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AIR TRAFFIC CONTROL

Challenges Facing FAA's
Modernization Program

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Mr. Chairman and Members of the Subcommittee:

We are pleased to appear before you today to testify on the Federal Aviation Administration's (FAA) Facilities and Equipment reauthorization, which will fund the agency's air traffic control (ATC) modernization program--called the Capital Investment Plan (CIP). The CIP represents one of the largest and most complex civilian procurements this nation has ever undertaken. We will discuss the challenges faced by FAA and the reforms that it has initiated to put the modernization program on track. We will also discuss uncertainties concerning ATC facility consolidation and the use of satellite technology that have direct implications for the size and length of the F&E reauthorization.

Our statement is based on several issued reports and testimonies, as well as ongoing work being done at the request of this Subcommittee. (See the attached list of related GAO products.)

Our testimony today will include four major points:

- First, as FAA faces the complex challenge of modernizing the ATC system, cost increases, schedule delays, and performance problems in modernization projects persist. Last spring, we reported that 8 of 12 major projects had experienced cost growth in the most recent year, with increases ranging from \$0.2 million to \$503.9 million. Implementation milestones have slipped between the 1990 and 1991 CIPs for 7 of the 12 projects, and their delays have averaged about 5 years since the 1983 Plan. As of April 1991, 30 of 233 projects were complete, and they represent about 2 percent of the total costs of modernization.
- Second, FAA has initiated projects to sustain the ATC system because of delays in modernization. Of course, this has contributed to the increase in the size and cost of the modernization plan. Also, while delays have deferred safety and efficiency benefits to system users from such projects as the Airport Surface Detection Equipment and Mode Select radars, some key new systems, including ones that detect unsafe weather conditions, have reached or soon will reach the field.
- Third, in the past 2 years, FAA has initiated major reforms in its modernization program. When it began the program, FAA did not fully recognize the enormous complexity of ATC modernization. As a result, it did not follow essential acquisition steps such as determining needs and testing systems before buying them. Cost increases, schedule delays, and performance problems were an inevitable result. We are encouraged that FAA's acquisition reforms occurring over the last 2 years appear headed in the right direction.

For example, FAA has required that needs be defined and approved by top management before projects can start and that operational testing be conducted before commitments to production. Reforms have more potential for positive impact on new projects than on those that have been in the Plan for many years. However, top management's follow through is critical to their success. Also, measurable goals are needed in the CIP to monitor the progress of modernization beyond the number of projects completed and the extent to which they are on time and within budget. Goals would help in evaluating to what extent modernization is benefitting the performance of the ATC system.

- Finally, FAA's plans to consolidate ATC facilities and apply satellite technology to the ATC system are still being formulated. Uncertainties surrounding these plans complicate the Facilities and Equipment reauthorization. We think it is highly unlikely that these uncertainties will be resolved before the Subcommittee completes its deliberations on funding levels and the length of reauthorization. Regarding consolidation, FAA's current funding estimates are based on its original plan to consolidate over 200 facilities into 23. Under discussion is a plan calling for over 50 facilities. The higher number of facilities could require an additional \$2.5 billion in Facilities and Equipment funds, including up to \$1 billion over the next 5 years. Regarding satellites, FAA needs to accomplish certain key tasks related to the use of satellite technology for ATC purposes. It is not clear what additional Facilities and Equipment funds will be required to accomplish these tasks.

ACQUISITION PROBLEMS POSE CONTINUING CHALLENGE

Schedule delays, cost overruns, and performance problems in CIP projects are well-known to the Congress and the aviation community. We have reported over the last decade on these problems, especially those in 12 key projects that will provide the majority of the projected benefits in the CIP. For example, 9 of the 12 projects have run into some type of serious performance problems during their development or implementation. System performance problems have serious consequences because these projects are needed to replace FAA's aging computers, radars, and communications systems and provide new weather capabilities.

In April 1991, we reported that 8 of FAA's 12 major projects had experienced cost growth in the most recent year. These increases ranged from \$0.2 million to \$503.9 million.¹ Some of

¹Air Traffic Control: Status of FAA's Modernization Effort
(GAO/RCED-91-132FS, Apr. 15, 1991).

these projects have experienced substantial cost increases since they were initiated. We are currently updating F&E cost estimates for these major projects in support of House and Senate Appropriations' Subcommittees on Transportation reviews of FAA's fiscal year 1993 budget. Thus far, our work indicates that many of these projects continue to experience cost increases.

