GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-276675

April 24, 1997

The Honorable Wendell H. Ford
Ranking Minority Member
Subcommittee on Aviation
Committee on Commerce, Science,
and Transportation
United States Senate

Subject: Aviation Security: Commercially Available Advanced Explosives Detection Devices

Dear Senator Ford:

As a result of the recommendations contained in the initial report by the White House Commission on Aviation Safety and Security, also known as the Gore Commission, and subsequent appropriations by the Congress,[1] the Federal Aviation Administration (FAA) is in the process of purchasing and installing a variety of advanced explosives detection devices at selected airports in the United States.[2] By February 1998, FAA plans to have purchased and installed over $100 million worth of devices at some of the nation's busiest airports.

In August and September 1996, we testified on aviation security issues before the Senate Commerce, Science, and Transportation Committee and provided

[1]Initial Report to President Clinton, White House Commission on Aviation Safety and Security (Sept. 9, 1996). Omnibus Consolidated Appropriations Act, 1997, P.L. 104-208, Sept. 30, 1996.

[2]For purposes of this report, we defined an advanced explosives detection device as one that, in most cases, has an automatic alarm that signals the operator if potential explosives are detected. If the device does not have an automatic alarm, then it has some other advanced capabilities to provide more information to the operator, such as highlighting or color coding a potential explosive.

158620

the Committee with information about devices that were currently available or under development for detecting explosives and the devices' operational capabilities.[3] As requested, we are providing you with updated information on the advanced explosives detection devices that are commercially available and can be used to screen checked baggage, carry-on items, passengers, and cargo and mail. Enclosures I through IV of this report provide information on these devices and their underlying technologies, manufacturers, costs, capabilities, and other related information.

You also asked that we review the financial, airport-related, and operational issues associated with deploying detection technology at U.S. airports. Many security initiatives have been undertaken since the July 1996 crash of TWA Flight 800. In its final report of February 1997, the Gore Commission said that it expected that the National Civil Aviation Review Commission would consider a variety of options to pay for security measures; a report on funding is expected to be made in the fall of 1997. In addition, FAA has directed that the contractors installing the explosive detection devices gather data on the effect that deploying these devices has on airport-related and operational issues. As discussed with your office, we agreed to reassess the need for us to do further work on the financial and operational issues associated with deploying detection technology at U.S. airports on the basis of the final outcome of these two initiatives.

In summary, a number of advanced explosives detection devices are commercially available that can increase the probability of detecting concealed explosives. However, all of them have performance limitations.[4] For example, some devices can detect only certain explosives, while others have slow baggage processing rates; others rely almost entirely on the skills of the operators rather than on automatic alarms. Despite their various performance limitations, these devices can improve security while providing operational

---

[3]Aviation Security: Immediate Action Needed to Improve Security (GAO/T-RCED/NSIAD-96-237, Aug. 1, 1996) and Aviation Security: Oversight of Initiatives Will Be Needed (C-GAO/T-RCED/NSIAD-96-20, Sept. 17, 1996). The September testimony, which is classified, was presented before the Committee in a closed-door hearing.

[4]We previously reported on the limitations in performance of explosives detection devices and their operators in our testimony entitled Aviation Security: Technology's Role in Addressing Vulnerabilities (GAO/T-RCED/NSIAD-96-262, Sept. 19, 1996).

performance information that can be useful in improving the current or next generation of devices.

The predominant technologies available for detecting the presence of explosive materials are various types of X-rays, chemical trace detection, and electromagnetic analyses. These technologies are incorporated into a variety of devices used to examine checked baggage; carry-on items and electronic equipment, such as personal computers; passengers; and cargo and mail.

