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The Honorable Tim Valentine
Chairman
The Honorable Tom Lewis
Ranking Minority Member
Subcommittee on Technology,
   Environment, and Aviation
Committee on Science, Space,
   and Technology
House of Representatives

In the aftermath of Pan Am 103, the Congress passed the
Aviation Security Improvement Act of 1990. The act set a
goal for the Federal Aviation Administration (FAA) to have
new explosive detection equipment in place by November
1993. The Congress took this action to ensure that FAA's
involvement would expedite the development of this
technology. FAA's responsibilities include developing
performance standards, assisting the private sector in
developing systems, and approving (certifying) systems for
airlines' use. To implement the act, FAA is supporting the
development of new explosive detection devices and methods
to improve the survivability of aircraft, such as blast
resistant luggage containers. This correspondence is based
on two issued reports--one analyzes FAA's compliance with
key provisions of the act and the other examines the
agency's efforts to develop new security technology.[1]

In summary, our work shows that despite FAA's efforts, the
agency did not meet the Congress' goal to deploy new
security technology at airports by November 1993 and may
still be several years away from achieving this goal.
Specifically,

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[1]Aviation Security: Additional Actions Needed to Meet
Domestic and International Challenges (GAO/RCED-94-38, Jan.
27, 1994) and Aviation Security: Development of New
Security Technology Has Not Met Expectations (GAO/RCED-94-
142, May 19, 1994).

GAO/RCED-94-307R, Aviation Security

-- Although several explosive detection devices show promise, technical problems have slowed their development. Barring a major technological breakthrough, it will take considerable time--perhaps several years--before airlines begin to use new technology at high-threat domestic and international airports. Similarly, although research on improving aircraft survivability through blast resistant luggage containers and hardened structures is promising, it is uncertain when these technologies will be in widespread use.

-- FAA can take steps to improve its process for certifying new explosive detection devices for industry use. For example, FAA's current process does not ensure the performance and reliability of new systems.[2] In addition, FAA does not plan to test devices at airports as part of the certification process. Instead, FAA plans to rely on tests by its own laboratory to determine the performance of the new devices. In our May 1994 report, we recommended that FAA test new devices at airports during the certification process. Although FAA now recognizes the importance of such testing, it disagrees that such testing should be part of certification since it will add time and cost to the process. In our view, testing at airports may be the key to gaining the confidence of the industry.

-- FAA can take actions to strengthen its security Research, Engineering, and Development (RE&D) program to meet current and future threats to aviation. In our May 1994 report, we recommended that FAA (1) evaluate the effectiveness of software used in new explosive detection devices, (2) focus greater attention on integrating various new technologies to maximize the strengths of each, and (3) place additional emphasis on human factors, such as how operators will work with new detection devices. Although FAA is taking steps to address our concerns about systems integration and human factors, the agency believes the industry, not FAA, should evaluate the software used in new explosive

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[2]Reliability is the length of time that explosive detection devices should operate without failure. For example, the Department of Defense generally uses "mean time between failure" as a measure of reliability for military equipment.

detection devices. In our view, FAA's evaluating
software is a necessary complement to examining hardware
because the new systems rely heavily on software to
analyze data and indicate whether an explosive device
may be present in checked baggage.

-- Important issues still exist about the eventual
   implementation of new security technology. Developing
   new explosive detection devices is only part of the
   challenge; the airline industry will also have to
   purchase and implement the devices throughout the next
   decade. The airline industry estimates that the new
   technology could cost from $250,000 to over $1 million
   per device. Because experts believe that two or more
   devices will probably be used in combination, the costs
   to acquire new security technology could be substantial.

