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Air Cargo Security

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Summary

The air cargo system is a complex, multi-faceted network that handles a vast amount of freight, packages, and mail carried aboard passenger and all-cargo aircraft. The air cargo system is vulnerable to several security threats including potential plots to place explosives aboard aircraft; illegal shipments of hazardous materials; criminal activities such as smuggling and theft; and potential hijackings and sabotage by persons with access to aircraft. While it is generally agreed that full screening of all cargo placed on aircraft is not currently feasible, several procedural and technology initiatives have been proposed to enhance air cargo security and deter terrorist and criminal threats. Procedural initiatives include proposals to: expand the "known shipper" program; increase cargo inspections; increase physical security of air cargo facilities; increase oversight of air cargo operations; provide security training for cargo workers; and tighten controls over access to aircraft during cargo operations. Technology being considered to improve air cargo security includes tamper-resistant and tamper-evident packaging and containers; explosive detection systems and other cargo screening technologies; blast-resistant cargo containers; and biometric systems for worker identification and access control.

The Aviation and Transportation Security Act (ATSA, P.L. 107-71) contains general provisions for cargo screening, inspection, and security measures. Cargo carried in passenger airplanes must be screened or its security otherwise ensured. In practice, the Transportation Security Administration (TSA) has relied heavily on "known shipper" programs to prevent shipments of cargo from unknown sources on passenger aircraft. ATSA also mandated that a security plan for all-cargo operations was to be put in place as soon as possible, but aviation security initiatives in the aftermath of the September 11, 2001, attacks primarily focused on enhancing the security of passenger operations.

Air cargo security consequently became a significant issue during the 108th Congress. To enhance all-cargo security, Vision 100 (P.L. 108-176) expanded the current program for arming pilots to include all-cargo pilots. Additionally, the FY2005 Homeland Security Appropriations Act (P.L. 108-334) included language calling for a threefold increase in the physical inspections or screening of cargo placed on passenger aircraft. Finally, the National Intelligence Reform Act of 2004 (P.L. 108-458) included several provisions pertaining to cargo security that establish a pilot program for evaluating the deployment of blast resistant cargo containers; promote the research, development, and deployment of enhanced air cargo security technology; evaluate international air cargo threats; and set a deadline of September 2005 for finalizing proposed rules pertaining to air cargo security. Those proposed rules, disclosed by the TSA in November 2004, would intensify security measures for cargo operations involving both passenger and all-cargo operations and is seen as the core regulatory framework for implementing their strategic plan for air cargo security. That plan centers around risk-based assessments and targeted physical screening of cargo shipments based on risk combined with enhanced measures for controlling access to cargo operations areas and improved vetting of shippers and freight forwarders. This report will be updated as needed.

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Overview of the Air Cargo System

The air cargo system is a complex, multi-faceted network responsible for moving a vast amount of freight, express packages, and mail carried aboard passenger and all-cargo aircraft. The air cargo system consists of a large, complex distribution network linking manufacturers and shippers to freight forwarders to airport sorting and cargo handling facilities where shipments are loaded and unloaded from aircraft. Business and consumer demand for fast, efficient shipment of goods has fueled the rapid growth of the air cargo industry over the past 25 years. In FY2003, about 14.3 billion revenue ton miles[1] (RTMs) of cargo[2] were shipped by air within the United States, and another 18.5 billion RTMs of cargo were shipped by air on international flights to and from the United States. The volume of air cargo operations since FY1999 and the forecast volume of air cargo through 2016 is shown in **Figure 1**. It is estimated that air cargo shipments, expressed in terms of revenue ton milage (RTMs), will increase by 50% domestically, and by 110% internationally by FY2016 compared to FY2003 levels.[3] In 2002, air cargo comprised about 0.3% by weight of all freight movement in the United States.[4] While this percentage may seem small, it is much greater than the 0.07% percent of freight that traveled by air in 1965, indicating that not only is the volume of air cargo increasing significantly, but so is the percent of total freight movements that travel by air. Also, cargo shipments by air comprise a significant percent of the total value of cargo shipments. In fact, in 2002, while air freight movements accounted for only about 0.3% of total domestic freight shipments by weight, these shipments accounted for 4.3% of the total value of freight shipped within the United States. Also, air cargo accounted for 26.2% of international trade by value, surpassed only by maritime shipping which accounted for 41.9% of the import/export value of cargo in 2002 reflecting the importance of air cargo in the international trade of high-value goods.[5] While the downturn in the aviation industry between 2000 and 2002 temporarily slowed the pace of growth in air cargo, shipments surpassed pre-9/11 levels in 2003. This increased demand reflects the importance of addressing air cargo security needs as the size and complexity of the air cargo system continues to expand.

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[1] A revenue ton mile is equivalent to one ton of cargo being transported one mile.

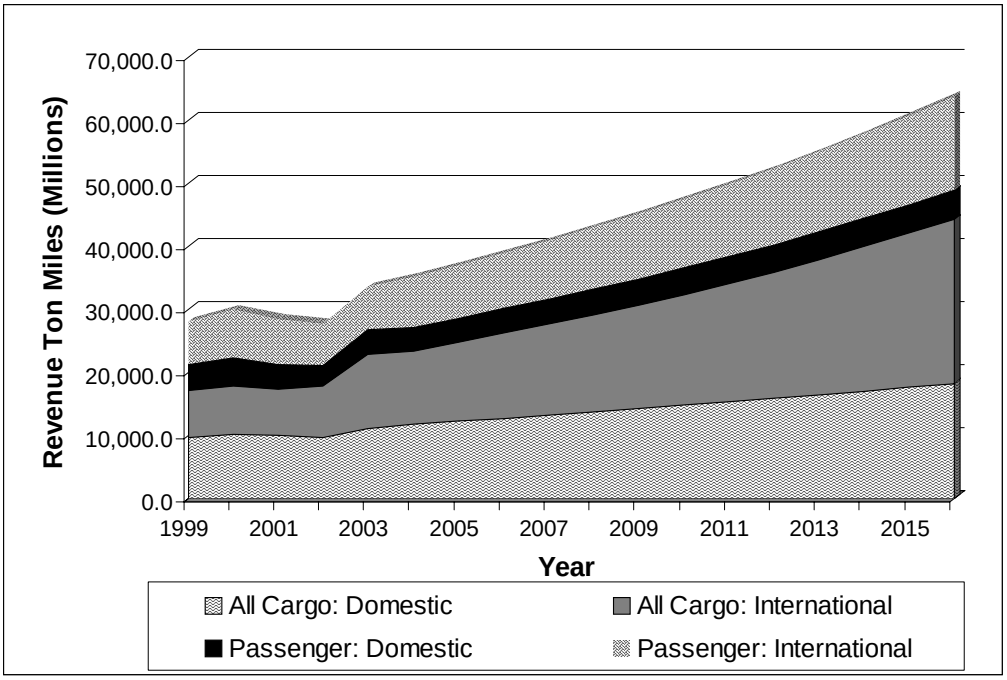
[2] Cargo, as defined by the Federal Aviation Administration (FAA), includes freight, express packages, and mail.

[3] Federal Aviation Administration. *FAA Aerospace Forecasts Fiscal Years 2005-2016.*

[4] Bureau of Transportation Statistics. *Pocket Guide to Transportation, 2006.* Washington, DC: U.S. Department of Transportation.

[5] *Ibid.*

Figure 1. Air Cargo Volume – Historic Data and Forecasts (FY1999 - FY2016)



Source: Federal Aviation Administration. *FAA Aerospace Forecasts Fiscal Years 2005-2016*.

Given the sheer volume of cargo that must be expediently processed and loaded on aircraft, it has been generally argued that full electronic screening of all air cargo, as is now required of checked passenger baggage, is simply not feasible with available screening technologies and procedures.[6] In 2002, it was reported that TSA computer models estimated that if full physical screening is implemented, only 4% of the daily volume of freight at airports could be processed due to the time that would be required to breakdown shipments, inspect them, and reassemble them for transport.[7] Since that time, considerable efforts have been made to increase the amount of cargo placed on passenger airliners that is screened and advance screening technologies to address concerns over the screening of cargo. What has resulted since is best described as a slow evolution of increasing inspections and screening of air cargo shipments placed on passenger aircraft since 2002. These inspections and screening operations are conducted by the airlines and freight shippers under the oversight of the TSA. While the TSA does not divulge the percentage of cargo that undergoes physical inspection, language in the FY2005 Homeland Security Appropriations Act (P.L. 108-334) calls for at least tripling the amount of cargo placed on passenger aircraft that is inspected. FY2006 appropriations language (P.L. 109-90) directs the TSA to take all possible measures – including the certification,

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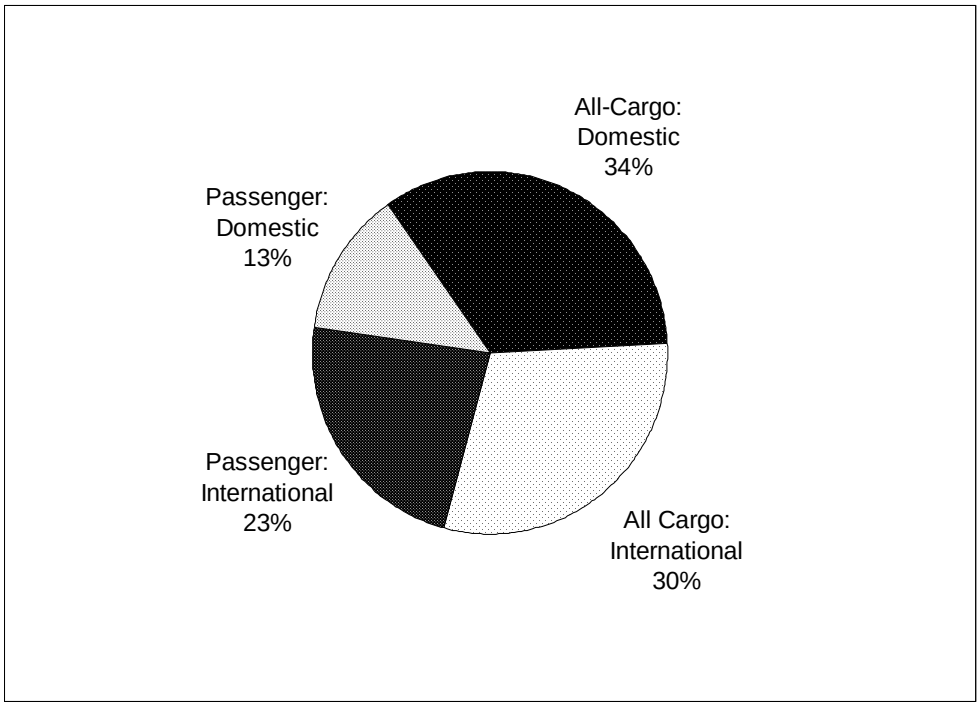
[6] See Statement of Admiral James M. Loy Under Secretary of Transportation for Security Before the Subcommittee on Aviation Committee on Commerce, Science, and Transportation U.S. Senate, February 5, 2003.

