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AVIATION RESEARCH

Progress Has Been Made but Several Factors Will Affect Program Success

Statement of
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Mr. Chairman and Members of the Subcommittee:

We appreciate the opportunity to appear before you today to discuss the Federal Aviation Administration's (FAA) Research, Engineering, and Development (RE&D) Program. FAA's RE&D program plays an important role in ensuring the safety, security, and efficiency of the U.S. air transport system. Today, we will discuss FAA's progress in responding to the Aviation Safety Research Act of 1988, conducting long-term research, and developing an RE&D Plan.

As you know, FAA's RE&D budget has grown over the past several years from $153 million in fiscal year 1988 to $205 million in fiscal year 1991. FAA received $218 million for fiscal year 1992 and the Administration has requested $230 million for fiscal year 1993. Much of the increase in funding over the past several years occurred in the areas of aircraft safety, security, and human factors, which includes the interface between controllers and air traffic control systems. Our testimony is based on the report you are releasing today that details the funding, staffing, and timing of FAA's research projects[1] and our efforts to monitor FAA's progress in responding to the Aviation Safety Research Act since we last testified before this Subcommittee.[2]

In summary, we found the following:

-- FAA has made progress in responding to the Aviation Safety Research Act of 1988. FAA has expanded research in aircraft structures, human factors, simulation modeling of the air traffic control system, and has developed a draft RE&D Plan.

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[1]Aviation Research: Funding, Staffing, and Timing of FAA's Research Projects (GAO/RCED-92-108FS, Feb. 28, 1992).

[2]FAA Research, Engineering, and Development Issues (GAO/T-RCED-89-21, Apr. 12, 1989).

The plan enjoys industry support and provides information on FAA's research efforts in, among other things, aircraft safety, security, and weather. However, FAA has not included resource estimates for future research efforts or delineated specific long-term projects in the plan as required by the act.

-- For many years, the Congress has been concerned that FAA's RE&D program is not sufficiently future-oriented. As a result, for fiscal years 1989 and 1990, the Congress mandated that FAA allocate at least 15 percent of its RE&D funds to long-term research. FAA met this requirement for 1989 and 1990 and the RE&D Program Analysis Division estimated that about 41 percent of fiscal year 1991 obligations were for long-term research. FAA's total RE&D efforts are difficult to estimate because FAA does not track the amount of long-term research underway in its program and some research is funded by other sources, including other federal agencies. However, on the basis of our review of individual projects and discussions with project managers, we estimate that 17 percent of FAA's 1991 RE&D obligations were for long-term research as defined in the Aviation Safety Research Act of 1988.

-- FAA's draft RE&D Plan establishes measurable goals. However, FAA's success in achieving these goals will depend on several interrelated factors. These factors include FAA's success in (1) incorporating RE&D goals into other programs, such as the Capital Investment Plan to modernize the air traffic control system, (2) utilizing research conducted by other federal agencies, (3) integrating various technologies to address existing and future capacity, security, and safety concerns, and (4) incorporating human factors into all research. To date, FAA has not included RE&D goals in other key program activities and cannot achieve the goals until it does so, has only recently begun to explore using other research

facilities, has had only limited success in integrating multiple technologies in aviation systems, and has only begun to explore the extent to which human factors should be considered in the RE&D program.

BACKGROUND

FAA conducts a wide range of research to ensure the safety, security, and efficiency of the U.S. aviation system. The results of FAA's research programs include prototypes of systems, new procedures, rules, regulations, and certification criteria. Most, if not all, of FAA's research focuses on refining existing technology and equipment. FAA has several joint programs with the National Aeronautics and Space Administration (NASA) in such areas as aging aircraft, windshear, and human factors. In fiscal year 1991, NASA contributed over $21 million to cooperative programs with FAA.

To assist FAA in meeting its long-term challenges, the Congress enacted the Aviation Safety Research Act of 1988. The act requires FAA to (1) submit to the Congress an annual aviation research plan with detailed cost, schedule, and staffing data for each project and a report of accomplishments for the preceding year; (2) allocate not less than 15 percent of its fiscal year 1989 and 1990 budget to long-term research;[3] (3) undertake research on aircraft structures, fire safety, human factors, aeromedical research, and computer simulation models of the air traffic control system; and (4) establish a research advisory committee.

