, and usually swabs the items to collect a sample for analysis using an ETD machine. TSA also uses this on-screen alarm resolution procedure with stand-alone EDS machines.¹⁵

A TSA official estimated that the on-screen alarm resolution procedure with in-line EDS baggage screening systems will enable TSA to reduce by 40 to 60 percent the number of bags requiring the more labor-intensive secondary screening using ETD machines. In estimating the potential savings in staffing requirements, TSA officials stated that they expect to achieve a 20 to 25 percent savings because of reductions in the number of staff needed to screen bags using ETD to resolve alarms from in-line EDS machines.

TSA also reported that because procedures for using stand-alone EDS and ETD machines require screeners to lift heavy baggage onto and off of the machines, the interim lobby screening solutions used by TSA led to significant numbers of on-the-job injuries.¹⁶ In addition, in responding to our survey about 263 airports, numerous federal security directors reported that on-the-job injuries related to lifting heavy baggage onto or off the EDS and ETD machines were a significant concern at the airports for which they were responsible. Specifically, these federal security directors reported that on-the-job injuries caused by lifting heavy bags onto and off of EDS machines were a significant concern at 65 airports, and were a significant concern with the use of ETD machines at 110 airports. To reduce on-the-job injuries, TSA has provided training to screeners on proper lifting procedures. However, according to TSA officials, in-line EDS screening systems would significantly reduce the need for screeners to handle baggage, thus further reducing the number of on-the-job injuries being experienced by TSA baggage screeners.

In addition, during our site visits to 22 large and medium-sized airports, several TSA, airport, and airline officials expressed concern regarding the security risks caused by overcrowding due to ETD and stand-alone EDS

¹⁵TSA began implementing the on-screen alarm resolution procedure in May 2004 after pilot testing the procedure.

¹⁶TSA was unable to provide GAO with data on the on-the-job injuries sustained during baggage screening operations.

machines being located in airport lobbies. The location of the equipment resulted in less space available to accommodate passenger movement and caused congestion due to passengers having to wait in lines in public areas to have their checked baggage screened. TSA headquarters officials also reported that large groups of people congregating in crowded airport lobbies increases security risks by creating a potential target for terrorists. The TSA officials noted that crowded airport lobbies have been the scenes of terrorist attacks in the past. For example, in December 1985, four terrorists walked to the El Al ticket counter at Rome's Leonardo DaVinci Airport and opened fire with assault rifles and grenades, killing 13 and wounding 75. On that same day, three terrorists killed three people and wounded 30 others at Vienna International Airport.

Airports and the Federal Government Are Taking Actions to Install In-line Baggage Screening Systems, but Resources Have Not Been Made Available to Fund These Systems on a Large-Scale Basis

Airport operators and TSA are taking actions to install in-line EDS baggage screening systems because of the expected benefits of these systems. Our survey of federal security directors and interviews with airport officials revealed that 86 of 130 category X, I, and II airports (66 percent) included in our survey either have, are planning to have, or are considering installing in-line EDS baggage screening systems throughout or at a portion of their airports. As of July 2004, 12 airports had operational in-line systems airportwide or at a particular terminal or terminals, and an additional 45 airports were actively planning or constructing in-line systems. Our survey of federal security directors further revealed that an additional 33 of the 130 category X, I, and II airports we surveyed were considering developing in-line systems.

While in-line EDS baggage screening systems have a number of potential benefits, the total cost to install these systems is unknown, and limited federal resources have been made available to fund these systems on a large-scale basis. In-line baggage screening systems are capital-intensive because they often require significant airport modifications, including terminal reconfigurations, new conveyor belt systems, and electrical upgrades. TSA has not determined the total cost of installing in-line EDS baggage screening systems at airports that it had determined need these systems to maintain compliance with the congressional mandate to screen all checked baggage for explosives using explosive detection systems, or to achieve more efficient and streamlined checked baggage screening operations. However, TSA and airport industry association officials have estimated that the total cost of installing in-line systems is—a rough order-of-magnitude estimate—from \$3 billion to more than \$5 billion. TSA officials stated that they have not conducted a detailed analysis of the costs required to install in-line EDS systems at airports because most of

their efforts have been focused on deploying and maintaining a sufficient number of EDS and ETD machines to screen all checked baggage for explosives. TSA officials further stated that the estimated costs to install in-line baggage screening systems would vary greatly from airport to airport depending on the size of the airport and the extent of airport modifications that would be required to install the system. While we did not independently verify the estimates, officials from the Airports Council International-North America and American Association of Airport Executives estimated that project costs for in-line systems could range from about \$2 million for a category III airport to \$250 million for a category X airport.¹⁷