Generally, X-ray devices operate by passing X-rays through screened items and projecting an image of the contents being examined on a monitor. Potentially explosive materials are identified by their density, average atomic number, and appearance. The detection capabilities of these devices vary in terms of how the X-ray systems function--for example, by providing cross-sectional images or by using "reflected" energies known as backscatter. The devices also vary in terms of whether the presence of potential explosives is signaled by an automatic alarm or is manually identified by an operator. FAA has certified one X-ray device for screening checked bags, the CTX 5000 SP, as meeting its performance standard.[5]

Chemical trace devices rely on the identification of the presence of explosive vapors and residues that are associated with explosive materials. These devices are also known as "sniffers" or "trace detectors." Samples are obtained through techniques such as using a wipe or a vacuum, examining a document or some other item that has been handled by the passenger, or sampling air gathered at walk-through portals. For each technique, the sample is analyzed by a device to detect explosives. Most of these devices include an automatic alarm when explosive materials are found.

Electromagnetic devices generally use radio frequency pulses that probe baggage or other items to elicit unique responses that would be associated with explosive materials. These devices generally include an automatic alarm if the presence of explosives is detected.

---

[5]The details of FAA's certification standard are classified. Generally, the standard sets minimum performance criteria for (1) the explosive substances to be detected, (2) the probability of detection, by explosive, (3) the quantity of explosive, and (4) the number of bags processed per hour. In addition, the standard specifies the maximum allowable false alarm rate, by type of explosive material.

AGENCY COMMENTS

We provided copies of a draft of this report to the Department of Transportation and FAA for review and comment. FAA agreed with the facts presented in this report and provided some suggested technical and clarifying language. We have incorporated these changes as appropriate. The Department did not provide any comments.

SCOPE AND METHODOLOGY

The information contained in this report is based on our previous work involving security technology and has been updated to include devices that have become commercially available since our testimonies in August and September of 1996.[6] A wide range of other devices, currently in various stages of development for screening applications, were discussed in a previously issued report.[7] Our work was conducted during February and March 1997 in accordance with generally accepted government auditing standards.

As requested, unless you publicly announce its contents earlier, we plan no further distribution of this report for 7 days. At that time we will send copies to appropriate congressional committees and make copies available to others on request. If you or your staff should have any questions about explosives detection technology, please call me at (202) 512-3650. Major contributors to this report were Michael Bollinger, Thomas Noone, and Marnie Shaul.

Sincerely yours,

Gerald L. Dillingham
Associate Director, Transportation Issues

Enclosures - 5

---

[6]A list of Related GAO Products appears in enclosure V at the end of this report.

[7]See Terrorism and Drug Trafficking: Technologies for Detecting Explosives and Narcotics (GAO/NSIAD/RCED-96-252, Sept. 4, 1996) for further details of the various types of equipment under development.

ENCLOSURE I

COMMERCIALLY AVAILABLE
ADVANCED EXPLOSIVES DETECTION DEVICES

Application: Checked Baggage

Technology	Manufacturer	Available devices	Unit price[a]	Device's characteristics, capabilities, and other related information
X-Ray				
Computerized axial tomography (CAT scan)	InVision Technologies, Inc. Foster City, CA	CTX-5000 SP	$850,000 to $1 million	This is the only device certified by FAA. The system is based on computer technology from the medical field that obtains a number of cross-sectional images of a bag that are displayed on a monitor. The device automatically alarms when potential explosives are detected. However, it is relatively slow in processing bags. As result, a certified system requires two devices to meet FAA's standard for processing a specific number of bags per hour. Using a portion of the $144.2 million appropriated in September 1996 for explosives detection devices, FAA recently purchased 54 of these units, which will be deployed at selected U.S. airports.