We have also reported on schedule delays in these same 12 projects. Our review of implementation dates in a draft of the 1991 CIP shows delays now average about 5 years since the 1983 National Airspace System (NAS) Plan, the predecessor to the CIP. Furthermore, 7 of these 12 systems have experienced schedule delays in the past year. (See appendix I for further details on schedules for these 12 projects.) FAA has also experienced delays in other modernization projects. Thirty of 233 total CIP projects were completed when we reported in April 1991. These completed projects represent 2 percent of the total estimated costs of modernization.

ACQUISITION DELAYS HAVE LED TO INTERIM PROJECTS AND DEFERRED BENEFITS TO SYSTEM USERS

The total cost of modernization has risen because of cost growth in long-standing projects and the addition of many new projects to the CIP. Some of these new projects have resulted directly from delays in original NAS Plan projects. For example, FAA has initiated the \$435 million Interim Support Plan to sustain existing equipment at air traffic facilities because of delays in the Advanced Automation System. ATC modernization will now cost about \$31 billion in F&E funds through the year 2000. This amount is \$4 billion more than FAA estimated 2 years ago.²

The most visible consequence of delays to those who use the ATC system is that the bulk of the planned benefits still lie far in the future. In its 1991 CIP, FAA has projected \$258 billion (in constant 1991 dollars) in benefits that will accrue in terms of safety and efficiency improvements. As a result of delays in modernization projects, most of the benefits projected in the CIP will not be realized until after the year 2000.

On an individual project basis, delays in a major surveillance and communications project, the Mode Select, or Mode S, radar have postponed FAA's plans to automatically uplink weather and air traffic messages to pilots, rather than having to rely on voice communications with controllers. Representatives of two major airlines have told us that they view this automatic data link function as critical among CIP projects. Data link would also help to reduce controller work load. However, more than 7 years after a production contract was signed, FAA does not have a working Mode S

²Issues Related to FAA's Modernization of the Air Traffic Control System (GAO/T-RCED-90-32, Feb. 27, 1990).

radar due to continued problems with software development. Mode S implementation is now scheduled to begin in 1993.

In 1991, we reported that FAA's new airport surface radar, the ASDE-3, could have helped to prevent fatal runway accidents which recently occurred because it will provide clearer images than FAA's current surface radar. However, its implementation has been delayed 4 years because of software development problems, the addition of requirements by FAA, and performance problems discovered during initial operational testing. ASDE-3 implementation is now scheduled to begin this month.

While delays in these systems push benefits into the future, FAA is making progress with some important safety-related projects. For example, the first Terminal Doppler Weather Radar, which will help to detect deadly wind shear at 47 airports, has been delivered to its test site and the first system is schedule to be installed next year. FAA is also delivering and installing Automated Weather Observing Systems at small, non-towered airports, providing pilots with weather information that was not previously available. FAA has completed installation at almost all sites in its Radio Communications Link system, which provides more reliable voice and data communications between ATC facilities.

FAA IS REFORMING ITS ACQUISITION PROCESS

ATC modernization has proven to be an enormously complex undertaking. FAA did not fully recognize this complexity when it started the program. The agency thought its major projects required little or no development and could be fielded by the early 1990s. As a result, FAA mistakenly committed to buying systems and developed cost and schedule estimates without following essential steps in its acquisitions. For example, it did not prepare mission needs statements at the start of projects, which would have identified goals, capabilities, required resources, and potential risks for these projects. FAA also did not thoroughly and independently test systems, the "fly before buy" concept, before committing to production.³ FAA did not adequately test the Mode S radar before committing to production; software problems have yet to be solved and the project is several years behind schedule. Cost, schedule, and performance problems are an inevitable result of not following such basic steps as defining mission needs and testing before buying.

In the last 2 years, FAA has been more responsive to concerns that GAO and others have had about its modernization plan and

³Aviation Acquisition: Improved Process Needs to Be Followed (GAO/RCED-87-8, Mar. 26, 1987) and Air Traffic Control: FAA Needs to Implement an Effective Testing Program (GAO/IMTEC-89-62, Sept. 22, 1989).

acquisition process. For example, we had recommended that FAA develop a single plan for all its modernization projects because FAA had differentiated between those projects in its original NAS Plan and those added subsequently.⁴ The CIP was responsive to this recommendation. Also, consistent with our recommendations for improving FAA's acquisition process along the lines of Office of Management and Budget Circular A-109,⁵ FAA implemented some important changes. In February 1991, FAA issued a revised order on major acquisitions that incorporates a disciplined acquisition process including independent operational testing and evaluation, regular progress reviews with the FAA Administrator, and mission needs statements and acquisition plans for each new project. Acquisition reform efforts have already made a difference by preventing premature production awards on the \$1.4 billion Voice Switching and Control System and another major project. Of course, acquisition reform has more potential for positive impact on new projects than on those that have been in the Plan for many years.