[7] Greg Schneider. "Terror Risk Cited for Cargo Carried on Passenger Jets; 2 Reports List Security Gaps." *The Washington Post*, June 10, 2002.

procurement, and deployment of screening systems – to inspect and screen air cargo on passenger aircraft and increase the percentage of cargo inspected beyond the level mandated in the FY2005 appropriations measure. Along similar lines, the National Intelligence Reform Act of 2004 (P.L. 108-458) require the TSA to pursue screening technologies and enhance security procedures to improve the inspection, screening, and tracking of air cargo on passenger aircraft as recommended by the 9/11 Commission.

While the primary focus has been on cargo carried aboard passenger aircraft, air cargo security is also a challenge for all-cargo operators. The largest all-cargo operators in the United States include FedEx, UPS, Airborne Express, and ASTAR Air Cargo (formerly DHL Airways). **Figure 2** shows the distribution of air cargo operations among passenger and all-cargo aircraft. International operations make up about half of the total system-wide air cargo operations in the United States. Historically, about 27% of revenue ton miles (RTMs) of domestic air cargo travels aboard passenger aircraft within the United States, 45% of international cargo RTMs to and from the United States is carried aboard passenger aircraft. The percentage of air cargo carried on passenger aircraft has dropped somewhat since September 11, 2001, with an estimated 26% of domestic RTMs and 37% of international air cargo RTMs carried on passenger aircraft in 2003. This slight reduction in the distribution of air cargo to passenger flights is primarily attributable to a post-9/11 restriction on mail parcels weighing more than 16 ounces, and a prohibition against carrying cargo from unknown shippers aboard passenger aircraft. A post-9/11 reduction in passenger flights to certain locations has also contributed to an increased reliance on all-cargo aircraft for cargo shipments.

Figure 2. Distribution of Air Cargo Revenue Ton Miles by Type of Operation (FY1999 - FY2016)



Source: Federal Aviation Administration. *FAA Aerospace Forecasts Fiscal Years 2005-2016*.

Since September 11, 2001, a variety of air cargo security measures have been put in place or are under consideration. The purpose of these security measures is to mitigate: (1) the risks associated with placing cargo on passenger and all-cargo aircraft; and (2) the high level of access to aircraft during cargo operations. This report will examine the key security risks associated with air cargo operations and options for mitigating these risks.

Air Cargo Security Risks

Potential risks associated with air cargo security include introduction of explosive and incendiary devices in cargo placed aboard aircraft; shipment of undeclared or undetected hazardous materials aboard aircraft; cargo crime including theft and smuggling; and aircraft hijackings and sabotage by individuals with access to aircraft.

Explosives and Incendiary Devices. Undetected explosive or incendiary devices placed in air cargo are potential threats to aircraft. Experts have warned that air cargo may be a potential target for terrorists because screening and inspection of air cargo is currently not as extensive as required screening of passengers and checked baggage. Cargo carried aboard passenger aircraft may be at particular risk since passenger aircraft are generally regarded as highly attractive targets to terrorists and have been attacked in the past. It has been reported that TSA considers the likelihood of a terrorist bombing of a passenger airplane to be between 35% and 65% based on 2002 intelligence reports, and TSA believes that cargo is either likely to become, or already is, the primary aviation target for terrorists in the short term.[8] However, other terrorism experts regard placing explosives in air cargo as less appealing to terrorists because typically a specific flight cannot be targeted without the assistance of an individual with access to aircraft. Furthermore, experts generally believe that all-cargo aircraft are less appealing targets to terrorists because an attack against an all-cargo aircraft is not likely to generate the degree of public and media attention that a bombing of a commercial passenger aircraft would have.

The December 22, 2001 attempted shoe bombing aboard a American Airlines Boeing 767 on a trans-Atlantic Paris to Miami flight has heightened concerns over possible terrorist bombings of U.S. aircraft in the wake of the terrorist attacks of September 11, 2001. Historically, bombings of U.S. airliners have been rare and have mostly involved bombs placed in either the aircraft passenger cabin or in checked passenger baggage. The most catastrophic bombing of a U.S. airliner was the December 21, 1988 crash of Pan Am flight 103, a Boeing 747, over Lockerbie, Scotland that was attributed to an explosive device placed in a baggage container in the airplane's forward hold.[9] Investigation of the deadliest bombing of a passenger aircraft, the June 23, 1985 downing of Air India flight 182 off the coast of Ireland, similarly revealed evidence of an explosive device that was most likely introduced

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[8] Greg Schneider. "Terror Risk Cited for Cargo Carried on Passenger Jets; 2 Reports List Security Gaps." *The Washington Post*, June 10, 2002.

[9] United Kingdom Air Accidents Investigation Branch. *Report on the accident to Boeing 747-121, N739PA at Lockerbie, Dumfriesshire, Scotland on 21 December 1988* (Aircraft Accident Report No 2/90 (EW/C1094)), July 1990.

in checked baggage and placed in the aircraft's forward cargo hold.[10] The most notable event involving detonation of an explosive device transported as cargo aboard an airliner in the United States was the November 15, 1979 explosion aboard an American Airlines Boeing 727 that made a successful emergency landing at Dulles Airport following the incident. Investigation revealed that the device was contained in a parcel shipped by U.S. mail that the Federal Bureau of Investigation (FBI) linked to convicted "Unabomber," Theodore Kaczynski.[11]

While using cargo as a means to place explosive or incendiary devices aboard aircraft has historically been rare, heightened screening of passengers, baggage, and aircraft may make cargo a more attractive means for terrorists to place these devices aboard aircraft, including all-cargo aircraft as well as passenger aircraft, in the future. Investigations have suggested that al Qaeda terrorists had an interest in bombing all-cargo aircraft prior to September 11, 2001, and were planning to bomb U.S.-bound cargo flights in an operation run out of the Philippines.[12] Given al Qaeda's continued interest in bombing aircraft and indications that they have already considered placing bombs in cargo, the specific vulnerability of air cargo is an issue of particular concern.

However, as previously noted, some terrorism experts believe that placing explosives or incendiary devices in cargo may be less appealing because it would be difficult to target specific flights without the cooperation of individuals with access to aircraft such as cargo workers. Thus, increased efforts to perform background checks of workers with access to aircraft and increased physical security around air cargo operations may further mitigate the threat of explosives and incendiary devices. Additionally, the use of hardened cargo containers capable of withstanding internal bomb blasts are being evaluated and may also provide a means of mitigating the risks of explosives and incendiary devices. The 9/11 Commission specifically recommended the deployment of at least one hardened cargo container in each passenger aircraft to mitigate the potentially catastrophic consequences of a bomb carried in air cargo.[13] The National Intelligence Reform Act of 2004 (P.L. 108-458) calls for establishing a pilot program to evaluate this concept.

Hazardous Materials.[14] Despite increased Federal Aviation Administration (FAA) and Department of Transportation (DOT) oversight and enforcement efforts, undeclared and undetected shipments of hazardous materials continues to pose a

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[10] Canadian Aviation Bureau Safety Board. Aviation Occurrence, Air India Boeing 747-237B VT-EFO, Cork, Ireland 110 Miles West, June 23, 1985.

[11] Affidavit of Assistant Special Agent in Charge, Terry D. Turchie, Before the U.S. District Court, District of Montana, April 3, 1996.

[12] National Commission on Terrorist Attacks Upon the United States. *The 9/11 Commission Report.* New York, NY: W. W. Norton & Company.

[13] Ibid.

[14] Hazardous materials or dangerous goods include explosives; gases; flammable liquids and solids; oxidizers and organic peroxides; toxic materials and infectious substances; radioactive materials; corrosive materials; and other miscellaneous dangerous goods (e.g. asbestos).

significant safety problem for air carriers. Most explosives and gases are prohibited aboard aircraft, however many properly handled hazardous materials are permitted aboard passenger and all-cargo aircraft within specified quantity limitations.[15]

Risks are introduced when hazardous materials are not declared leading to the potential transport of prohibited materials by air or improper handling of hazardous goods during loading and while in transit. The dangers of undetected and improperly handled hazardous materials in air cargo shipments were highlighted by the May 11, 1996 crash of a ValuJet DC-9 in the Florida Everglades. The National Transportation Safety Board (NTSB) determined that improperly carried oxygen generators ignited an intense fire in one of the airplane's cargo holds leading to the crash and issued several safety recommendations for improving the handling and tracking of hazardous materials to prevent improper carriage aboard passenger aircraft.[16]

While safety concerns regarding hazardous cargo shipments aboard passenger aircraft are of particular concern, preventing unauthorized shipments of hazardous materials is a challenge for all-cargo aircraft operators as well. About 75% of hazardous materials shipped by aircraft are carried aboard all-cargo aircraft, while the remaining 25% is shipped on passenger aircraft.[17] Enhanced air cargo security measures may also improve air cargo safety by increasing the detection of undeclared hazardous materials.

Cargo Crime. Cargo crimes include theft of goods transported as cargo, and shipment and smuggling of contraband, counterfeit, and pirated goods through the cargo distribution network. It is estimated that direct losses due to cargo theft across all transportation modes total between $10 and $25 billion annually in the United States.[18] The large range in this estimate reflects the fact that cargo theft is not a specific crime category and therefore reliable statistics on cargo theft are unavailable. Furthermore, many experts believe a large percentage of cargo theft is unreported. The Cargo Theft Prevention Act, H.R. 785, introduced by Representative Stearns seeks to improve the understanding and tracking of cargo crimes by requiring the Department of Justice to establish a coordinated cargo theft crime database and integrate and disseminate cargo theft information to federal, state, and local law enforcement authorities. The bill also would establish cargo theft as a specific crime classification in the Uniform Crime Reporting System.

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[15] U.S. General Accounting Office. *Aviation Safety: Undeclared Air Shipments of Dangerous Goods and DOT's Enforcement Approach.* (GAO-03-22, January 2003).

[16] National Transportation Safety Board. *Aircraft Accident Report: In-Flight Fire and Impact with Terrain, ValuJet Airlines, Flight 592,DC-9-32, N904VJ, Everglades, Near Miami, Florida, May 11, 1996* (AAR-97/06).