ENCLOSURE I

Technology	Manufacturer	Available devices	Unit price[a]	Device's characteristics, capabilities, and other related information
Advanced X-ray	Vivid Technologies, Inc. Waltham, MA	H-1 VIS VIS-M VDS	$250,000 to $375,000	Two different X-ray energies are used to determine the densities and average atomic numbers of the target material. These devices automatically alarm when potential explosives are detected. As part of the $144.2 million appropriated in September 1996, FAA plans to purchase 20 units from among these manufacturers, which will be deployed at selected U.S. airports to test their on-line performance capabilities.
	EG&G Astrophysics, Inc. Long Beach, CA	Z-Scan-7 Z-Scan-12	$350,000	
	Heimann Systems Wiesbaden, Germany	Hi-Scan 10050EDS	$300,000	
X-ray backscatter	AS&E, Inc. Billerica, MA	Z-Backscatter 101Z 101ZZ	$75,000 to $100,000	Backscatter detects reflected X-rays, which provides an image on a monitor that highlights organic materials, such as explosives. These devices do not automatically alarm and therefore require operators to interpret the images for every screened object.
Electromagnetic				
Quadrupole resonance	Quantum Magnetics San Diego, CA	Q-Scan 1000	$340,000	It uses radio frequency pulses that probe bags to elicit unique responses from explosives. It is a nonimaging technology that provides chemically specific detection and automatically alarms when explosives are detected. Using a portion of the September 1996 appropriated funds, FAA plans to purchase 5 of these devices, which will be tested at selected U.S. airports.

ENCLOSURE I

[a]Prices indicated are a range of costs or an approximate cost to purchase a unit. The price range on some units may vary widely because of options that may be added to a device. For example, some devices can be outfitted to detect both explosives and drugs.

ENCLOSURE II

COMMERCIALLY AVAILABLE
ADVANCED EXPLOSIVES DETECTION DEVICES

Application: Carry-on Items/Electronics

Technology	Manufacturer	Available devices	Unit price [a]	Device's characteristics, capabilities, and other related information
Trace				
Ion Mobility Spectroscopy (IMS)[b]	Barringer Instruments, Inc. New Providence, NJ	Ionscan 400	$45,000 to $50,000	IMS devices operate by measuring the mobility of various molecules through a gas in an electrical field. Trace samples are gathered using a wipe or a vacuum and then analyzed by the device, which takes approximately 5 seconds for analysis. These devices provide chemical-specific detection and automatically alarm when explosives are detected. The devices are portable with low false alarm rates.
	Ion Track Instruments, Inc. Wilmington, MA	Itemiser	$55,000	
	Graseby Security Herts, UK	Plastec	$45,000	
	CPAD Technologies, Inc. Ottawa, Ontario, Canada	Sirius Orion	$70,000 $90,000	
Combination Technologies[b]	Thermedics Detection, Inc. Chelmsford, MA	Egis Rampart	$30,000 to $170,000	These devices utilize a chemical separation and identification technique used in advanced forensic laboratories (known as chromatography and chemiluminescence). The devices are highly sensitive and have chemical-specific capabilities. They automatically alarm when explosives are detected. The devices are portable with a low false alarm rate.

ENCLOSURE II

Technology	Manufacturer	Available devices	Unit price [a]	Device's characteristics, capabilities, and other related information
Electromagnetic				
Quadrupole Resonance	Quantum Magnetics San Diego, CA	Package Scanner QED-600	$65,000	These devices work on radio frequency pulses that probe bags to elicit unique responses from explosives. The devices provide chemically specific detection and automatically alarm when they detect explosives.

[a]Prices indicated are a range of costs or an approximate cost to purchase a unit. The price range on some units may vary widely because of options that may be added to a device. For example, some devices can be outfitted to detect both explosives and drugs.

[b]Using a portion of the $144.2 million appropriated in September 1996, FAA recently purchased a mix of 30 devices that use IMS or combination technologies. FAA plans to purchase another 459 devices among these two types of technologies from the various manufacturers.

ENCLOSURE III

COMMERCIALLY AVAILABLE
ADVANCED EXPLOSIVES DETECTION DEVICES

Application: Passenger Screening

Technology	Manufacturer	Available devices	Unit price[a]	Device's characteristics, capabilities, and other related information
X-Ray				
X-ray backscatter	AS&E Billerica, MA	BodySearch	$150,000	This device uses a low level X-ray producing a backscatter image capable of detecting organic and non-organic materials. The device is nonintrusive, which allows the passenger to remain fully clothed while being scanned. The device has been approved by the Food and Drug Administration and the Department of Health and Human Services in connection with safety issues and X-ray levels. It is currently in use at several foreign locations, but none has been deployed in the U.S. The device does not automatically alarm but relies on an operator's interpretation of image.