BACKGROUND

Protecting civil aviation against terrorist attacks is a
major challenge for security personnel throughout the
world. The 1988 terrorist bombing of Pan Am Flight 103,
which killed 270 people, clearly illustrated the need for
new explosive detection technology. In May 1990, the
President's Commission on Aviation Security and Terrorism
reported that aviation security was seriously flawed and
was failing to adequately protect the traveling public. In
October 1990, the Congress passed the Aviation Security
Improvement Act, requiring FAA to, among other things,
promote and strengthen aviation security through research
and development. In this regard, the act directed FAA to
support the acceleration of technologies and procedures to
counteract terrorist acts against civil aviation and set a
goal to deploy new explosive detection equipment at
airports by November 1993.

Since the passage of the act, the Congress has provided FAA
with about $130 million for security research.
Specifically, FAA's security RE&D funding has grown from
$9.9 million in fiscal year 1989 (before the act's
enactment) to $35.9 million in fiscal year 1994--a 262-
percent increase. FAA's Technical Center in Atlantic City,
New Jersey, is responsible for managing the security RE&D
program and has 35 staff working on various projects.

In the past, FAA has had difficulty developing effective
explosive detection systems. For example, the industry was
not satisfied with FAA's efforts on a thermal neutron

analysis device.[3] The industry criticized FAA for not rigorously testing this equipment before mandating its use. FAA had intended to require U.S. airlines to deploy the system at domestic and international airports over a 5 year period, at an estimated cost of about $900 million. In its May 1990 report, the President's Commission on Aviation Security and Terrorism objected to the deployment of thermal neutron devices because the equipment could not, without an unacceptably high false alarm rate, detect the amount of explosive widely believed to have destroyed the Pan Am 103 aircraft. Although FAA continues to test this technology, the agency currently has no plans to mandate its deployment.

NEW SECURITY TECHNOLOGY IS NOT
AVAILABLE FOR AIRLINES' USE

In September 1993, FAA published performance standards that new explosive detection devices for checked baggage must meet to be certified for airlines use. FAA's Aviation Security Research and Development Scientific Advisory Panel estimates that FAA could take 2 to 5 years to certify a device that can meet the performance standards for screening checked baggage.[4] Likewise, although research on improving aircraft survivability through blast resistant luggage containers and hardened aircraft structures is promising, widespread use of such technologies is not imminent.

Issues Affecting the Development
and Deployment of New Devices

New explosive detection technology is still evolving. Some technologies, such as automated X-ray devices, show promise for detecting explosives, but technical problems have slowed their development. Other technologies that FAA is pursuing--trace and nuclear--show little possibility of

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[3]This device uses neutron radiation to detect explosives in checked baggage. It represents the first FAA-supported effort to develop an explosive detection device.

[4]This panel advises FAA on a wide range of security research issues and comprises scientific and technical experts from the Department of Defense, a major airline, a law enforcement agency, an aircraft manufacturer, and academia.

meeting FAA's requirements for checked baggage at this time.[5] FAA officials cautioned that many technical challenges remain and that estimating development time is difficult.

Since FAA is several years away from approving new explosive detection equipment for checked baggage, the agency has considered allowing airlines to use commercially available equipment--a step some foreign governments have taken. We recommended in our May 1994 report that FAA assess the effectiveness of commercially available equipment by acquiring and testing such equipment at airports. FAA agrees with this recommendation but noted that recent tests conducted at a foreign airport indicate that such equipment did not perform as well as expected.

The next year is important for FAA because it could lead to significant changes that will impact the development and deployment of new security technology. An FAA in-house task force plans to report on its efforts to identify short-term actions to approve new explosive detection equipment for the industry.[6] FAA has completed an assessment of current technologies and expects to finalize its report this month and has begun some computer modeling of new detection systems. Although the results of this study are classified, FAA's analysis generally confirms that advanced X-ray (computerized tomography)--which borrows heavily from advances in the medical field--is the most promising near-term candidate for screening checked baggage. In addition, FAA plans to decide in January 1995 whether additional program changes are warranted. Agency officials have publicly commented that they do not expect manufacturers of new devices to be able to meet the performance standards for screening checked baggage and that they will decide in January 1995 whether to hold to the current performance standards or adopt an interim standard.