TSA and airport operators are relying on LOI agreements as their principal method for funding the modification of airport facilities to incorporate in-line baggage screening systems.¹⁸ As of January 2005, TSA had issued eight LOIs to reimburse nine airports for the installation of in-line EDS baggage screening systems for a total cost of \$957.1 million to the federal government over 4 years. In addition, TSA officials stated that as of July 2004, they had identified 27 additional airports that they believe would benefit from receiving LOIs for in-line systems because such systems are needed to screen an increasing number of bags due to current or projected growth in passenger traffic. TSA officials stated that without such systems, these airports would not remain in compliance with the congressional mandate to screen all checked baggage using EDS and ETD.¹⁹ However,

¹⁷ Joint Statement of David Z. Plavin, President, Airports Council International-North America (ACI-NA) and Todd Hauptli, Sr. Executive Vice President, American Association of Airport Executives (AAAAE) before the House Aviation Subcommittee Hearing on Passenger and Baggage Screening Problems; February 12, 2004. GAO did not independently verify cost figures provided in this testimony.

¹⁸ The fiscal year 2003 Consolidated Appropriations Resolution, Pub. L. No. 108-7, 117 Stat. 386, approved the use of LOIs as a vehicle to leverage federal government and industry funding to support facility modification costs for installing in-line EDS baggage screening systems. When an LOI is established to provide multiyear funding for a project, the airport operator is responsible for providing—up front—the total funding needed to complete the project, even though the LOI is not a binding commitment of federal funds. Work proceeds with the understanding that TSA will, if sufficient funding is appropriated, reimburse the airport operator for a percentage of the facility modification costs, with the airport funding the remainder of the costs. LOIs issued by TSA for in-line baggage screening systems provide for reimbursement payments over a multiple year period, contingent upon the appropriation of sufficient funding to cover such projects.

¹⁹ TSA officials stated that the number of airports that could benefit most from in-line checked baggage screening systems varies depending on changing airport circumstances, such as adding new terminals or an increased or decreased number of flights.

because TSA would not identify these 27 airports, we were unable to determine whether these airports are among the 45 airports we identified as in the process of planning or constructing in-line systems.

TSA officials stated that they also use other transaction agreements as an administrative vehicle to directly fund, with no long-term commitments, airport operators for smaller in-line airport modification projects.²⁰ Under these agreements, as implemented by TSA, the airport operator also provides a portion of the funding required for the modification. As of September 30, 2004, TSA had negotiated arrangements with eight airports to fund small permanent in-line projects or portions of large permanent in-line projects using other transaction agreements.²¹ These other transaction agreements range from about \$640,000 to help fund the conceptual design of an in-line system for one terminal at the Dallas Fort-Worth airport to \$37.5 million to help fund the design and construction of in-line systems and modification of the baggage handling systems for two terminals at the Chicago O'Hare International Airport. TSA officials stated that they would continue to use other transaction agreements to help fund smaller in-line projects.²²

Airport operators also used the FAA's Airport Improvement Program—grants to maintain safe and efficient airports—in fiscal years 2002 and 2003 to help fund facility modifications needed to accommodate installing in-line systems. Twenty-eight of 53 airports that reported either having constructed or planning to construct in-line systems relied on the Airport Improvement Program as their sole source of federal funding.

²⁰Other transaction agreements are administrative vehicles used by TSA to directly fund airport operators for smaller airport modification projects without undertaking a long-term commitment. These transactions take many forms; are generally not required to comply with federal laws and regulations that apply to contracts, grants, or cooperative agreements; and enable the federal government and others entering into these agreements to freely negotiate provisions that are mutually agreeable.