ENCLOSURE III

Technology	Manufacturer	Available devices	Unit price[a]	Device's characteristics, capabilities, and other related information
Trace				
Ion Mobility Spectroscopy (IMS)	Barringer Instruments, Inc. New Providence, NJ	Token System Document Scanner	$55,000 to $59,000	Using a document or token handled by a passenger, the device can analyze the item for the presence of residual explosives left by a person's hand. Both devices can automatically detect the presence of explosives.
	CPAD Technologies, Inc. Ottawa, Ontario, Canada	NOVA	$250,00 to $350,000	NOVA is a walk-through portal device that samples air using gas chromatography and IMS. While passing through the portal, the device captures an image of the person being screened. This device has been deployed overseas but not domestically. It automatically alarms when explosives are detected.

[a]Prices indicated are a range of costs or an approximate cost to purchase a unit. The price range on some units may vary widely because of options that may be added to a device. For example, some devices can be outfitted to detect both explosives and drugs.

COMMERCIALLY AVAILABLE
ADVANCED EXPLOSIVES DETECTION DEVICES

Application: Cargo and Mail

Technology	Manufacturer	Available devices	Unit price[a]	Device's characteristics, capabilities, and other related information
X-Ray				
High energy fixed-site system with backscatter	AS&E Billerica, MA	Pallet Search	$900,000 to $950,000	This device relies on an operator's interpretation of X-ray images and does not have an automatic alarm but can be equipped with an auto alarm as an option. The device can be used to screen bulk mail and containerized cargo. This device has not been deployed at any U.S. airports to date.
Trace				
Ion Mobility Spectroscopy (IMS)	CPAD Technologies, Inc. Ottawa, Ontario, Canada	Mail Scanner	$75,000	This device automatically alarms when explosives are detected. It operates under the same principal as the manufacturer's Orion trace detection device, which is used for screening carry-on items. It can be used to scan mail bags in bulk or individual mail pieces.

[a]Prices indicated are a range of costs or an approximate cost to purchase a unit. The price range on some units may vary widely because of options that may be added to a device. For example, some devices can be outfitted to detect both explosives and drugs.

RELATED GAO PRODUCTS

Aviation Security: Technology's Role in Addressing Vulnerabilities (GAO/T-RCED/NSIAD-96-262, Sept. 19, 1996).

Aviation Security: Urgent Issues Need to Be Addressed (GAO/T-RCED/NSIAD-96-251, Sept. 11, 1996).

Terrorism and Drug Trafficking: Technologies for Detecting Explosives and Narcotics (GAO/NSIAD/RCED-96-252, Sept. 4, 1996).

Aviation Security: Immediate Action Needed to Improve Security (GAO/T-RCED/NSIAD-96-237 Aug. 1, 1996).

Terrorism and Drug Trafficking: Threats and Roles of Explosives and Narcotics Detection Technology (GAO/NSIAD/RCED-96-76BR, Mar. 27, 1996).

Aviation Security: Development of New Security Technology Has Not Met Expectations (GAO/RCED-94-142, May 19, 1994).

(341520)

Ordering Information

The first copy of each GAO report and testimony is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. VISA and MasterCard credit cards are accepted, also. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

Orders by mail:

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20884-6015

or visit:

Room 1100
700 4th St. NW (corner of 4th and G Sts. NW)
U.S. General Accounting Office
Washington, DC

Orders may also be placed by calling (202) 512-6000
or by using fax number (301) 258-4066, or TDD (301) 413-0006.

Each day, GAO issues a list of newly available reports and testimony. To receive facsimile copies of the daily list or any list from the past 30 days, please call (202) 512-6000 using a touchtone phone. A recorded menu will provide information on how to obtain these lists.

For information on how to access GAO reports on the INTERNET, send an e-mail message with "info" in the body to:

info@www.gao.gov

or visit GAO's World Wide Web Home Page at:

http://www.gao.gov

United States
General Accounting Office
Washington, D.C. 20548-0001

Bulk Rate
Postage & Fees Paid
GAO
Permit No. G100

Official Business
Penalty for Private Use $300

Address Correction Requested