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[5]Trace detection devices "sniff" baggage, people, and electrical items for chemical particles used in explosives.

[6]The task force was formed in January 1994 to accelerate FAA's short-term efforts to approve new explosive detection equipment for the industry. The task force is examining, among other things, current explosive detection technology and simulating, through computer modeling, explosive detection systems and their impact on airport operations.

The Outcome of FAA's Efforts to Improve
Aircraft Survivability is Uncertain

FAA's research on aircraft survivability techniques may
offer the potential to significantly reduce the effects of
in-flight explosions. However, it is uncertain when such
techniques will be in widespread use. FAA is conducting
research to (1) refine blast-resistant luggage containers,
(2) assess the vulnerability of aircraft to different types
and quantities of explosives, and (3) identify techniques
to harden aircraft structures to withstand explosions.
FAA's efforts to harden aircraft structures have benefited
from research on aircraft catastrophic failure--work
mandated by the Aviation Safety Research Act of 1988.
Although FAA may complete its efforts to develop more
blast-resistant luggage containers in fiscal year 1994, it
will probably not demonstrate its efforts to harden
structures until the next generation of aircraft enter
service.

FAA's efforts on blast-resistant luggage containers may
bridge the gap between the capability of existing detection
technology and the types of blasts that aircraft can
survive. However, the airline industry has raised
questions about the containers' cost, weight, and
durability. Airline security officials point out that
containers now used throughout the world (between 350,000
and 400,000) are generally made of aluminum, are frequently
damaged by forklifts, and are exposed to a wide range of
harsh weather conditions. Industry officials have similar
concerns about the durability of the new containers; that
is, how they will be affected by routine damage that is a
common occurrence at airports and exposure to various
weather conditions.

In addition, because of their size, the hardened containers
FAA is considering can be used only on wide-body aircraft
that typically fly international routes. Wide-body
aircraft in operation or on order comprise about 29 percent
(4,435) of the aircraft worldwide (15,470). However,
nearly 75 percent of the 57 bombings known to have taken
place between 1971 and 1991 occurred on narrow-body
aircraft that do not use containers to store checked
baggage. Therefore, it is questionable whether hardened
containers will have a major impact on increasing aircraft
survivability until more wide-body aircraft are in service.
FAA believes that some narrow body aircraft may be able to
use the new containers and that research being conducted by

the United Kingdom may lead to a container for narrow body aircraft.

FAA CAN TAKE STEPS TO IMPROVE ITS
PROCESS FOR CERTIFYING NEW TECHNOLOGY

FAA's process for certifying new explosive detection equipment for checked baggage is the key to ensuring that the new technology can meet the threat to aviation. However, the process does not include testing the new systems at airports as a condition of certification, and FAA's performance standards do not set reliability criteria for new devices. Under FAA's planned approach, the agency runs the risk of approving devices that cannot reliably detect sophisticated explosive devices under actual airport conditions. We recommended in our May 1994 report that FAA (1) require operational tests of the performance and reliability of detection devices at airports as part of the certification process and (2) include reliability criteria in the certification standards for new equipment.

Certification Process Does
Not Include Operational Tests

In September 1993, FAA issued its plan for certifying bulk detection systems (nuclear and advanced X-ray technologies). FAA's certification plan defines the process, performance requirements, and testing standards for vendors to obtain approval for explosive detection devices and systems. The plan, however, does not include airport testing--a key step to ensure that new equipment works and to boost the airline industry's confidence in the equipment.

The airline industry, the National Academy of Sciences, and others believe that airport testing must play an important role in FAA's certifying new detection technology for the industry's use. However, FAA officials believe that such major obstacles as time and cost preclude their testing new equipment at airports during the certification process and that they can simulate realistic operating conditions at the FAA Technical Center.