²¹The eight airports included four category X airports: Dallas Fort-Worth International, Chicago O'Hare International, Detroit Metro Wayne County, and San Francisco International; three category I airports: Piedmont Triad International (North Carolina), Pittsburgh International, and Sacramento International; and one category II airport Harrisburg International (Pennsylvania). These eight airports were among the 45 airports that we identified as being in the process of planning or constructing in-line systems.

²²TSA also used four other transaction agreements to fund work related to interim solutions, three of these agreements were for partial in-line systems that eventually were to be replaced by permanent in-line systems.

Airport officials at over half of the 45 airports that we identified are in the process of planning or constructing in-line systems stated that they will require federal funding in order to complete the planning and construction of these in-line systems. TSA officials also reported that additional airports will require in-line systems to maintain compliance with the congressional mandate to screen 100 percent of checked baggage for explosives. Despite this reported need, TSA officials stated that they do not have sufficient resources in their budget to fund additional LOIs beyond the eight LOIs that have already been issued. The Vision 100—Century of Aviation Reauthorization Act (Vision 100)²³ provided for the creation of the Aviation Security Capital Fund to help pay for, among other things, placing EDS machines in line with airport baggage handling systems.²⁴ However, according to OMB officials, the President's fiscal year 2005 budget request, which included the Aviation Security Capital Fund's mandatory appropriation of \$250 million, only supported continued funding for the eight LOIs that have already been issued and did not provide resources to support new LOIs for funding the installation of in-line systems at additional airports. Further, while the fiscal year 2005 Department of Homeland Security (DHS) Appropriations Act provided \$45 million for installing explosive detection systems in addition to the \$250 million from the Aviation Security Capital Fund, Congress directed, in the accompanying conference report, that the \$45 million be used to assist in the continued funding of the existing eight LOIs. Further, the President's fiscal year 2006 budget request for TSA provides approximately \$240.5 million for the continued funding of the eight existing LOIs and does not allocate any funding for new LOI agreements for in-line system integration activities. The fiscal year 2006 Department of Homeland Security appropriations bill passed by the House on May 17, 2005, and the appropriations bill pending before the Senate include, among other things \$75 million and \$14 million for installation of checked baggage explosive detection systems, respectively. The committee reports accompanying the House and Senate appropriations bills state that the amounts included for installation are in addition to the \$250 million mandatory appropriation of

²³Vision100—Century of Aviation Reauthorization Act, Pub. L. No. 108-176, 177 Stat. 2490 (2003).

²⁴Vision 100 authorizes a \$250 million mandatory appropriation for the Aviation Security Capital Fund for each of fiscal years 2004 through 2007. Of that mandatory amount, the act designates \$125 million as priority funding to fulfill intentions to obligate under LOIs. In fiscal year 2004, Congress provided \$250 million for the physical modification of airports to install checked baggage explosive detection systems but did so separate from the Aviation Security Capital Fund because a provision of that act precluded the use of funds to establish the Fund in fiscal year 2004.

the Aviation Security Capital Fund but do not earmark these funds specifically for the installation of in-line EDS systems.

In addition, perspectives differ regarding the appropriate role of the federal government, airport operators, and air carriers in funding these capital-intensive in-line EDS systems. Airport operators and TSA have shared in the total costs—25 percent and 75 percent respectively under LOI agreements, which have been TSA's primary method for funding in-line EDS systems. A 75 percent federal cost-share will apply to any project under an LOI for fiscal year 2005.²⁵ Further, the President's fiscal year 2006 budget request for TSA requests to maintain the 75 percent federal government cost share for projects funded by LOIs at large and medium airports. For fiscal year 2006 appropriations for DHS, both the Senate, in its pending appropriations bill, and the House, in its committee report, also propose to maintain the 75 percent federal cost share for LOIs. However, in testimony before Congress, an aviation industry official expressed a different perspective regarding the cost sharing between the federal government and the aviation industry for installing in-line checked baggage screening systems. Testifying in July 2004, the official said that airports contend that the cost of installing in-line systems should be met entirely by the federal government, given its direct responsibility for screening checked baggage, as established by law, in light of the national security imperative for doing so, and because of the economic efficiencies of this strategy. Although the official stated that airports have agreed to provide a local match of 10 percent of the cost of installing in-line systems at medium and large airports, as stipulated by Vision 100, he expressed opposition to the administration's proposal, which was subsequently