The RE&D program played a role in developing FAA's plan to modernize the air traffic control system. FAA is currently

[3]The act defined a long-term research project as a discrete project in the aviation research plan that was unlikely to result in a final rulemaking within 5 years or in initial installation of operational equipment within 10 years after the project began.

attempting to incorporate satellites for communications, navigation, and surveillance into future air traffic control systems. In response to recent incidents, FAA is spending more of its RE&D funds on aircraft safety, security, and human factors. (App. I compares funding levels for fiscal years 1988 and 1991 by major research area.) Nevertheless, FAA believes it faces many long-term challenges that will require sustained research over the next few years. These include:

-- Capacity and congestion problems continue to plague the national airspace system. In 1990 alone, almost 400,000 flights experienced delays in excess of 15 minutes.

-- FAA now faces increasingly sophisticated threats to security and must develop systems that can detect a wide range of explosives with a high degree of reliability at an affordable cost.

-- FAA faces a major challenge in developing tools to detect cracks and corrosion in the nation's aging fleet without grounding aircraft for extended periods of time.

-- FAA has to ensure that its next generation of air traffic control systems, which rely heavily on automation, are engineered so that controllers and pilots can effectively operate and work with the systems.

FAA HAS MADE PROGRESS IN RESPONDING TO THE AVIATION SAFETY RESEARCH ACT OF 1988

In responding to the act's requirements, FAA has expanded research in aircraft structures, human factors, and simulation modeling; established the advisory committee; and developed a draft RE&D Plan. FAA's RE&D Plan enjoys industry support and provides information on, among other things, aircraft safety, security, and

weather research. However, FAA has not included resource estimates--either staff or dollars--for future research efforts or delineated specific long-term projects in the plan as required by the act.

FAA Has Expanded Research Mandated by the Act

FAA has increased overall funding for research mandated by the act by almost 300 percent between 1988 and 1991. Simulation modeling of the air traffic control system experienced the most dramatic growth--in excess of 1,000 percent. The hallmark of this effort is FAA's National Simulation Laboratory that for the first time will allow FAA to simulate the interaction between new air traffic control systems and controllers. Laboratory studies also will provide better information on the manner in which major air traffic control systems work together before they are installed in an operational environment. FAA plans to continue to refine the laboratory over the next few years and complete it in 1995. Table 1 compares FAA obligations in fiscal year 1988--before the passage of the Aviation Safety Research Act--and fiscal year 1991.

Table 1: Research Underway Mandated by the Aviation Safety Research Act, Fiscal Years 1988 and 1991

Dollars in thousands

Research Area	Obligations 1988	Obligations 1991	Percent increase
Human factors and medicine	$ 6,186	$ 17,164	177.5
Simulation modeling	764	9,223	1,107.2
Aircraft structures	1,680	17,566	946.2
Fire safety	3,544	4,250	20.0
Total	$ 12,174	$ 48,203	296.0

Source: GAO analysis of FAA data.

Although FAA has increased funding for research areas mandated by the act, FAA officials told us that it will take time to complete much of the work. For example, FAA plans to explore the human factors issues associated with the interface between air traffic control automation and controllers. Similarly, FAA's aging aircraft research program (aircraft structures) has tested several prototype techniques for detecting cracks and corrosion in aircraft, but additional research will be needed to identify and test systems that can quickly detect all types of cracks and corrosion with a high degree of accuracy.

FAA's Draft RE&D Plan Does Not Provide Resource Requirements

Although FAA's draft RE&D Plan contains information on key dates for each project, it does not include detailed cost and staffing levels for each project or distinguish projects that are long-term. Such information is important because some research areas, especially human factors and security, have the potential to cost significantly more in the next several years. For example, FAA officials told us that the joint human factors plan with NASA will cost about $90 million annually to implement. FAA will be making key decisions regarding allocation of scarce RE&D resources to many competing areas in the next decade. Without cost and staffing information, neither the Congress nor FAA can adequately oversee decisions to ensure that resources are being used most effectively and that FAA's RE&D program is being carried out as intended.

MOST OF FAA'S RESEARCH IS FOCUSED ON SHORT-TERM PROJECTS

A major concern of this Committee over the past several years has been FAA's emphasis on short-term research at the expense of long-term research. Long-term research is important because it can identify potential safety vulnerabilities before they result in catastrophic accidents or incidents. In addition, such research

will help ensure that air traffic control systems, when fielded, will reduce burdens on controllers and increase their efficiency. FAA's RE&D Program Analysis Division estimated that about 41 percent of fiscal year 1991 obligations was for long-term research.[4] Our calculations--based on an analysis of individual projects and discussions with project managers--differs significantly from FAA's estimate.