In our view, FAA cannot adequately portray such airport conditions as crowds, heat, and scheduling pressures in its laboratory or by simulating the operation of new equipment. Furthermore, airport testing may be the key to gaining the confidence of an industry that is growing increasingly

skeptical about FAA's ability to develop effective explosive detection equipment. Throughout our review, we noted a reluctance by FAA to test new explosive detection technology at airports before mandating its use. Since our report, FAA has developed a proposal to demonstrate new explosive detection equipment at one or more airports. This effort would provide FAA with valuable information on the effectiveness of new equipment and represent a first step toward addressing our concerns about equipment reliability. As of today, FAA has not decided on the specifics and timing of the proposal.

Certification Standards Do Not Include Reliability Requirements

FAA does not plan to test the reliability of new explosive detection equipment during the certification process nor did the agency include specific criteria for reliability in its certification standard. Therefore, FAA cannot assure airlines that the equipment will operate without failure for a reasonable period of time and will not disrupt airport operations. Our observations of new technology and the conditions under which it must operate confirm the need for reliability standards and testing. We observed that equipment failed during FAA's tests at Miami International Airport.[7] Specifically, FAA could not operate two of the four test devices for 2 days. Moreover, FAA had to suspend the tests until the equipment failures were resolved.

FAA disagrees that reliability criteria should be part of the certification standard. In responding to our report, agency officials said that the issues of equipment availability, reliability, maintainability, and operating efficiency are not fundamental to their certifying the detection capabilities of the equipment. According to the officials, the economic trade-offs among purchase price, availability, reliability, and maintainability can be made only by the end user--the airlines.

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[7]The purpose of these tests was to examine the characteristics of baggage, not the ability of the devices to detect explosives.

FAA CAN IMPROVE ITS SECURITY RE&D PROGRAM

Because of the changing nature of the threat to aviation and the technical challenges facing FAA, the agency will be conducting security research well into the foreseeable future.   To improve FAA's efforts, we recommended in our May 1994 report that FAA (1) evaluate software when reviewing systems' designs, (2) place greater emphasis on integrating devices when initiating development projects, and (3) focus on such human factors as training, selecting, and motivating operators (screeners) of the new technology.

FAA is Taking Actions to Improve Systems Integration and Human Factors

FAA has actions underway to address our concerns about systems integration and human factors. FAA now believes it must take a more active role in integrating explosive detection devices, and agency officials told us that they have several initiatives underway to do so. Within the next 12 to 18 months, FAA expects to have working laboratory prototypes of three explosive detection systems. Department of Transportation (DOT) and industry officials commented that it will be important to test the systems-- not individual components or devices--under actual airport conditions.

With regard to human factors, FAA plans to spend about $2.3 million this year (a 100-percent increase) to improve screener performance and training. FAA's recent tests at a high-threat domestic airport confirmed that improved training for screeners can dramatically improve their performance. As we have pointed out in the past, enhancing human performance is equally important to developing and fielding new technology. FAA officials now recognize the importance of human factors in improving security.

FAA is Not Evaluating the Performance of Critical Software in New Systems

Currently, FAA technical staff do not evaluate software that performs explosive detection system functions even though automation is a major element of the new technology. A major objective of FAA's security RE&D program is to automate systems, thereby improving airlines' ability to detect explosives and process baggage and minimizing reliance on human screeners to detect explosives.

Therefore, FAA is developing devices that utilize
sophisticated software to determine whether a suspicious
object requires closer scrutiny. As the agency moves
towards integrating explosive detection systems, software
becomes even more important because it is a critical factor
in making systems work together.

Although FAA agrees that software plays a critical role in
the new detection equipment, it disagrees with our
recommendation that it should evaluate the software of new
explosive detection devices. FAA believes that the
industry should be responsible for evaluating the software
systems that perform explosive detection system functions
and that the agency should not be concerned with verifying
computer code and/or optimizing hardware and software. In
addition, for technology that the industry has already
developed, FAA officials say they have had difficulty
obtaining information about the hardware and software
because the industry claims it is proprietary.