FAA Needs To Follow Through On Reforms

Follow through on the acquisition reforms is critical, especially when considering the expansion of FAA's modernization program. As we noted in testimony last year before the House Committee on Appropriations, Subcommittee on Transportation, the agency added 94 projects to its 1990 CIP which were not part of its last NAS Plan update in 1989.⁶ Projects added since the original NAS Plan now account for about half of FAA's F&E budget, and this percentage will increase over the next few years. FAA faces a real challenge in resolving problems with existing projects while undertaking so many new ones.

In 1991, we reported that FAA was not enforcing an important change to its acquisition process. Both FAA's and the Department of Transportation's revised orders state that no funding for a project will be included in the budget until the mission needs have been approved by the Department. Contrary to this requirement, FAA's fiscal year 1992 budget request included \$116.7 million for 10 new projects that did not have approved mission needs statements at the time the budget was submitted to the Congress.⁷ We are

⁴Air Traffic Control: Continued Improvements Needed in FAA's Management of the NAS Plan (GAO/RCED-89-7, Nov. 10, 1988).

⁵Circular A-109, Major System Acquisitions, is the principal guidance for major acquisitions in the federal government.

⁶FAA Budget: Key Issues in Facilities & Equipment and Operations Accounts Need Resolution (GAO/T-RCED-91-58, June 5, 1991).

⁷Aviation Acquisition: Further Changes Needed in FAA's Management and Budgeting Practices (GAO/RCED-91-159, July 29, 1991).

reviewing the mission needs element of FAA's acquisition reforms at the request of the Subcommittee on Transportation, House Committee on Appropriations. We expect to report our results later this year.

Finally, the leadership at FAA has changed several times during the evolution of the NAS Plan and CIP. Over the modernization plan's 10-year history, FAA has had seven different Administrators and Acting Administrators, and it has only been in the past 2 years that FAA has begun to institute major reforms in its acquisition process. In our opinion, the new FAA Administrator's support for these reforms will be a vital element in the modernization program's success.

Measurable Goals Would Improve The CIP

While the CIP is responsive to our recommendation for a single modernization plan, one important change is still needed. We believe that an essential element of an ATC modernization plan should be a set of measurable goals. Goals would set expectations and establish a basis for measuring to what extent modernization is improving ATC system performance. Although the current CIP has six goals, these are general in nature and do not allow for measurement by FAA or other decision-makers. FAA's original NAS Plan did include some quantifiable goals. For example, FAA planned to increase controller and flight specialist productivity by a factor of two by the year 2000. However, the CIP does not assert any measurable productivity goal.

Two weeks ago, we appeared before this Subcommittee and testified that inclusion of measurable goals would give direction to FAA's National Plan of Integrated Airport Systems and form a basis for later feedback on that program. Similarly, goals for the modernization program could provide measures of progress beyond the number of completed projects and the extent to which they were on time and within budget.

We would also like to call to the Subcommittee's attention that measurable goals are included in FAA's draft Research, Engineering, and Development (RE&D) Plan. For example, one goal is to increase airspace and airport capacity at least 20 percent by the year 1999, and an additional 20 percent by 2005. Another goal is to reduce runway incursions 80 percent by the year 2000. It seems incongruous that FAA has measurable RE&D goals, but not CIP goals, because goals such as reducing runway incursions could not be achieved without ASDE-3 and other CIP projects.

MAJOR UNCERTAINTIES EXIST IN FAA'S PLANS

FAA has not yet announced its plans to consolidate ATC facilities nor to accomplish key tasks needed to allow the use of satellites for ATC purposes. It is not clear what additional

Facilities and Equipment funds will be needed over the next few years for FAA to accomplish these major changes. These uncertainties and their implications for Facilities and Equipment funding levels need to be taken into account as the Congress considers both the size and length of the reauthorization.