We found that about $33 million, or 17 percent, of FAA's 1991 obligations were for long-term research as defined by the Aviation Safety Research Act; the remaining $163 million (83 percent) focused on short-term projects. Moreover, many projects that FAA had classified as long-term were actually short-term or a combination of short- and long-term efforts. For example, FAA officials said that they obligated about $12 million for long-term aging aircraft research. Our calculations show that only about $2.9 million was used exclusively for such research. (App. II shows the amount of long-term research undertaken in fiscal year 1991 by major research area.)

Furthermore, in the past FAA's total RE&D efforts have been difficult to estimate because some research is funded from other sources, including other federal agencies and the facilities and equipment (F&E) account for modernizing the air traffic control system. We previously reported that FAA needed to link its process for acquiring major projects with its budget to enhance project management and reduce the potential for cost growth and schedule delays.[5] On the basis of our recommendations, FAA has for the first time delineated F&E funds for engineering, development, test,

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[4]FAA's RE&D appropriation in fiscal year 1991 was $205 million. FAA's obligations of appropriated funds almost kept pace at $196 million.

[5]Aviation Acquisition: Further Changes Needed in FAA's Management and Budgeting Practices (GAO/RCED-91-159, July 29, 1991).

and evaluation in its fiscal year 1993 budget. These activities are considered to be research and development rather than production oriented.

Finally, FAA does not track information on the amount of long-term research conducted. Consequently, budget and planning documents do not indicate the level of funds for short- or long-term efforts. Tracking long-term research would allow FAA to make judgements on the overall direction of the RE&D program, identify trends, and make the necessary adjustments. For example, FAA has no long-term research related to airport technology or weather. However, a mechanism exists that could help FAA track long-term research. The Department of Transportation has implemented the Departmental Accounting and Financial Information System at FAA. On the basis of our preliminary work, the system seems to have the capability to track long-term projects and resources.

SEVERAL INTERRELATED FACTORS WILL AFFECT FAA'S ABILITY TO ACHIEVE RE&D GOALS

The draft RE&D Plan includes nine ambitious but, in FAA's view, attainable goals. For example, the plan shows that FAA expects to increase airspace and airport capacity by at least 20 percent in 1999 and an additional 20 percent by 2005 and reduce runway incursions by 80 percent by the year 2000. (App. III lists FAA's RE&D goals.) Goals are important elements of a good plan because they set expectations and establish a basis to measure performance. Further, goals will give the RE&D Plan direction and form a basis for later providing feedback on the overall program. We recently testified that two other key FAA programs--the Capital Investment Plan and National Plan of Integrated Airport Systems--did not have measurable goals and would benefit by having them.

However, the RE&D program alone cannot achieve these goals because they rely heavily on capital investment projects underway

in other FAA programs. Our review of FAA's program and discussions with NASA, Department of Defense (DOD), and industry officials identified four interrelated factors that will affect FAA's success in achieving the RE&D goals.

First, the RE&D goals must be incorporated into other program areas. This is important because the RE&D program must rely heavily on other programs. For example, FAA has not included the RE&D goals to increase capacity in its plan to purchase the next generation of air traffic control systems. Similarly, FAA will need to integrate the reduced runway incursion goal into agency-wide efforts to reduce the number of accidents on crowded runways.

Second, FAA must utilize research conducted by other federal agencies and private organizations. For example, FAA is working to make better use of NASA's investment in aeronautical research, which amounted to $900 million in fiscal year 1991.[6] In the past several months, FAA has begun a dialogue to increase its use of DOD's laboratories. Although the extent and type of technologies that could be transferred is unknown, DOD officials believe that they can contribute to FAA's research efforts. In addition, the Congress gave FAA the authority to make grants to and operate Centers for Excellence in Aviation Research at colleges and universities. The centers will expand FAA's access to the resources of the academic community. FAA has yet to select a grantee to establish a center and believes the cost of establishing and maintaining the centers--between $2 and $3 million annually per center--may limit FAA to establishing no more than one or two in the next few years. Officials at the National Science Foundation and NASA believe that FAA should encourage industry participation in these centers to offset costs and speed technology transfer.

[6]NASA's efforts include a wide range of research on civil and military aircraft, including helicopters.