In our view, evaluating the software is a necessary
complement to examining the hardware of a system. New
explosive detection equipment relies heavily on software to
analyze data and, ultimately, to determine whether an
explosive device exists in checked baggage. Major
improvements in detection may come from software
refinements, and systems integration depends on linking
devices, and their software, together. A closer
examination of software might identify a problem that could
forestall deployment of equipment in the future.

IMPORTANT ISSUES REMAIN ABOUT THE
IMPLEMENTATION OF NEW SECURITY TECHNOLOGY

Developing new explosive detection technology is only part
of the challenge; the airline industry will also have to
purchase and implement the new technology throughout the
next decade. The cost and source of funds for purchasing
new security equipment are important issues. The airline
industry is concerned about the costs of purchasing and
operating new detection devices, which, it estimates, could
range from $250,000 to over $1 million per device. Because
devices will probably be used in combination, the costs to
acquire new security technology could be substantial.
However, FAA does not have a plan or strategy to guide the
government's and the airline industry's efforts in this
area. As a result, airlines cannot plan or budget for new
security equipment. Therefore, we recommended in our May

1994 report that FAA develop a plan to guide its and industry's efforts over the next several years.

The Cost of New Detection Equipment is a Major Concern

Because of the precarious financial condition of the airline industry, Air Transport Association (ATA) and airline officials believe that the estimated costs of the new systems alone dictate that FAA carefully evaluate their operational and economic implications as part of the certification process. Airline officials with whom we spoke expressed concern that the cost of a single integrated system could be in excess of $2 million at one location, for one airport. FAA officials could not provide us with information on the cost of acquiring new technology but noted that the most promising device would cost about $800,000 per unit.

Last month, the Congress enacted legislation that allows airports to purchase explosive detection equipment with Airport Improvement Program (AIP) grant funds if the equipment is approved by FAA.[8] In addition, since the Federal Aviation Act, as amended, makes airlines--not airports--responsible for screening passengers and their luggage, FAA officials told us that airlines would have to enter into agreements with airports to use the equipment.

FAA Needs a Strategy to Implement New Technology

Introducing new explosive detection equipment will be difficult because the airlines are concerned about costs and the aviation community has little experience with the technology. Therefore, DOT and industry officials--and FAA's own Aviation Security Research and Development Scientific Advisory Panel--believe that FAA needs to develop, in close cooperation with the industry, a plan or vision that clearly outlines the agency's strategy for introducing new detection equipment. In our May 1994 report, we recommended that such a plan should, among other things, articulate FAA's role in developing and assisting the industry in implementing new technology, set milestones

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[8]AIP provides grants to airports to sustain or increase their safety, security, and capacity by expanding and improving their facilities.

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indicating when airlines should be prepared to purchase and deploy new equipment, and outline anticipated procedures for using new equipment in the general framework for aviation security. FAA concurs with our recommendation and has begun to work on the development of such a plan.

CONCLUSIONS

Although FAA has made some progress in developing new detection technology, it did not met the Congress' goal to deploy new technology at airports by November 1993. Improvements are needed in FAA's certification process and other aspects of its security research program to ensure the development of new technology in a timely manner. In addition, FAA needs to address such operational issues as reliability and the impact of new technology on airline operations by testing systems at airports. The cost and source of funds will also remain important issues and will challenge FAA and the aviation community. We recognize that research and development entails risk and that not all technologies considered will be successful. We believe that if planned actions and the implementation of our recommendations occur, more will be known about the impact of new technology on airline operations, direction of current and future research and development efforts, and milestones for introducing new explosive detection equipment.

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We are sending copies of this correspondence to the Secretary of Transportation and the FAA Administrator. Please contact me on (202) 512-3600 if you or your staff have any questions.

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