²⁵The fiscal year 2003 Consolidated Appropriations Resolution authorized TSA to issue LOIs for terminal modifications related to the installation of in-line baggage screening systems and mandated that each LOI provide for a 75 percent federal cost-share of the project's cost, with the remaining 25 percent to be paid by the airport operator at airports with at least 0.25 percent of the total number of passenger boardings each year at all airports (and 90 percent for projects at all other airports). Subsequently, Vision 100 instituted a 90 percent federal cost-share of the project's cost, with the remaining 10 percent to be paid by the airport operator at medium and large hub airports (and 95 percent for projects at any other airport) though TSA continued to operate at the 75 percent cost-share. The fiscal year 2005 DHS Appropriations Act, Pub. L. No. 108-334, 118 Stat. 1298, signed into law in October 2004, reestablished the federal cost-share at 75 percent for any medium or large hub airport during fiscal year 2005.

adopted by Congress for fiscal year 2005, to reestablish the airport's cost-share at 25 percent.²⁶

In July 2004, the National Commission on Terrorist Attacks upon the United States (the 9/11 Commission) also addressed the issue of the federal government/airport cost-share for installing EDS in-line baggage screening systems.²⁷ Specifically, the commission recommended that TSA expedite the installation of in-line systems and that the aviation industry should pay its fair share of the costs associated with installing these systems, since the industry will derive many benefits from the systems. Although the 9/11 Commission recommended that the aviation industry should pay its fair share of the costs of installing in-line systems, the commission did not report what it believed the fair share to be.²⁸

²⁶TSA officials stated that the increased cost-share to 90 percent as stipulated in Vision 100 would further constrain their ability to fund future LOIs, as well as impact their ability to assist airports to achieve and maintain compliance with the congressional mandate to screen all checked baggage for explosives.

²⁷*The 9/11 Commission Report: Final Report of the National Commission on Terrorist Attacks Upon the United States* (Washington, D.C.: July 2004).

²⁸The Intelligence Reform and Terrorism Prevention Act of 2004, Pub. L. No. 108-458, 118 Stat. 3638, enacted in December 2004, requires the Secretary of Homeland Security to conduct a cost-sharing study that must include, among other things, a proposed formula for cost sharing among the federal, state, and local governments and the private sector for projects to install in-line baggage screening equipment that reflects the benefits that each such entity will derive from the projects, including national security benefits and labor and other cost savings.

TSA Has Not Systematically Planned for the Optimal Deployment of Checked Baggage Screening Equipment to Ensure the Efficient and Cost-Effective Screening for Explosives while Enhancing Security Benefits

At the time of our March 2005 report,²⁹ TSA has not completed a systematic, prospective analysis of individual airports or groups of airports to determine at which airports installing in-line EDS systems would be cost-effective in terms of reducing long-term screening costs for the government and would improve security. Such an analysis would enable TSA to determine at which airports it would be most beneficial to invest limited federal resources for in-line systems rather than continue to rely on the stand-alone EDS and ETD machines to screen checked baggage for explosives, and it would be consistent with best practices for preparing benefit-cost analysis of government programs or projects called for by OMB Circular A-94.³⁰ TSA officials stated that they had not conducted the analyses related to the installation of in-line systems at individual airports or groups of airports because they have used available staff and funding to ensure all airports have a sufficient number of EDS or ETD machines to meet the congressional mandate to screen all checked baggage with explosive detection systems. During the course of our review, in September 2004, TSA contracted for services to develop methodologies and criteria for assessing the effectiveness and suitability of airport screening solutions requiring significant capital investment, such as those projects associated with the LOI program. In July 2005, TSA officials stated that TSA and DHS are reviewing a draft report from the study. According to these officials, the study will provide TSA with a strategic plan for its checked baggage screening program, including the best screening solution for airports processing most of the airlines' baggage volume, and the capital costs and staffing requirements for each solution.

Although TSA had not conducted a systematic analysis of cost savings and other benefits that could be derived from the installation of in-line baggage screening systems, TSA's limited, retrospective cost-benefit analysis of in-line projects at the nine airports with signed LOI agreements found that significant savings and other benefits may be achieved through the

²⁹ GAO-05-365.