Third, in such areas as air traffic control and security, an important relationship exists between developing specific technologies and determining the manner in which various technologies work together (system engineering and integration). For example, in the air traffic control area FAA must ensure the integration of ground-based systems and satellites for communications, navigation, and surveillance functions. Also, FAA must ensure that future security devices can successfully blend several technologies to detect a wide range of explosives. In the past, integration problems and issues have contributed to cost increases. For example, costs increased for the Terminal Doppler Weather Radar System because FAA did not fully consider the need to integrate that system with the Low-Level Windshear Alert System.

Finally, for more than 30 years, human error has contributed to over 65 percent of aviation accidents. As a result, FAA has developed a multi-year plan with NASA that focuses on many aspects of human factors in aviation. FAA is prioritizing efforts in the plan to determine the correct balance of short- and long-term human factors research. The results of this work will help identify potential safety issues and maximize efficiency in air traffic control and the operation and maintenance of aircraft. A critical area in the plan is the relationship between automation and air traffic controllers. Increased automation has profound implications for air traffic controllers and may bring a new generation of problems. For example, FAA officials told us that as automation increases, controllers will rely on advanced systems to make decisions about traffic flow. These officials emphasized the importance of research to ensure that automation does not diminish controllers' ability to effectively monitor traffic because of boredom.

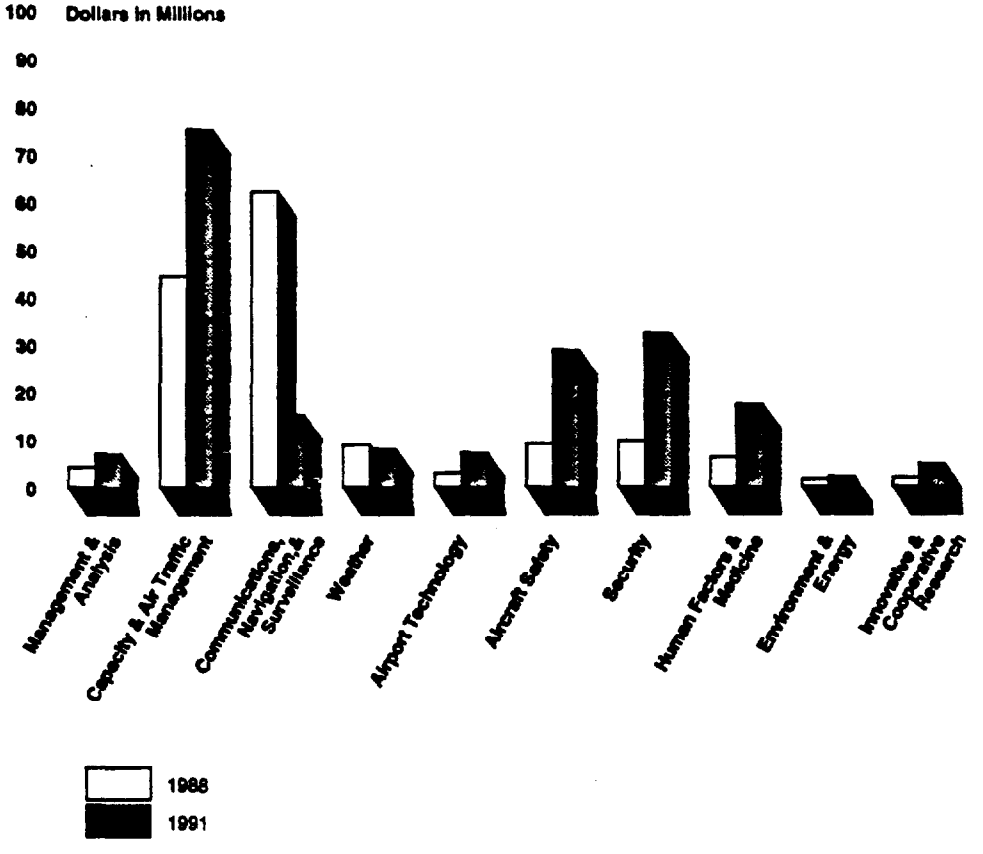
CONCLUSION

In conclusion, Mr. Chairman, FAA has taken some important steps to improve its RE&D program and respond to the Aviation Safety Research Act of 1988. FAA has embarked on significant research in human factors, simulation modeling, and aircraft structures. However, much important research remains to be done.