[17] U.S. General Accounting Office. *Aviation Safety: Undeclared Air Shipments of Dangerous Goods and DOT's Enforcement Approach.* GAO-03-22, January 2003.

[18] U.S. General Accounting Office. *Aviation Security: Vulnerabilities and Potential Improvements for the Air Cargo System.* GAO-03-334, December, 2002. FIA International Research, Ltd. *Contraband, Organized Crime and the Threat to the Transportation and Supply Chain Function*. September 2001.

The large estimated level of cargo theft and other cargo crimes is indicative of potential weaknesses in cargo security including air cargo security. Specific weaknesses in air cargo security have been highlighted in several high profile investigations of cargo theft. Major cargo and baggage theft rings have been uncovered at JFK International Airport in New York, Logan International Airport in Boston, and at Miami International Airport.[19] In addition to theft, smuggling is a problem for air cargo security. Smuggling of contraband, counterfeit, and pirated goods undermines legal markets and reduces government tax and tariff revenues. Smuggling operations are often linked to organized crime, and may provide support for terrorist activities.[20] A large portion of cargo crime is either committed by or with the assistance of cargo workers. Therefore, increased security measures such as conducting more stringent or more frequent background checks of cargo workers and enhancing physical security of cargo operations areas are likely to reduce cargo crimes and improve the capability to detect criminal activity in air cargo operations. A review of transportation security needs for combating cargo crime identified six key issues regarding cargo security:

- A lack of effective cargo theft reporting systems;
- Weaknesses in current transportation crime laws and prosecution;
- A lack of understanding regarding the nature of cargo crime by governments and industry;
- Inadequate support for cargo theft task forces;
- A need to improve local law enforcement expertise on cargo theft; and
- The need for more effective cargo security technology including cargo tracking systems, tamper-evident and tamper-resistant seals, high-speed screening devices, and integration of security technology into supply chain management systems.[21]

Addressing these issues specific to cargo crime may also improve overall cargo security and could deter terrorist threats to cargo shipments. While these recommendations are directed toward cargo crime issues in all modes of transportation, they could be particularly applicable to air cargo security where other security concerns such as explosive and incendiary device detection, hazardous materials detection, and deterring hijackings and sabotage may also be addressed through the implementation of tighter controls to deter cargo crime.

Aircraft Hijacking and Sabotage. Individuals with access to aircraft may pose a risk of potential hijackings and aircraft sabotage. Instances of hijackings by individuals with access to aircraft have been extremely rare, but include two examples of particularly violent incidents by disgruntled individuals who had access to aircraft that facilitated their plots. A particularly dramatic hijacking attempt by an

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[19] U. S. General Accounting Office. *Ibid*; Department of Transportation, Office of the Inspector General. *Press Release: Six MIA Airport Employees Indicted for Stealing from Checked Passenger Bags*. December 11, 2002.

[20] FIA International Research, Ltd. *Op cit.*

[21] Ed Badolato. "Cargo Security: High-Tech Protection, High-Tech Threats. *TR News*, 211, November-December 2000, pp. 14-17.

individual with access to aircraft and cargo operations facilities occurred on April 7, 1994.[22] An off-duty Federal Express flight engineer attempted to hijack a FedEx DC-10 aircraft and crash it into the company's Memphis, Tennessee headquarters. The hijacker boarded the airplane in Memphis under the guise of seeking free transportation to San Jose, California. His only luggage was a guitar case that concealed hammers, mallets, a knife, and a spear gun. At the time there was no requirement or company procedure to screen or inspect personnel with access to cargo aircraft or their baggage. The flight crew thwarted the hijacker's attempt to take over the airplane by force and made a successful emergency landing in Memphis despite serious injuries to all three flight crew members.

Individuals have also used their access to aircraft credentials to bypass existing security measures. For example, on December 7, 1987, a PSA regional jet crashed near San Luis Obispo, California killing all 43 people on board.[23] Investigation revealed that a disgruntled former USAir employee, recently fired for alleged theft, used his employee identification, which had not been returned, to bypass airport security with a loaded handgun. At altitude, he shot his former supervisor who was a passenger on the airplane. He then entered the flight deck, shot the two pilots, and then shot himself after putting the airplane into a crash dive. At the time, federal regulations permitted airline employees to bypass airport security checkpoints.

Since these incidents, airport and air cargo security regulations have been tightened to establish better controls over aircraft access including background checks and physical screening of individuals with access to aircraft. Background checks of workers with unescorted access to passenger aircraft was mandated under ATSA, and background checks of workers with unescorted access to air cargo are under consideration as part of proposed regulations issued by the TSA in November 2004.[24] However, without full screening of air cargo and airport personnel, the potential still exists for persons with access to aircraft to pass weapons inside the secured areas of airports. Under proposed regulations, crewmembers and individuals carried aboard large all-cargo aircraft would be subject to pre-flight screening conducted by either the TSA or, more typically, by the aircraft operator using methods approved by the TSA and detailed in the operator's security program.

Heightened security measures on passenger aircraft since September 11, 2001 could make all-cargo aircraft more attractive to terrorists seeking to hijack large airplanes. Currently, federal air marshals are not deployed on all-cargo aircraft, and cargo airplanes are not required to have hardened cockpit doors so long as alterative TSA-approved security measures are implemented to control access to the aircraft and flight deck while the airplane is on the ground. Vision 100 (P.L. 108-176) expanded the Federal Flight Deck Officer program to include pilots of all-cargo aircraft. This program trains and deputizes pilots to carry firearms to protect the

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[22] Dave Hirschman. *Hijacked: The True Story of the Heroes of Flight 705*. (New York: William Morrow & Co, 1997).

[23] National Transportation Safety Board. Accident Brief, NTSB Identification: DCA88MA008. Available at [http://www.ntsb.gov].

[24] Department of Homeland Security, Transportation Security Administration. "Air Cargo Security Requirements; Proposed Rule." *Federal Register*, (69) 217, 65258-65291.

flight deck against a terrorist attack. (see CRS Report RL31674, *Arming Pilots Against Terrorism: Implementation Issues for the Federal Flight Deck Officer Program*, by Bartholomew Elias.)

Sabotage by individuals with access to aircraft is also a potential risk, although generally not considered a significant threat because of the high level of knowledge regarding aircraft systems needed to sabotage flight critical systems, the levels of redundancy of flight critical systems on modern transport category airplanes[25], and the existing capabilities to detect sabotage attempts through aircraft systems checks and pre-flight inspections. While numerous cases of sabotage by disgruntled employees have been documented, these incidents of aircraft tampering have typically been discovered during pre-flight inspections resulting in aircraft groundings and delays and costly repairs, but have not resulted in catastrophes. Such incidents have not been linked to terrorism.

Cargo Screening and Inspection

Screening and inspection of air cargo may be an effective means for detecting explosives, incendiary devices, and hazardous materials in air cargo. The Aviation and Transportation Security Act (ATSA, P.L. 107-71) requires the screening of all property, including mail and cargo, carried aboard passenger aircraft in the United States. In implementing the security procedures for cargo carried aboard passenger airplanes, TSA has relied extensively on "known shipper" programs to prevent the shipment of cargo from unknown sources aboard passenger aircraft. ATSA also specifies that, as soon as practicable, a system must be implemented to screen, inspect, or otherwise ensure the security of all cargo transported in all-cargo aircraft using methods such as those outlined in this report. However, the General Accounting Office (GAO) noted that the TSA lacked specific long-term goals and performance targets for cargo security.[26] In response, the TSA has developed an air cargo security strategic plan and has proposed comprehensive regulations designed to enhance air cargo security. The TSA's strategy centers on risk-based assessments and targeted physical screening of cargo based on risk as well as increased random inspections of shipments.

Current aviation security regulations require that each passenger aircraft operator and indirect air carrier[27] develop a security program for acceptance and screening of cargo to prevent or deter the carriage of unauthorized explosives or incendiaries. However, the volume of air cargo handled and the distributed nature

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[25] Transport category airplanes include all jet-powered airplanes with 10 or more passenger seats or weighing more than 12,500 pounds maximum takeoff weight (MTOW), and all propeller-driven airplanes with 19 or more seats or weighing more than 19,000 pounds MTOW.

[26] U.S. General Accounting Office. *Post-September 11th Initiatives and Long-Term Challenges.* Statement of Gerald L. Dillingham, Testimony Before the National Commission on Terrorist Attacks Upon the United States, April 1, 2003 (GAO-03-616T).

[27] An indirect air carrier refers to an entity, such as a freight forwarder, that engages indirectly in the air transportation of property on passenger aircraft (See Title 49 Code of Federal Regulations, Chapter XII, Part 1544).

of the air cargo system presents significant challenges for screening and inspecting air cargo. Presently, in the United States, about 50 air carriers transport air cargo on passenger aircraft handling cargo from nearly 2 million shippers per day.[28] About 80% of these shippers use freight forwarders who operate about 10,000 facilities across the country.[29] Since experts generally believe that 100% screening of all air cargo is not a practical solution with currently available technology, security programs have relied on pre-screening of cargo to identify shipments for physical screening and inspection.

The TSA is currently working toward fully implementing its Air Cargo Strategic Plan which was released in November 2003.[30] In keeping with the risk-based approach of implementing air cargo security measures typified in the known shipper concept, the core elements of this plan consist of: improving shipper and supply chain security through improved vetting of shippers and freight forwarders; enhancing cargo pre-screening processes; developing and deploying appropriate screening technologies to conduct targeted air cargo inspections; and implementing appropriate facility security measures.

"Known Shipper" Programs. The principal means for pre-screening or profiling cargo has been though use of "known shipper" programs. Current administration regulatory proposals seek to establish an industry-wide known shipper database for vetting all shipments placed on passenger aircraft.[31] Under a provision in the Intelligence Reform Bill of 2004 (P.L. 108-458), the TSA was required to finalize these proposed regulatory changes by September 2005 but has not yet done so. According to the TSA, about one-third of air carriers and indirect air carriers are participating in the voluntary central database of known shippers to vet cargo destined for passenger aircraft as required under ATSA. Other air carriers and freight forwarders currently use internal databases and security protocols approved by TSA for determining whether shipments bound for a passenger airplane come from known sources and that shippers have adequate security measures in place to protect the integrity of those shipments. These protocols are collectively known as "known shipper" programs.

Known shipper programs were created to establish procedures for differentiating trusted shippers, known to a freight forwarder or air carrier through prior business dealings, from unknown shippers who have conducted limited or no prior business with a freight forwarder or air carrier. Using this system, packages from unknown shippers can then be identified for additional screening and inspection. Currently, shipments from unknown sources are prohibited from passenger aircraft. Additionally, air carriers and freight forwarders must refuse to transport any cargo from shippers, including known shippers, that refuse to give consent for searching

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[28] See S.Rept. 108-38.