³⁰ OMB Circular A-94 *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, January 22, 2002. Agencies use this guidance to support government decisions to initiate, review, or expand programs that would result in measurable costs or benefits extending for 3 or more years into the future.

installation of these systems.³¹ This analysis was conducted in May 2004—after the eight LOI agreements for the nine airports were signed in July and September 2003 and February 2004—to estimate potential future cost savings and other benefits that could be achieved from installing in-line systems instead of using stand-alone EDS systems. TSA estimated that in-line baggage screening systems at these airports would save the federal government about \$1 billion³² compared with stand-alone EDS systems and that TSA would recover its initial investment in a little over 1 year.³³ TSA's analysis also provided data to estimate the cost savings for each airport over the 7-year period. According to TSA's data, federal cost savings varied from about \$50 million to over \$250 million at eight of the nine airports, while at one airport, there was an estimated \$90 million loss.³⁴

According to TSA's analysis of the nine LOI airports, in-line cost savings critically depend on how much an airport's facilities have to be modified to accommodate the in-line configuration. Savings also depend on TSA's costs to buy, install, and network the EDS machines; subsequent maintenance cost; and the number of screeners needed to operate the machines in-line instead of using stand-alone EDS systems. In its analysis, TSA also found that a key factor driving many of these costs is throughput—how many bags an in-line EDS system can screen per hour

³¹We reviewed the TSA cost model showing savings expected to be achieved with in-line rather than stand-alone EDS equipment at nine airports. We assessed the model's logic to ensure its completeness and correctness of calculations. Also, as discussed in appendix IV of our March 2005 report ([GAO-05-365](#)), we conducted a Monte Carlo simulation to: (1) illustrate sensitivity of potential cost savings of replacing stand-alone with in-line EDS systems to alternative values of key cost drivers and (2) to explore the variability in the key factors used by TSA in their model. Based on our review of TSA's cost model, we believe that it is sufficiently reliable for the analyses we conducted and the information included in this testimony.

³²This figure refers to the net present value saved over 7 years if received up front.

³³For a basis of comparison, Office of Management and Budget Circular A-94 stipulates using a 7 percent real discount rate to compute the present value of cost savings. TSA used a 4 percent real discount rate. Following Office of Management and Budget guidance, cost savings are \$1.14 billion. In addition, in TSA's analysis, the federal government does not pay for \$319 million, or 25 percent, of project costs. Accounting for these costs to reflect total costs, as recommended by Circular A-94, lowers overall savings to \$820 million.

³⁴The relatively large costs for upfront in-line EDS at one airport are not offset by the modest amount of estimated operation and maintenance cost savings; therefore, the in-line EDS system may be more costly than EDS stand-alone. By contrast, at another airport the upfront costs of in-line EDS are lower than for stand-alone EDS, and there is a substantial amount of estimated operation and maintenance cost savings. Therefore, the in-line EDS system at this latter airport may be less costly than stand-alone EDS.

compared with the rate for a stand-alone system. TSA used this factor to determine how many stand-alone EDS machines could be replaced by a single in-line EDS machine while achieving the same throughput. According to TSA's analysis, in-line EDS would reduce by 78 percent the number of TSA baggage screeners and supervisors required to screen checked baggage at these nine airports, from 6,645 to 1,477 screeners and supervisors. However, the actual number of TSA screeners and supervisor positions that could be eliminated would be dependent on the individual design and operating conditions at each airport.

TSA also reported that aside from increased efficiency and lower overall costs, there were a number of qualitative benefits that in-line systems would provide over stand-alone systems, including:

- fewer on-the-job injuries, since there is less lifting of baggage when EDS machines are integrated into the airport's baggage conveyor system;
- less lobby disruption because the stand-alone EDS and ETD machines would be removed from airport lobbies; and
- unbroken chain of custody of baggage because in-line systems are more secure, since the baggage handling is performed away from passengers.