In addition, FAA's inclusion of the requisite project cost and staffing information in the RE&D Plan as the Congress directed would strengthen the plan and including the amount of funding dedicated to long-term efforts in budget documents would demonstrate to the Congress FAA's future vision for aviation research. Without this information, neither the Congress nor FAA can adequately assess the plan's requirements or its overall direction. Further, several key factors, such as the manner in which FAA incorporates RE&D goals into other program areas, will shape the RE&D Plan's success in meeting safety, capacity, and security needs for the next decade and beyond.

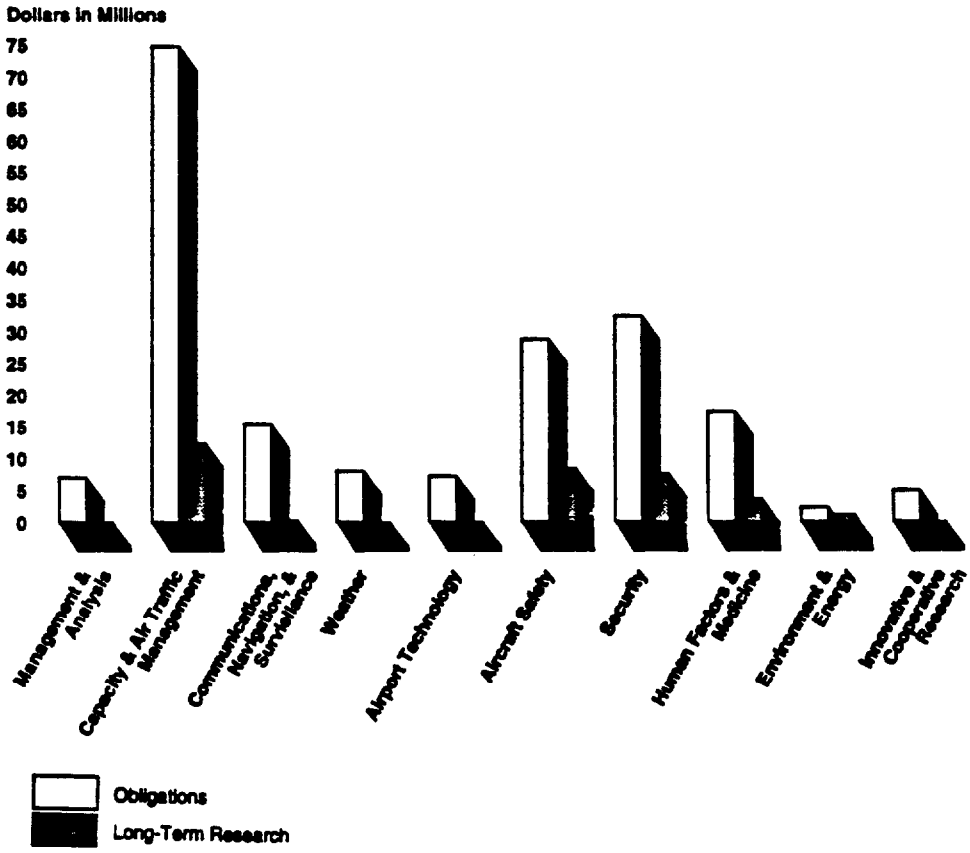
Mr. Chairman, this concludes our statement. We would be pleased to respond to questions at this time.

RE&D Funding by Major Research Area, Fiscal Years 1988 and 1991



Source: GAO analysis of FAA data.

Long-Term Research Undertaken in Fiscal Year 1991
by Major Research Area



Source: GAO analysis of FAA data.

FAA's RE&D GOALS

-- Reduce civil aviation fatality rate from all causes by at least 10 percent by 1999.

-- Develop a fire-resistant aircraft cabin.

-- Increase airspace and airport capacity by at least 20 percent by 1999 and an additional 20 percent by 2005, achieving commensurate reductions in delay.

-- Reduce runway incursions by 80 percent by the year 2000.

-- Reduce the number of accidents and incidents attributable to controller, flight crew, and maintenance crew human error by 50 percent by the year 2000.

-- Reduce the number of accidents and incidents attributable to weather by 20 percent in 1997.

-- Eliminate aircraft fires and aging aircraft concerns as significant safety issues by 1996.

-- Provide nonprecision approach capability or better at 95 percent of all U.S. public airports by 1996.

-- Anticipate new threats and implement new security philosophies, technologies, and systems that operate effectively with minimal interference to passengers and carriers.

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