[29] U.S. General Accounting Office. *Aviation Security.*

[30] U.S. Department of Homeland Security, Transportation Security Administration. *Air Cargo Strategic Plan.* November 13, 2003.

[31] Department of Homeland Security, Transportation Security Administration. "Air Cargo Security Requirements; Proposed Rule." *Federal Register*, (69) 217, 65258-65291.

and inspecting the cargo. ATSA provides for use of known shipper programs as an alternate means for ensuring the security of cargo carried aboard passenger aircraft in lieu of screening of property by federal government employees prior to aircraft boarding.

The development of known shipper programs was prompted by industry experts and Congress in the mid-1990s who recognized that increased controls over air cargo shipments were needed to better ensure air cargo safety and security. Key concerns included the need for increased compliance with guidelines for the shipment of hazardous materials and the need to deter terrorists from using cargo as a means to place explosives or incendiary devices on aircraft. In addition, congressional hearings on the 1996 Valujet accident concluded that air cargo safety could only be achieved through a comprehensive inspection program encompassing all components of the air cargo network.[32]

In December 1996, the FAA's Aviation Security Advisory Committee (ASAC) Security Baseline Working Group issued a series of recommendations that formed the basis for FAA's effort to strengthen aviation security in response to this need. Recommendations issued by the working group regarding air cargo security included tightening the definition of a "known shipper"; using profiles to review the shipments of known shippers and apply additional security measures; and exploring technologies to develop a profile to be applied to cargo shipments. The White House Commission on Aviation Safety and Security, formed after the 1996 crash of TWA Flight 800 and commonly referred to as the Gore Commission, urged the adoption of the recommendations made by the FAA's Baseline Working Group regarding the profiling of "known" and "unknown"shippers.[33] As part of FAA's efforts in air cargo safety and security, a "known shipper" program was subsequently established, outlining procedures for freight forwarders and air carriers to review the security practices of known frequent customers and establish a cargo security plan for handling cargo from known and unknown shippers. With the passage of ATSA, oversight of cargo security measures was transferred from the FAA to the TSA. The TSA has continued to rely on known shipper programs as a principle means for pre-screening air cargo.

A review of aviation security after the September 11, 2001 terrorist attacks by the Department of Transportation (DOT) Office of the Inspector General, drew attention to the vulnerabilities of air cargo and questioned the overall effectiveness of the known shipper program.[34] In Congressional testimony following the terrorist attacks of September 11, 2001, DOT Inspector General, Kenneth Mead, referenced a 1998 report by the DOT Office of the Inspector General documenting a high rate of non-compliance with hazardous materials regulations and cargo security

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[32] Department Of Transportation, Office of the Inspector General. *Aviation Security: Federal Aviation Administration* (Report No. AV-1998-134, May 27, 1998).

[33] White House Commission on Aviation Safety and Security. *Final Report to President Clinton.* Vice President Al Gore, Chairman. February 12, 1997. Washington, DC: The White House.

[34] Ken Leiser. "Gaps in air cargo security may offer terrorism openings". *AEROTECH News and Review,* June 21, 2002, p. B2.

requirements across the air cargo industry and a lack of industry oversight to ensure that security procedures were carried out by cargo workers.[35] In 1998, the DOT Inspector General noted that FAA was making progress toward improving the policies, procedures, and controls over air cargo safety and security.[36] However, Mead testified that a follow-up audit revealed continued weaknesses in FAA's policy for allowing cargo on passenger aircraft. Several loopholes have been noted, including the relative ease of obtaining known shipper status, and the relative ease with which someone could pose as a known shipper by falsifying or counterfeiting shipping documents used to identify the source as a known shipper.[37]

Two main issues regarding the current implementation of known shipper programs are the adequacy of procedures for auditing and monitoring known shippers and the current lack of a consolidated database of known shippers. Critics of existing known shipper programs argue that currently very little investigation of known shippers is required to demonstrate that these shippers are trustworthy and have adequate security measures in place to ensure the integrity of their shipments.[38] Freight forwarders and air carriers have also questioned why extensive background checks and established relations with a particular customer are required to establish that the customer is a known shipper when that customer is already considered a known shipper to another air carrier or freight forwarder. Therefore, some have suggested a standardized, centralized database of known shippers. To address these concerns, the TSA has instituted an industry-wide pilot program database of known shippers which is presently used by about one-third of the industry. The TSA has issued a proposed rule that would make using the consolidated known shipper database an industry-wide requirement. This move by the administration is largely in step with language passed by the Senate during the 108th Congress (see S. 165, S. 2845 as passed by the Senate). The administration's initiatives in drafting regulatory action to require an industry-wide known shipper datatbase led Congress to ultimately drop the Senate-passed provision in the Intelligence Reform Act of 2004 (P.L. 108-458) that would have established a statutory requirement for establishing a standardized industry-wide known shipper program and database. Congress instead settled on including language calling for the TSA to finalize its rulemaking on air cargo security, including the proposed establishment of the industry-wide known shipper database, by September 2005. However, despite this mandate, the TSA has not finalized and implemented the proposed rules to date. The Congressional Budget Office (CBO) estimates that it will cost about $10 million per year to maintain an industry-wide database of known shippers.[39]

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[35] Statement of The Honorable Kenneth M. Mead, Inspector General U.S. Department of Transportation. "Action Needed to Improve Aviation Security." Before the Committee on Governmental Affairs and the Subcommittee on Oversight of Government Management, Restructuring and the District of Columbia, United States Senate, September 25, 2001.

[36] Department Of Transportation, Office of the Inspector General. *Aviation Security: Federal Aviation Administration* (Report No. AV-1998-134, May 27, 1998).

[37] Greg Schneider. *Op cit.*

[38] Ken Leiser, *Op cit.*

[39] See S.Rept. 108-38. *Air Cargo Security Improvement Act: Report of the Committee on* (continued...)

Cargo Inspection. Another issue for air cargo security is the adequacy of cargo inspection procedures and oversight of cargo inspections at air carrier and freight forwarder facilities. ATSA established requirements for screening and inspection of all individuals, goods, property, vehicles, and other equipment entering a secured area of a passenger airport that assures the same level of protection as passenger and baggage screening.

ATSA did not establish specific requirements for the screening of air cargo. With regard to air cargo, current regulations specify that aircraft operators must use the procedures, facilities, and equipment described in their security program to prevent or deter the carriage of unauthorized explosives or incendiaries in cargo onboard a passenger aircraft and inspect cargo shipments for such devices before it is loaded onto passenger aircraft. Additionally, aircraft operators must establish controls over cargo shipments, in accordance with their security program, that prevent the carriage of unauthorized explosive or incendiary devices aboard passenger aircraft and access by unauthorized individuals. Aircraft operators must refuse to transport any cargo presented by a shipper that refuses to consent to a search and inspection of their shipment.[40] The Homeland Security Appropriations Act of 2005 (P.L. 108-334) calls for tripling the amount of cargo placed on passenger airplanes that is screened or inspected, however the absolute number or percentage of cargo subject to inspection is considered security sensitive. With regard to all-cargo aircraft, ATSA mandates that a system to screen, inspect, or otherwise ensure the security of all-cargo aircraft is to be established as soon as practicable, but sets no specific deadlines or time frame for compliance.

A significant challenge regarding cargo inspection is the feasibility of implementing inspection procedures that offer adequate assurances for security without unduly affecting cargo shipment schedules and processes. In 1997, the Gore Commission recommended that unaccompanied express packages shipped on commercial passenger aircraft should be subject to examination by explosives detection systems.[41] However, most experts agree that current technology does not offer a readily available, affordable solution for scanning cargo containers or cargo unit loading devices (ULDs) in an expeditious manner that would not unduly affect the schedule of air cargo operations. Also, scanning or inspecting individual packages is considered infeasible by many experts due to the volume of cargo handled and the schedule demands of the air cargo business. Therefore, most experts agree that the most practical solution, using available technology, is the application of physical screening and inspections on selected shipments and the use of cargo profiling procedures such as known shipper programs to identify shipments that may require additional screening and inspection.

Since the ability to screen and inspect cargo is limited by available technology, flight schedules, and cargo processing demands, alternative measures for screening

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[39] (...continued)
Commerce, Science, and Transportation on S. 165. United States Senate, April 11, 2003.

[40] See Title 49, Code of Federal Regulations, Chapter XII, Part 1544.205

[41] White House Commission on Aviation Safety and Security. *Op cit.*

and inspection at cargo handling facilities have been suggested. In particular, the Gore Commission recommended a significant expansion of the use of bomb-sniffing dogs. Former TSA head, Admiral James Loy, testified that increased use of canine teams may be an effective means for increasing inspections of cargo and mail.[42] Canine teams may offer a viable alternative means for screening air cargo at a relatively low cost.

U.S. Mail Carried on Aircraft. In fact, canine teams presently provide the only means approved by the TSA for screening mail weighing more than one pound that is put on passenger aircraft under a long-running pilot program in place at 11 airports.[43] Mail weighing more than one pound is otherwise prohibited from carriage aboard passenger aircraft.

The transport of U.S. mail aboard aircraft introduces unique security challenges to prevent illegal hazardous material shipments and the introduction of explosive and incendiary devices. Inspecting first class, priority, and express mail prior to shipment by air is difficult because the Postal Service regards these items as private materials protected by the Fourth Amendment against search.[44] The Postal Service has implemented a screening process to prevent unauthorized shipments of hazardous substances that relies on customer screening by postal clerks who are trained to question individuals shipping packages weighing more than one pound by air. Items weighing less than one pound, on the other hand, are not subject to any inquiry and can be deposited in mailboxes thereby precluding any inquiry of the sender. However, only a small percentage of this mail is shipped by air. About 5 to 7.5 percent of all domestic mail shipments, regardless of weight, are transported by either passenger or all-cargo aircraft. Federal Express is the largest carrier of U.S. mail and its all-cargo operations account for about half of the total volume of U.S. mail shipments by air.[45]

In 1997, the Gore Commission recommended that the Postal Service obtain authorization from customers shipping mail weighing more than one pound allowing examination by explosive detection systems, and if necessary, seek appropriate legislation to accomplish this.[46] Since September 11, 2001, postal shipments weighing more than one pound have been limited to all-cargo aircraft. Passenger air carriers have been pushing to have these restrictions lifted because of a significant loss of revenue from U.S. mail shipments. Items weighing less than one pound shipped by U.S. mail are not subject to this restriction from carriage aboard passenger airliners. As seen in **Figure 3**, there was a precipitous decline in mail shipments by passenger airlines that resulted from this restriction. While all-cargo air carriers have

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[42] See Statement of Admiral James M. Loy, *Op cit.*

[43] U.S. Department of Homeland Security, Transportation Security Administration. "TSA Canine Teams Screen U.S. Mail for Explosives - Pilot Program to Expand to Airports Across the Country." Press Release 03-34, May 29, 2003.