TSA's retrospective analysis of these nine airports indicates the potential for cost savings through the installation of in-line EDS baggage screening systems at other airports, and it provides insights about key factors likely to influence potential cost savings from using in-line systems at other airports. This analysis also indicates the merit of conducting prospective analyses of other airports to provide information for future federal government funding decisions as required by the OMB guidance on cost-benefit analyses.³⁵ This guidance describes best practices for preparing benefit-cost analysis of government programs or projects, one of which involves analyzing uncertainty. Given the diversity of airport designs and operations, TSA's analysis could be modified to account for uncertainties in the values of some of the key factors, such as how much it will cost to modify an airport to install an in-line system. Analyzing uncertainty in this manner is consistent with OMB guidance.

³⁵ OMB Circular A-94.

TSA also has not systematically analyzed which airports could benefit from the implementation of additional stand-alone EDS systems in lieu of labor-intensive ETD systems at more than 300 airports that rely on ETD machines, and where in-line EDS systems may not be appropriate or cost-effective. More specifically, TSA has not prepared a plan that prioritizes which airports should receive EDS machines (including machines that become surplus because of the installation of in-line systems) to balance short-term installation costs with future operational savings. Furthermore, TSA has not yet determined the potential long-term operating cost savings and the short-term costs of installing the systems, which are important factors to consider in conducting analyses to determine whether airports would benefit from the installation of EDS machines. TSA officials said that they had not yet had the opportunity to develop such analyses or plans, and they did not believe that such an exercise would necessarily be an efficient use of their resources, given the fluidity of baggage screening at various airports.

There is potential for TSA to benefit from the introduction of smaller stand-alone EDS machines—in terms of labor savings and added efficiencies—at some of the more than 300 airports where TSA relies on the use of ETD machines to screen checked baggage. Stand-alone EDS machines are able to screen a greater number of bags in an hour than the ETD used for primary screening while lessening reliance on screeners during the screening process. For example, TSA's analysis showed that an ETD machine can screen 36 bags per hour, while the stand-alone EDS machines can screen 120 to 180 bags per hour. As a result, it would take three to five ETD machines to screen the same number of bags that one stand-alone EDS machine could process. In addition, greater use of the stand-alone EDS machines could reduce staffing requirements. For example, one stand-alone EDS machine would potentially require 6 to 14 fewer screeners than would be required to screen the same number of bags at a screening station with three to five ETD machines. This calculation is based on TSA estimates that 4.1 screeners are required to support each primary screening ETD machine, while one stand-alone EDS machine requires 6.75 screeners—including staff needed to operate ETD machines required to provide secondary screening.

Without a plan for installing in-line EDS baggage screening systems, and for using additional stand-alone EDS systems in place of ETD machines at the nation's airports, it is unclear how TSA will make use of new technologies for screening checked baggage for explosives, such as the smaller and faster EDS machines that may become available through TSA's research and development programs. For example, TSA is working

with private sector firms to enhance existing EDS systems and develop new screening technologies through its research and development (R&D) efforts. As part of these efforts, in fiscal year 2003, TSA spent almost \$2.4 million to develop a new computer-aided tomography explosives detection system that is smaller and lighter than systems currently deployed in airport lobbies. The new system is intended to replace systems currently in use, including larger and heavier EDS machines and ETD equipment. The smaller size of the system creates opportunities for TSA to transfer screening operations to other locations such as airport check-in counters. TSA certified this equipment in December 2004 and is operationally testing the machine at three airports to evaluate its operational efficiency.

TSA's checked baggage screening R&D efforts are part of a broader DHS program focused on researching and developing technologies to detect, prevent, and mitigate terrorist threats. In September 2004, we reported that TSA and DHS have made some progress in managing transportation security R&D programs according to applicable laws and R&D best practices.³⁶ However, we found that their efforts were incomplete in several areas. For example, as of our September 2004 report, although both TSA and DHS had established processes to select and prioritize R&D projects that include risk management principles, they had not yet completed vulnerability and criticality assessments, which we have identified as key elements of a risk management approach, for all modes of transportation.³⁷ In the absence of completed risk assessments, TSA and DHS officials reported basing funding decisions on other factors—such as available threat intelligence, expert judgment, and information about past terrorist incidents. However, TSA officials stated that they do not use formal threat assessments to make R&D decisions. During our review, we also found limited evidence of coordination between TSA and DHS, or between these agencies and other federal agencies, such as the Department of Transportation, and industry stakeholders. Without such coordination, DHS raises the risk that its R&D resources will not be effectively leveraged and that duplication may occur. We also found that although many of TSA's R&D projects were in later phases of

³⁶ GAO, *Transportation Security R&D: TSA and DHS Are Researching and Developing Technologies, but Need to Improve R&D Management*, [GAO-04-890](#) (Washington, D.C.: Sept. 30, 2004).

³⁷ GAO, *Homeland Security: Key Elements of a Risk Management Approach*, [GAO-02-150T](#) (Washington, D.C.: Oct. 12, 2001).

development, the agency had not estimated deployment dates, without which managers do not have information needed to plan, budget, and track the progress of projects. We also found that TSA and DHS did not have adequate databases to monitor and manage the spending of the hundreds of millions of dollars that Congress had appropriated for R&D. In moving forward, it will be important for DHS to resolve these challenges to help ensure that limited R&D resources are focused on the areas of greatest need.

Concluding Observations

TSA has made substantial progress in installing EDS and ETD systems at the nation's airports—mainly as part of interim lobby screening solutions—to provide the capability to screen all checked baggage for explosives, as mandated by Congress. With the objective of initially fielding this equipment largely accomplished, TSA needs to shift its focus from equipping airports with interim screening solutions to systematically planning for the more optimal deployment of checked baggage screening systems. Part of such planning should include analyzing which airports should receive federal support for in-line EDS baggage screening systems based on cost savings that could be achieved from more effective and efficient baggage screening operations and on other factors, including enhanced security. Also, for airports, where in-line systems may not be economically justified because of high investment costs, a cost effectiveness analysis could be used to determine the benefits of additional stand-alone EDS machines to screen checked baggage in place of the more labor-intensive ETD machines that are currently being used at the more than 300 airports. In addition, TSA should consider the costs and benefits of the new technologies being developed through its research and development efforts, which could provide smaller EDS machines that have the potential to reduce the costs associated with installing in-line EDS baggage screening systems or to replace ETD machines currently used as the primary method for screening.

An analysis of airport baggage screening needs would also help enable TSA to determine whether expected reduced staffing costs, higher baggage throughput, and increased security would justify the significant up-front investment required to install in-line baggage screening. TSA's retrospective analysis of nine airports installing in-line baggage screening systems with LOI funds, while limited, demonstrated that cost savings could be achieved through reduced staffing requirements for screeners and increased baggage throughput. In fact, the analysis showed that using in-line systems instead of stand-alone systems at these nine airports would save the federal government about \$1 billion over 7 years and that TSA's

initial investment would be recovered in a little over 1 year. However, this analysis also showed that a cost savings may not be achieved for all airports. In considering airports for in-line baggage screening systems or the continued use of stand-alone EDS and ETD machines, a systematic analysis of the costs and benefits of these systems would help TSA justify the appropriate screening for a particular airport, and such planning would help support funding requests by demonstrating enhanced security, improved operational efficiencies, and cost savings to both TSA and the affected airport.

To assist TSA in planning for the optimal deployment of checked baggage screening systems, we recommended in our March 2005 report that TSA systematically evaluate baggage screening needs at airports, including the costs and benefits of installing in-line baggage screening systems at airports that do not yet have in-line systems installed. DHS agreed with our recommendation, stating that TSA has initiated an analysis of deploying in-line EDS machines and is in the process of formulating criteria to identify those airports that would benefit from an in-line EDS system. DHS also stated that TSA has begun conducting an analysis of the airports that rely heavily on ETD machines as the primary checked baggage screening technology to identify those airports that would benefit from augmenting ETDs with stand-alone EDS equipment.

Mr. Chairman, this concludes my statement. I would be pleased to answer any questions that you or other members of the Subcommittee have.

Contact Information

For further information on this testimony, please contact Cathleen A. Berrick at (202) 512-3404.

Individuals making key contributions to this testimony included Charles Bausell, Amy Bernstein, Kevin Copping, Christine Fossett, David Hooper, Noel Lance, Thomas Lombardi, and Alper Tunca.

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