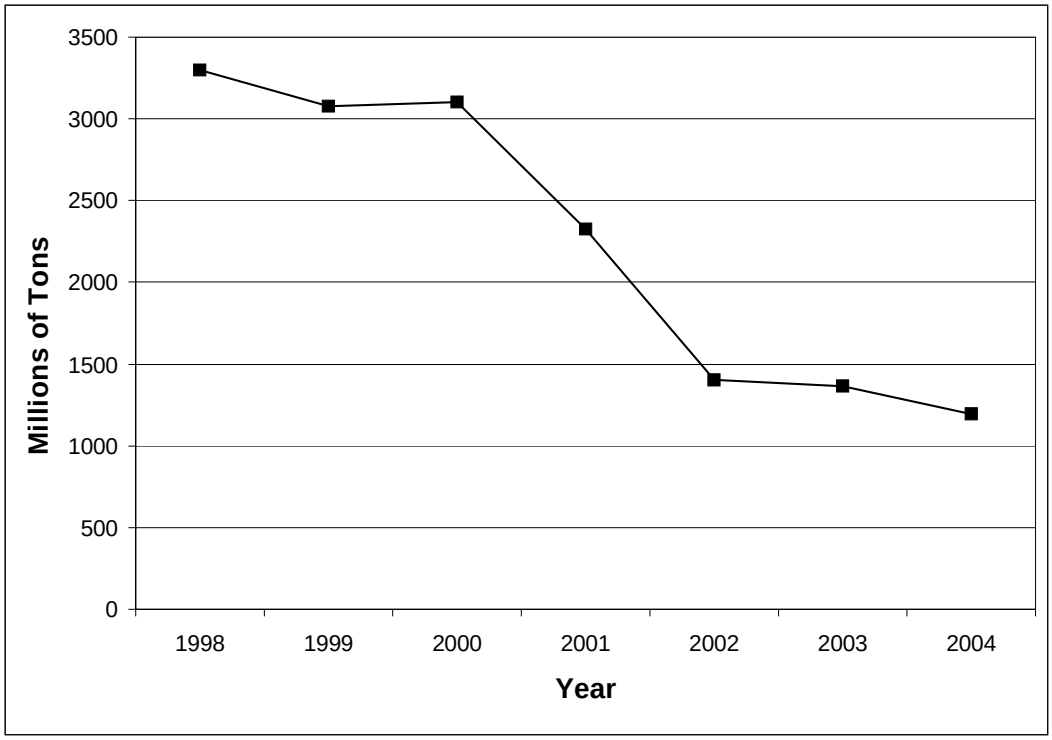
[44] U.S. General Accounting Office. *Aviation Security.*

[45] "Northwest to drop U.S. mail; Canceled domestic routes to cost 250 ground jobs". *Detroit Free Press*, September 5, 2003.

[46] White House Commission on Aviation Safety and Security. *Op cit.*

increased their mail carriage to some degree in response, most of the mail once carried aboard passenger aircraft is now being transported by other modes.

Figure 3. Domestic Mail Carried on Scheduled Passenger Airlines



Source: CRS analysis of Bureau of Transportation Statistics, *Air Carrier Statistics (Form 41 Traffic)*.

Assuring the safety and security of U.S. mail transported by aircraft, and preventing the introduction of explosives or incendiaries in mail shipped by aircraft while maintaining privacy rights of postal patrons remains an important issue in the debate over air cargo security. Following the events of September 11, 2001 and the Postal Service anthrax incidents, the Technology Subcommittee of the President's Commission on the United States Postal Service recommended that the Postal Service, in coordination with the Department of Homeland Security, should explore technologies and procedures for utilizing unique sender identification on all mail.[47] Such procedures may provide a means of pre-screening all mail shipped by air, including packages weighing less than one pound.

Physical Security of Air Cargo Facilities

Air cargo facilities present unique challenges for physical security. The large physical size of these facilities and relatively continuous high-volume cargo operations introduce numerous individuals, vehicles, and shipments into secured

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[47] President's Commission on the United States Postal Service. *Final Recommendations of the Technology Challenges and Opportunities Subcommittee.* Washington, DC: United States Department of the Treasury [http://www.ustreas.gov/offices/domestic-finance/usps/].

access areas around aircraft. Key issues regarding physical security of these air cargo facilities include the adequacy of:

- Inspections and oversight of air cargo facilities to ensure compliance with aviation security regulations and procedures established in the approved security programs of air carriers and freight forwarders;
- Training for air cargo personnel with regard to security procedures and guidelines; and
- Access control requirements for personnel with access to air cargo facilities and aircraft.

Inspection and Oversight of Air Cargo Facilities. Current regulations specify that all air carriers and freight forwarders must allow the TSA to conduct inspections and to review and copy records in order to determine compliance with applicable laws and regulations pertaining to aviation security. The Homeland Security Appropriations Act for FY2005 provided the TSA with $40 million to hire an additional 100 inspectors and carry out oversight and enforcement activities related to air cargo security. The TSA has responded by launching focused inspections of air cargo operations and conducting monthly "blitz" audits or "strikes" of selected air cargo facilities. In FY2006, Congress again provided the TSA with a $10 million set-aside to hire 100 more air cargo inspectors and for travel related to carrying out regulatory oversight and inspections of air cargo shipping and handling facilities.

The ability to maintain this increased oversight of air cargo facilities is likely to be highly dependent on the continued availability of resources and funding. The effectiveness of this oversight will also likely be highly dependent on the adequacy of available tools and procedures to track needed corrective actions and ensure compliance among air carriers and freight forwarders. Therefore, the adequacy of TSA's oversight of air cargo security could be a significant area of focus for congressional oversight during the 109th Congress.

Cargo Security Training. Currently, air cargo handlers are not required to receive any specific or formal training on security procedures or identification of suspicious activities. However, air cargo handlers may be considered the front line in protecting against security threats by adhering to procedures that would mitigate physical security breaches at cargo operations facilities, and by increasing their awareness of suspicious activities and knowing the proper procedures for reporting their observations. Security training for cargo workers may focus on security procedures for ensuring cargo integrity, protecting facilities, reporting suspicious activities, and so on. Under TSA's proposed rulemaking, workers for all-cargo carriers and for indirect air carriers with security-related duties — such as carrying out security inspections of shipments — would be required to receive specific training on the company's security program and their individual security-related responsibilities under that program. Similar training is already required of workers for passenger airlines that are assigned security-related duties.

Increased Control over Access to Aircraft and Cargo Facilities. Under ATSA, TSA was directed to work with airport operators to strengthen access control points in secured areas and was authorized to use biometric screening

procedures to positively identify individuals with access to secure airport areas. ATSA contains provisions for TSA oversight of secured-area access control to assess and enforce compliance with access control requirements. These requirements include screening and inspection of individuals, goods, property, vehicles and other equipment seeking to access secure airport areas. Background checks for individuals having access to passenger aircraft are required and vendors with direct access to airfields where passenger operations take place are required to have a TSA-approved security program in place. Presently, background checks and displayed identification serve as the principal means for screening airport workers including cargo handlers.

There has been growing concern over the adequacy of these procedures for screening and monitoring airport workers. One particular concern is the integrity of airport worker credentials and the potential that unauthorized individuals could gain access to secure areas of the airport using stolen or fraudulent identification. TSA currently has ongoing contracts to conduct field tests of various technologies for transportation worker identification, including biometric markers, in an effort to develop a common and universally recognized Transportation Workers Identification Credential (TWIC). Biometric technology has received considerable attention from Congress as a means to authenticate individuals, particularly airport workers, and improve access controls to secured areas of airports. These proposals are discussed in further detail below in the section titled **Biometric Screening Technology**.

Another concern has been raised over the use of identification checks in lieu of physical screening of airport workers, including cargo handlers. Representative Peter DeFazio recently expressed concern over this practice noting that workers who bypass physical screening could potentially carry threat objects into secured areas of the airport or on board aircraft.[48] Congress may consider whether existing security procedures regarding airport worker access to secured airport areas meets the intent of ATSA with regard to providing at least the same level of protection of secured airport areas and passenger aircraft as screening passengers and their baggage.

In addition to ongoing concerns over access controls around passenger aircraft, access control and monitoring of workers at all-cargo facilities remains a significant challenge. While all-cargo operators have various security measures in place to control access to their facilities and monitor operations areas, there is no existing regulatory framework regarding the security of all-cargo operations. Proposed regulations would establish an all-cargo security program detailing the physical security measures for air cargo operations areas, cargo placed aboard all-cargo aircraft, and background checks and screening of individuals having access to their aircraft on the ground or in flight. In addition, the proposed rules would require airports to designate cargo operations areas, including areas where all-cargo aircraft are loaded and unloaded, as security identification display areas (SIDAs). This would effectively elevate the security measures for these cargo handling areas and would require that workers with unescorted access to these areas be vetted through fingerprint based criminal history records check as is presently done for workers having access to secured areas around passenger aircraft.

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[48] National Public Radio. "Some Members of Congress Raising Concerns about Potential Lapses at Airports", *Morning Edition*, May 22, 2003.

Arming All-Cargo Pilots. During the 108th Congress, proponents for arming all-cargo pilots urged Congress to allow all-cargo pilots to join the ranks of passenger airline pilots who can volunteer for selection and training in the Federal Flight Deck Officers (FFDO) program. This program, established by the Homeland Security Act of 2002 (P.L. 107-296), trains and deputizes qualified pilots to carry firearms and use deadly force to protect the flight deck against terrorist attacks (see CRS Report RL31674, *Arming Pilots Against Terrorism: Implementation Issues for the Federal Flight Deck Officer Program*, by Bartholomew Elias). While the plan was originally limited to only pilots of passenger airliners, Vision 100 (P.L. 108-176) expanded the program to allow cargo pilots and flight engineers to participate as well.

Proponents for including all-cargo pilots in the program point out that all-cargo aircraft lack hardened cockpit doors, federal air marshals, and passengers that may assist in thwarting a hijacking attempt.[49] They also point out that physical security and access control to cargo operations areas and all-cargo aircraft is lax compared to the tight screening of passengers and baggage since September 11, 2001, and the current lack of screening of individuals and property at these sites could offer the opportunity for terrorists plotting to hijack an aircraft to board an all-cargo aircraft as stowaways and seize the cockpit in flight. All-cargo aircraft include more than 1,000 transport category jet airplanes, of which about half are wide-body jets similar to those used in the September 11, 2001 terrorist attacks.[50] Proponents for arming all-cargo pilots contend that the provision in Vision 100 that includes cargo pilots in the FFDO program will mitigate the risk of a hijacking aboard all-cargo aircraft. They further argue that training for cargo pilots is needed expediently given the limited measures currently in place to mitigate this risk.

Cargo airlines, on the other hand, had opposed allowing their pilots to join the FFDO program. Air carriers, in general, have been hesitant about the program because of liability concerns even though specific liability protections were extended to the airlines and pilot participants when the FFDO program was established under the Homeland Security Act of 2002 (P.L. 107-296). Proponents for the program and the inclusion of cargo pilots in the program have voiced concerns that the manner in which the program has been implemented and the remoteness of the training facilities have limited the program's overall effectiveness. The program received $27 million for FY2006 and few, if any, changes to the program are expected in the near term. Nontheless, Congress may address some lingering concerns over the program such as the convenience of training and requalification sites, the carriage of firearms outside the cockpit which is presently highly restricted, and program liability surrounding the role of the federal flight deck officer as both an airline pilot and a deputized federal officer.

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[49] See Statement of Captain Duane Woerth, President, Air Line Pilots Association, International. *The Status of the Federal Flight Deck Officer Program.* Before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives. Washington, DC: May 8, 2003.

[50] Federal Aviation Administration. *FAA Aerospace Forecast Fiscal Years 2003-2014.*

Technology For Air Cargo Security

Because the capability of available technology is seen as a significant constraining factor on the ability to screen, inspect, and track cargo, initiatives to improve cargo screening technology have been a focus of recent legislation to enhance air cargo security.

In response to the 9/11 Commission recommendation that the TSA intensify its efforts to identify, track, and appropriately screen potentially dangerous cargo, the National Intelligence Reform Act of 2004 (P.L. 108-458) directs the TSA to develop technologies for this purpose and authorizes $100 million annually in FY2005 through FY2007 for the research, development, and deployment of enhanced air cargo security technology. The act also establishes a competitive grant program to foster the development of advanced air cargo security technology.

Appropriations for research and development of technologies specifically tailored for air cargo security had increased significantly, totaling $55 million in FY2004 and $75 million for FY2005. In FY2006, TSA research and development functions were realigned into the Department of Homeland Security's Science and Technology Directorate and research and development funding for air cargo was scaled back to $30 million, and specifically designated for conducting three cargo screening pilot programs testing different concepts of operation.

Various technologies are under consideration for enhancing the security of air cargo operations.[51] Tamper-evident and tamper resistant packaging and container seals may offer a relatively low cost means of protecting cargo integrity during shipping and handling. Cargo screening technology using x-rays, chemical trace detection systems, or possibly neutron beams or other techniques may offer means to screen cargo prior to placement aboard aircraft. Additionally, canine teams may be used to augment cargo screening technology or to screen cargo independently. Hardened cargo container technology may be used to mitigate the threat of in-flight explosions or incendiary fires aboard aircraft. Finally, biometric technologies are being evaluated and may be useful in authenticating cargo worker identification and improving access control to aircraft and cargo operations areas.

Tamper-Evident and Tamper-Resistant Seals. Various technologies exist for sealing cargo shipments and cargo containers to prevent tampering. Relatively low cost solutions such as tamper-evident tapes that provide visual indications of tampering are readily available and could easily be implemented during packaging. Such technology could be used in combination with "known shipper" protocols to insure that known shippers provide sufficient security in their packaging facilities and deter tampering during shipping and handling. Tamper-evident tape can identify cargo during inspections processes for further screening and inspection to safeguard against the introduction of explosives and incendiary devices. Tamper-evident tape may also be an effective tool to deter cargo crime, including cargo theft

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[51] Technologies for enhancing the security of passenger flight operations are detailed in CRS Report RL31151, *Aviation Security Technologies and Procedures: Screening Passengers and Baggage*, by Daniel Morgan.

and the introduction of contraband, counterfeit, and pirated goods during shipment.

At cargo handling facilities, tamper evident seals and locks can be utilized on cargo containers to prevent theft and the introduction of contraband or threat objects into air cargo shipments. Electronic seals may serve as an additional deterrent to terrorist and criminal activity by providing more immediate detection of tampering. Electronic seals have alarms, some triggered by fiber optic cable loops, that activate a transmitted signal when tampered with.[52] Electronic seals cost about $2,500 per unit, but are reusable. However, the utility of electronic seals in air cargo operations has been questioned by some experts because currently available electronic seals have a limited transmission range which may make detecting and identifying seals that have been tampered with difficult. In addition, there is some concern that they may interfere with aircraft electronic systems.[53]

In addition to tamper-evident and tamper-resistant seals, technologies to better track cargo shipments are being considered to maintain better control and tracking of cargo shipments along the supply chain. Both global positioning system (GPS) and radio-frequency identification (RFID) technologies are seen as emerging technologies for improving the tracking of air cargo in the supply chain.

Cargo Screening Technology. Various technologies are available for detecting explosives, incendiary devices, and the presence of various chemical and biological agents and nuclear weapons in cargo. Key technologies under consideration for screening air cargo for threat objects include x-ray screening, x-ray based explosive detection systems, chemical trace detection systems, and technologies based on neutron beams. In addition to these technological approaches, several experts and TSA officials have been advocating and pursuing an increased use of canine teams for screening cargo and mail. The main drawback to any of these screening techniques is that the screening process takes time and may significantly impact cargo delivery schedules. While the various technologies differ in their capabilities and performance, in general, more detailed screening analyses require more time and could affect cargo throughput. Another concern regarding these technologies is the cost associated with acquisition, operation, and maintenance of screening systems.

X-Ray Screening. The most common systems currently available for large-scale screening of cargo shipments utilize x-ray technology. These systems rely on well understood transmission and backscatter x-ray techniques to probe cargo containers. Many of these systems utilize low-dose x-ray sources that emit narrow x-ray beams thus virtually eliminating the need for shielding. These devices are compact and light weight, thus allowing them to be mounted on moving platforms that can scan over containers.[54] X-ray devices are becoming more common at major ports of entry, border crossings, and airports overseas as post-September 11th security

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[52] "Electronic cargo security seals" *Frontline Solutions, 3*(6), 42 (June, 2002).

[53] U.S. General Accounting Office. *Aviation Security*.

[54] David S. De Moulpied & David Waters. "Cargo Screening Techniques Become More Widely Accepted." *Port Technology International, 10*, pp. 127-129.

concerns are spurring increased development and deployment of these devices. The systems are being utilized to screen for drugs and other contraband as well as explosives in cargo shipments.

One of the most significant operational challenges in using x-ray screening devices is the performance of the human operator. A variety of human factors considerations contribute to the operator's ability to detect threat objects when viewing x-ray images. These include the monotony of the task, fatigue, time pressure, the adequacy of training, and working conditions. These human factors are important to consider in fielding x-ray screening systems to ensure high detection rates of threat objects while minimizing false alarm rates that would unnecessarily slow the cargo inspection and handling process. Technologies such as threat image projection (TIP), that superimpose stored images of threat objects on x-ray scans can help keep operators alert and may be effective tools for training and performance monitoring. Additional technologies, such as computer algorithms for highlighting potential threat objects, may also be considered to aid human observers.

Explosive Detection Systems. Currently, explosive detection systems (EDS) are being used extensively in the aviation security environment, particularly in response to the mandate in ATSA requiring screening of all checked passenger baggage by EDS. These systems use x-ray computed tomography (CT) to scan objects, and computational algorithms that assess the probability of threat object detection based on object density characteristics. Certified EDS systems must meet acceptable detection and false alarm rates for bulk explosives detection. While most specific performance criteria of certified EDS systems are classified, EDS systems used for passenger checked baggage must meet or exceed a throughput rate of 450 bags per hour.

In 1997, the Gore Commission specifically recommended that unaccompanied express packages carried on passenger aircraft should be subject to EDS examination,[55] however to date this recommendation has not been acted upon by regulatory agencies and has not been proposed in legislation. Undoubtedly, the TSA has gained considerable experience with the large scale deployment and use of EDS equipment to meet the mandate for full explosives detection screening of checked passenger bags. Many of the lessons learned by TSA from this experience will be useful for assessing the technical and operational challenges of applying large-scale EDS screening initiatives for air cargo operations. Efforts are also underway at TSA to improve the performance of EDS equipment and reduce its cost. However, air cargo operations are likely to present some of their own unique challenges for implementing large scale EDS screening of freight, express packages, and mail. Some of the potential operational challenges associated with effectively fielding EDS equipment for screening air cargo include:

- The limited size of objects that can be placed in EDS machines which would require objects to be screened before being placed in containers or on pallets;

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[55] White House Commission on Aviation Safety and Security. *Op cit.*

- The distributed nature of the air cargo system often involves loading containers at remote sites, and EDS screening at these remote sites may leave the system vulnerable to possible introduction of explosives or incendiary devices at points along the supply chain beyond the screening site;
- Reported high false alarm rates of current generation EDS systems may lead to high levels of secondary screening and detailed inspections that could impact the ability to meet the schedule demands of cargo operations; and
- The processing rate of current generation EDS equipment may require the purchase of large numbers of EDS machines, thus increasing program costs, to minimize the impact on cargo operations scheduling and meet desired security program goals (e.g., reaching a desired percentage of cargo that is screened by EDS).

Chemical Trace Detection Systems. Chemical trace detection systems, referred to commonly as explosive trace detection (ETD) devices are being widely used as secondary screening tools for passenger carry-on and checked baggage. Items identified for closer scrutiny by initial screening methods or selected at random may undergo further examination using these systems. These systems use a variety of technical principles to analyze the chemical composition of sample residue wiped from suspect articles. These systems compare the chemical composition of such a sample to the signature of known explosive materials and signal an alarm to the operator if the probability of a match exceeds a specified threshold.

The use of chemical trace detection systems is now common practice in the screening of checked and carry-on bags. It has been reported that TSA is considering expanding the use of chemical trace detection systems for screening cargo carried aboard passenger aircraft.[56] However, screening procedures using these systems is very labor intensive and time consuming. Like the manner in which this technology is used to perform secondary screening of checked and carry on bags, chemical trace detection may be employed in air cargo operations to perform detailed screening of suspicious packages identified through known shipper databases, or can be used for detailed secondary screening in conjunction with primary screening performed by x-ray and EDS systems similar to procedures currently in use for checked baggage screening. Random screening of cargo using chemical trace detection systems as a primary screening method is unlikely to be effective given the very low percentage of cargo that could be screened using this technique without significantly impacting cargo operations schedules.

Neutron Beam Technologies. Another potential class of technologies for screening air cargo is based on neutron beams. These systems use a pulsed neutron generator to probe an object, initiating several low energy nuclear reactions with the chemical elements comprising the object. Detectors can then measure the nuclear signature of the transmitted neutrons and/or the gamma-rays emitted from the reactions. Since neutrons and gamma-rays have the ability to penetrate through various materials to large depths in a non-intrusive manner, neutron technologies

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[56] Greg Schneider. *Op cit.*

may have advantages for cargo screening, and some of these technologies are currently being operationally evaluated for use in contraband and explosives detection.[57] However, the GAO noted that currently available neutron-based technologies cost about $10 million per machine and require about one hour per container for screening thus making this option very expensive and time consuming.[58]

In addition to the cost and time factors associated with neutron beam technologies, the National Research Council (NRC) has raised considerable doubts about performance capabilities for screening the full spectrum of cargo containers or pallets for explosives.[59] The NRC also expressed potential safety concerns over the use of radiation-producing particle accelerators, and expressed concerns over the practicality of using this technology in the aviation environment because of the size and weight of the equipment.

In 1999, the NRC advised the FAA against further funding for research, development, and deployment of a neutron-based explosive detection system known as pulsed fast/thermal neutron spectroscopy (PFTNS) for primary screening of carry-on baggage, checked baggage, or cargo citing low current explosive threat levels and inadequate performance. In 2002, the NRC concluded that another neutron-based technique, pulsed fast neutron analysis (PFNA), is not ready for airport deployment or testing. However, the NRC conceded that PFNA has greater potential for screening containerized cargo that any other technology currently under consideration.[60]

Because the perceived threat of explosives has increased since September 11, 2001, neutron-based detection technology continues to be mentioned as a possible means for screening air cargo. However, wide-scale deployment of this technology for air cargo security in the near term seems unlikely.

Hardened Cargo Containers. In addition to cargo screening technology, hardened cargo container technology is being considered as a means to mitigate the threat of an explosion or fire caused by a bomb or incendiary device that makes its way onto an aircraft undetected. The 9/11 Commission formally recommended the deployment of at least one hardened cargo container on every passenger aircraft that also hauls cargo to carry suspicious cargo.[61] The National Intelligence Reform Act

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[57] G. Vourvopoulos & P. C. Womble. "Pulsed Fast/Thermal Neutron Analysis: A Technique for Explosives Detection." *TALANTA (54)*, pp. 459-468, 2001.

[58] U.S. General Accounting Office. *Aviation Security.*

[59] National Research Council. *The Practicality of Pulsed Fast Neutron Transmission Spectroscopy for Aviation Security.* NMAB-482-6. Washington, DC: National Academy Press, 1999.

[60] National Research Council. *Assessment of the Practicality of Pulsed Fast Neutron Analysis for Aviation Security.* Washington, DC: National Academy Press, 2002.

[61] Currently the TSA's resource for vetting whether cargo is suspicious is the known shipper program, and under ATSA all suspicious cargo from unknown sources must be prohibited (continued...)

of 2004 (P.L. 108-248) requires the TSA to establish a pilot program to explore the feasibility of this concept and authorizes the use of incentives to airlines to offset added fuel, maintenance, and other operational costs associated with using hardened cargo containers in an effort to encourage voluntary participation in the pilot program. The act authorizes $2 million to conduct the pilot program, however no funding has been appropriated for this purpose so far.

In fact, the concept of deploying hardened cargo containers has been a topic of ongoing research for some time. Following the December 21, 1988 bombing of Pan Am flight 103 over Lockerbie, Scotland, the British Air Accident Investigation Branch recommended that regulatory authorities and airplane manufacturers study methods to mitigate the effects of in-flight explosions.[62] The FAA has had a active research program in blast resistant containers for more than 10 years examining the airworthiness, ground handling, and blast resistance of hardened containers which is now overseen by the TSA's Transportation Security Laboratory. These containers, or hardened unit-loading devices (HULDs), are seen as a potential means for mitigating the threat of explosives placed aboard passenger aircraft in either checked baggage or cargo. These containers must withhold an explosive blast of a specified magnitude without any rupturing or fragment penetration of the container wall or the aircraft structure, and must contain and "self-extinguish" any post-blast fire in order to meet the FAA-established test criteria.[63]

However, the increased weight of these containers could have significant operational impacts on airlines by increasing fuel costs and decreasing payload capacity for carrying revenue passengers and cargo. Challenges associated with deploying hardened cargo containers include:

- Increased weight affecting aircraft range and payload capacity;
- Increased procurement cost for hardened containers;
- Potentially higher maintenance costs for hardened container materials;
- Potential reduction in cargo volume (in addition to reduced payload weight) due to thicker container walls; and
- Possible design specifications, such as door hinging and positioning, that are not compatible with current airline baggage and cargo loading procedures and operations facilities.[64]

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[61] (...continued)
from passenger aircraft. The TSA envisions using additional risk-based screening tools in the future to determine whether a shipment is suspicious. Under current law, such a tool would likely be needed to implement the hardened cargo container concept offered by the 9/11 Commission.

[62] United Kingdom Air Accidents Investigation Branch. *Op cit.*

[63] National Research Council. *Assessment of Technologies Deployed to Improve Aviation Security: First Report*. Publication NMAB-482-5. Washington, DC: National Academy Press, 1999.

[64] Ibid.

The National Research Council (NRC) estimated that the per unit cost for acquiring hardened cargo containers would be $10,000, and recommended that the FAA continue efforts to operationally test HULDs and establish more rigorous protocol for certifying HULDs, but should not deploy them unless deemed to be a necessary security measure based on the assessments of cost, operational, and deployment studies by FAA and other stakeholders.

The NRC panel also recommended further economic assessment of their proposed deployment plan for fielding one HULD per wide-body aircraft. The NRC panel also noted that research and development on the use of HULDs on narrow-body aircraft was lagging far behind the work done on wide-body aircraft, and recommended an increased emphasis on research in this area to assess the operational effectiveness of HULDs in narrow-body aircraft before any further recommendations could be made. The NRC panel estimated that the cost of deploying enough HULDS for airlines to carry at least one HULD per passenger flight would require an industry-wide procurement cost of $125 million, and would create an annual industry-wide economic impact of $11 million in increased fuel burn and reduced payload revenue.[65]

The recommendation made by the 9/11 Commission calls for the deployment of at least one hardened cargo container on every passenger aircraft for carrying any suspect cargo.[66] This recommendation implies that a cargo pre-screening or risk evaluation process such as a known shipper program would be used to determine what cargo should be loaded into the hardened container. Presently, ATSA requires shipments from unknown sources to travel on all-cargo aircraft. The known-shipper program is the currently implemented risk-based tool for determining what cargo must be kept off passenger flights. One strategic objective of the TSA's Air Cargo Strategic Plan is to develop a means for identifying elevated risk cargo through pre-screening.[67] Such a tool would likely be needed to assess risk and determine what cargo should be placed in a hardened container. Besides the need for a pre-screening process, the use of hardened cargo containers is likely to be opposed by the airline industry because of the direct costs of acquiring these units as well as the increased operational cost associated with increased fuel burn and lost payload capacity. The benefits of using hardened cargo containers would likely be highly dependent on the security of the pre-screening process and its ability to detect high risk cargo since the benefits of a hardened container would largely be negated if the pre-screening process could be circumvented by terrorists. A key policy issue that is likely to emerge as the feasibility of hardened cargo containers is further evaluated is the potential implications of allowing suspicious cargo to travel on passenger aircraft even if this cargo is secured in hardened cargo containers. In other words, policymakers may debate what the risks and benefits of loading suspicious cargo on passenger airplanes

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[65] Ibid.

[66] National Commission on Terrorist Attacks Upon the United States. *The 9/11 Commission Report.*

[67] U.S. Department of Homeland Security, Transportation Security Administration. *Air Cargo Strategic Plan.*

in hardened cargo containers is as compared to the alternative of offloading this suspicious cargo to all-cargo aircraft.

In any case, under a plan in which only one hardened cargo container is deployed per aircraft, it is likely that only a relatively small fraction of available cargo space will be reinforced. For example, a Boeing 747-400 passenger jet is capable of holding up to 13 full-width, or 26 half-width containers.[68] Thus, providing just one full sized hardened cargo container for a 747-400 would provide reinforcement for less than 10% of the available cargo storage area. While a greater percentage of available cargo space on smaller jets could be protected by hardened containers, any policy regarding the use of just one hardened container per aircraft will likely need to carefully evaluate the criteria and methods for vetting cargo to determine what cargo should be designated for carriage inside these hardened cargo containers.

Biometric Screening Technology. Provisions of ATSA give the TSA authority to use biometric technology to verify the identity of employees entering the secured areas of airports and directed the TSA to review the effectiveness of biometrics systems currently used by airports such as San Francisco International Airport. Additionally, the Maritime Transportation Security Act of 2002 (P.L. 107-295) requires the issuance of biometric transportation security cards for identity authentication of individuals with background checks for entry to any secured area of a vessel or facility. The TSA's approach to meet these various mandates is through the establishment of a universal Transportation Worker Identification Credential (TWIC) to be used across all transportation modes for any personnel requiring unescorted access to secure areas of the national transportation system.[69] The proposed TWIC Program is currently under evaluation at two regional pilot sites: the Philadelphia/Delaware River and Los Angeles/Long Beach ports. Available biometric technologies such as fingerprint, retinal scan, and facial pattern recognition are being evaluated in the current operational evaluation phase of the TWIC program. It is likely that system-wide deployment of a common transportation worker credentialing system will evolve from this program and could be applied to improve access control to air cargo operations areas and cargo handling facilities.

The National Intelligence Reform Act of 2004 (P.L. 108-458) contains extensive provisions requiring the TSA to develop specific guidance for the use of biometric or other technologies for airport access control systems by March 31, 2005. The guidance is to include comprehensive technical and operating system requirements and performance standards for the use of biometric identifier technology in airport access control systems; a list of products and vendors meeting these specifications; and specific procedures for implementing biometric identifier systems; and a discussion of best practices for incorporating biometric identifier technologies into airport access control systems. The act also provides authorization for $20 million for the research and development of advanced biometric technology applications for

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[68] Boeing Commercial Airplanes. *747-400 Airplane Characteristics for Airport Handling.* D6-58326-1, December 2002.

[69] Transportation Security Administration. *Credentialing: TSA TWIC Program.* See [http://www.tsa.gov/public/].

aviation security. Given the proposed regulatory changes to enhance access controls to all-cargo facilities and improve existing access controls around passenger aircraft, it is likely that the implementation of biometric identifier technology will play an increasingly important role in air cargo security policy.

Funding for Air Cargo Security

The cost of air cargo security options are significant to both the Federal government and the air cargo industry. Furthermore, the indirect costs of air cargo security on air cargo operations may pose significant long-term challenges. On the other hand, the potential costs of a terrorist attack, both in terms of the loss of life and property and the long term economic impacts may also be significant but are difficult to predict and quantify. An ongoing debate tied to air cargo appropriations and oversight of aviation security is the amount of physical screening and inspection of air cargo that is needed and achievable and whether risk-based pre-screening tools can provide an adequate means to ensure the security of air cargo by identifying at-risk cargo for targeted physical inspections. Besides the logistic complexities of inspecting large amounts or 100% of cargo on passenger flights, many are concerned that the cost of doing so outweighs the potential benefit, especially given the capabilities of current screening systems.

While expenditures on air cargo security measures have been growing over the past two years, these efforts are a relatively small element (about 2%) of TSA's overall operating budget for aviation security. While these expenditures are presently a small component of the overall cost for aviation security, they could continue to grow if additional technology and resources are devoted to the tracking and screening of cargo shipments. In contrast to passenger and baggage screening which are, with few exceptions, the operational responsibility of the TSA, under the current scheme, much of the cost of inspection and screening of cargo is borne by the airlines and shippers, while TSA only maintains oversight responsibility. If 100% inspections of air cargo were made mandatory as some have proposed, TSA estimates that this could result in a cost of more than $650 million in the first year of implementation.[70] To address concerns over funding such an initiative, some past legislative proposals calling for the TSA to physically screen all cargo shipments bound for passenger aircraft incorporated a fee schedule for shippers to cover costs associated with screening cargo transported in passenger aircraft that is similar to the security service fee imposed on airline passengers (see H.R. 2455 and H.R. 3798 introduced in the 108th Congress). Imposing a fee on air cargo shipments for security could provide offsetting collections for security costs. Regardless of how such a fee is collected — either through fees assessed to air carriers or freight forwarders or through direct fees applied to each shipment — the costs will ultimately be borne by shippers and ultimately passed on to the customers of their products. The overall impact of fees on air cargo is dependent on the relative cost of the fee. Since air cargo shipments tend to consist of relatively high value goods, it is likely that the relative cost of a security fee in relation to the value of the shipment will be low which would minimize the economic impact of imposing such a fee. However, if fees applied to

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[70] Department of Homeland Security, Transportation Security Administration. "Air Cargo Security Requirements; Proposed Rule."

air cargo carried on passenger aircraft are higher than fees for transporting that same cargo on all-cargo aircraft, a significant impact on passenger air carrier revenues from cargo may result. Equity in fee collections will likely be an important consideration in assessing if and how air cargo security fees should be collected.

Another possible concern over the increased cost of cargo security and proposals to impose fees on shippers is the potential to increase shipment costs related to manufacturing, particularly the distribution of time-critical parts. If unit shipping costs rise enough because of security-related costs and fees, it is possible that domestic manufacturing and assembly costs will not be able to remain competitive in a global market. For example, if the costs of shipping time-critical parts from Asia for final assembly in the United States rise because of security-related fees, it may become cost advantageous to manufacture the entire product overseas. In the long term, this could result in a possible loss of manufacturing jobs in the United States. For this reason, the economic implications of any proposal to impose security-related fees on air cargo will likely need to be carefully evaluated to avoid or minimize any unintended impacts on manufacturers and their suppliers.

While Congress continues to debate the needed level of physical screening and inspection of cargo, current appropriations figures are predicated on continuing and expanding the risk-based approach of pre-screening cargo and conducting targeted inspections of elevated-risk cargo and increasing random inspections of other shipments. In FY2003, the TSA received $20 million for cargo screening improvements. For FY2004, the TSA was appropriated $30 million for air cargo security operations. Additionally, research and development related to air cargo security was appropriated $55 million. For FY2005, the Administration recommended flat funding for air cargo, while the House and the Senate agreed to increases to both the air cargo operations and air cargo research and development accounts totaling $115 million. In FY2006, there was a shift in funding with, for the first time, a larger proportion being allocated to air cargo operations ($55 million) as compared to research and development ($30 million) (see **Table 1**). Also, as previously noted, the FY2006 air cargo research and development funding has been more specifically directed to focus on three pilot projects. This may reflect a maturation in the approach to air cargo screening and inspections in the near term with technologies and approaches being migrated from purely a research activity to an operational concept.

Table 1. Appropriations for Air Cargo Security ($ in millions)

Air cargo security	FY2004	FY2005	FY2006
Operations:	30.0	40.0	55.0
Research and Development:	55.0	75.0	30.0
Total:	**85.0**	**115.0**	**85.0**

Potential Congressional Approaches

Under ATSA, a mandate for screening or otherwise ensuring the security of all cargo placed on passenger aircraft already exists. ATSA also mandated that a system to screen, inspect, or otherwise insure the security of cargo carried aboard all-cargo aircraft is put in place as soon as possible. The law gives the TSA broad authority to carry out these requirements. Therefore, many of the proposed cargo security initiatives could be accomplished under existing law as reflected in the TSA's air cargo strategic plan and the comprehensive proposed rulemaking to enhance air cargo security for both passenger and all-cargo operations. While ATSA gives the administration flexibility in meeting the mandate to screen and inspect air cargo, it is likely that TSA will continue to rely heavily on "known shipper" programs for air cargo security for two key reasons. First, many of the proposed options for increasing air cargo security, such as full cargo screening, are costly. Second, the potential impacts on the air cargo industry are not fully understood but could be significant. Therefore, any significant changes in air cargo security practices will likely be dependent on Congressional action.

An appropriate course of action for air cargo security was debated extensively during the 108th Congress and continues to be a significant issue for debate and oversight in the 109th Congress. Initial proposals for immediate 100% screening of all cargo shipments placed on passenger aircraft were seen by many as too complex to implement given available technology and logistic challenges, but gave rise to compromise language in the FY2005 Homeland Security Appropriations Act (P.L. 108-334) calling for a tripling of physical inspections of cargo placed on passenger aircraft and additional direction in the FY2006 Homeland Security Appropriations Act (P.L. 109-90) requiring the TSA to increase air cargo screening and inspections beyond this enhanced level. Similarly, a recommendation by the 9/11 Commission calling for the TSA to intensify its efforts to identify, track, and screen potentially dangerous cargo and deploy hardened cargo containers led to the inclusion of numerous provisions to enhance air cargo security technology in the National Intelligence Reform Act of 2004 (P.L. 108-458). Oversight of the implementation of these provisions as well as the proposed regulatory enhancements for air cargo security are likely to remain issues of considerable interest during the 109th Congress.

While these recent legislative actions are likely to shift the focus on air cargo security from legislation to oversight in the near term, a variety of options for implementing air cargo security measures continue to exist and may be revisted during the 109th Congress. Some possible approaches and the potential benefits and risks associated with implementing these approaches are provided in **Table 2**. In general, for any of the listed approaches, there is a tradeoff between program costs and potential impacts on the air cargo industry on the one hand and the level of security that can be achieved by implementing the option on the other hand. Currently, there are two main positions or views on air cargo security. One position argues that full screening of air cargo and extensive security measures would be too costly and too disruptive to the air cargo industry to successfully implement. The alternative position argues that full screening and enhanced security measures are needed to adequately mitigate the risks associated with air cargo to the maximum extent possible and maintain public confidence in air travel. The current focus, as reflected in recently enacted legislation, is to focus on intensifying air cargo security

using available techniques, while investing in the research and development of technology that can enhance the capability to identify, screen, and track cargo shipments on passenger aircraft as recommended by the 9/11 Commission.

Table 2. Potential Benefits and Possible Risks of Various Congressional Approaches

Option	Potential benefits	Possible risks
Allow the TSA to implement planned air cargo security enhancements including expanding the known shipper program	• Relatively low cost • Consistent with administration approach • Provides administration flexibility to meet changing threat levels with a relatively small budget	• Provides limited security that could be circumvented • Possible over-reliance on known shipper programs • Limited screening of cargo may not adequately mitigate the risk of explosives • Limited funds to initiate targeted security in response to threats
Increase funding and grants for physical security of air cargo facilities	• Could deter a variety of risks to cargo including cargo crime, hijacking, and sabotage	• May be difficult and costly to provide increased physical security • May not mitigate the risk of explosives introduced in pre-packaged cargo
Mandate the use of tamper resistant and tamper evident packaging and containers	• Could deter terrorists from attempting to place explosives in air cargo • Could mitigate cargo crime such as theft and contraband	• Low cost solutions may be circumvented relatively easily • More sophisticated solutions, such as fiber optic loops, may be relatively costly
Mandate physical screening of all persons with access to air cargo facilities and aircraft	• Ensure that workers with access to aircraft meet the same level of security as passengers • Mitigate risk of weapons and explosives introduced by cargo workers	• Relatively high cost • Would require additional screeners and screening stations at air cargo facilities
Mandate increased screening and inspection of air cargo shipments	• Deter terrorists from attempting to place explosives in air cargo • Addresses the 9/11 Commission recommendation to intensify efforts to identify, track, and screen air cargo	• Without full screening, explosives may not be detected • May impact air cargo operations and schedules

Option	Potential benefits	Possible risks
Mandate full screening of air cargo on passenger flights	• Ensure that cargo placed on passenger aircraft meets the same level of security as passengers and their property	• High cost • May significantly impact air cargo schedules • May significantly impact air carrier revenues from air cargo if shipments are diverted to all-cargo flights in response to requirement
Increase funding for air cargo security research and development	• May lead to new technologies and procedures for improving air cargo security.	• Numerous technical challenges and uncertainty regarding the performance of screening technologies continue to exist • Currently funded programs such as neutron beam technologies and hardened cargo containers have operational limitations
Deploy hardened cargo containers on passenger aircraft as recommended by the 9/11 Commission	• May mitigate the effect of an in-flight explosion • New, congressionally mandated pilot program can help evaluate the feasibility of the concept with a relatively small investment	• Effectiveness is largely negated if the cargo pre-screening process can be circumvented by terrorists • Operational costs may prevent passenger airlines from being cost competitive with all-cargo carriers