A Change In FAA's Consolidation Plan Will Increase F&E Costs

As we reported in 1991, a likely change in FAA's ATC consolidation plan will increase costs.⁸ The \$31-billion estimate for modernization effort through the year 2000 is based on a plan developed in 1983 to consolidate all 202 terminal radar approach controls and en-route centers into 23 facilities. For the last several years, however, FAA has had serious reservations about the operational feasibility of this plan because of the potential impact on the ATC system if any of these consolidated facilities experienced a catastrophic failure. FAA vulnerability studies indicate that if a consolidated facility failed, adjacent facilities could not adequately manage the airspace, increasing aircraft delays and the risk of tragic accidents.

Because of the vulnerability issue, FAA has studied other consolidation scenarios that would increase the number of facilities around major airports. Under discussion is a plan calling for 53 or 54 facilities instead of the 23 in the CIP. According to one of FAA's own estimates, under such a scenario, the agency would need an additional \$2.5 billion in Facilities and Equipment costs during the next decade over and above its current funding plan. About \$1 billion of those funds would be needed during the next 5 years. However, we believe these estimates may be low given that, in 1988, FAA estimated a \$4 billion increase for another consolidation plan that included 44 sites. In any case, a change in FAA's consolidation plans will have a major impact on Facilities and Equipment funding levels over the next few years.

Because of the importance of this issue, the House Committee on Appropriations required that FAA report on its consolidation plans, including an implementation schedule and funding estimates, by February 1, 1992. FAA did not meet this deadline and plans to ask for an extension until June 1992. Without a final consolidation plan, FAA cannot take the steps needed to allow consolidation to commence by 1997, as planned. These steps include planning for new buildings and exercising options in existing contracts for additional quantities of equipment. ATC consolidation also has serious consequences for FAA field staff since it could involve moving as many as 6,000 air traffic controllers and maintenance technicians.

⁸FAA Budget: Key Issues in Facilities & Equipment and Operations Accounts Need Resolution (GAO/T-RCED-91-58, June 5, 1991).

Satellites Offer ATC Improvements But Key Tasks Need To Be Accomplished

FAA's plans to apply satellite technology to the ATC system are still being formulated. Satellites offer significant safety and efficient improvements, but FAA needs to accomplish certain key tasks before satellite technology can be used for ATC purposes. Until FAA's plans are announced, it will not be clear what additional Facilities and Equipment funds are required to accomplish these tasks.

On the basis of our work to date for this Subcommittee, we have found that applying satellite technology can improve the communications, navigation, and surveillance capabilities of the ATC system by providing direct, more reliable communications between aircraft and ATC ground facilities; highly accurate navigation information to aircraft; and precise aircraft position data to ATC facilities for monitoring aircraft movements. As a result of these improvements, the application of this technology could offer important safety and efficiency benefits to system users.

Although the application of satellite technology has much potential, some major tasks must be accomplished before this technology can be used extensively for ATC purposes. For example, satellite-based communications, navigation, and surveillance procedures must be implemented at the international level. This is not likely to happen before the late 1990s because of the many players involved.

Furthermore, military satellite navigation systems, such as the Global Positioning System (GPS), must be enhanced for use by civil aviation. For example, FAA is considering two systems--one ground-based and the other on-board aircraft--to enhance GPS so that users can receive warning messages more quickly in the event of a satellite failure. FAA is also considering options such as adding satellites or using ground-based transmitters, so called pseudolites, to transmit GPS-like radio signals to enhance satellite accuracy.

CONCLUSION

In conclusion, FAA has taken some important steps in reforming its acquisition process in order to minimize continuing cost increases, schedule delays, and performance problems in key ATC modernization projects. We believe that FAA needs to follow through with its acquisition reforms to prevent new projects from experiencing the same problems. This is especially important considering the large number of new projects in the CIP. We also believe that the inclusion of measurable goals would make the CIP a more useful document by allowing FAA and decision-makers to better gauge progress in the modernization program.

While acquisition reform has begun, FAA still has not announced its new plan to consolidate major ATC facilities. FAA's decisions on consolidation will impact Facilities and Equipment funding levels because its current funding plans are based on a level of consolidation not operationally feasible. Additionally, the accomplishment of key tasks needed to make satellite technology useful in an ATC environment may also impact Facilities and Equipment funding levels in the next few years. We are not confident that these uncertainties will be resolved before the Congress decides on the length and size of the Facilities and Equipment reauthorization.

We will be happy to respond to any questions you might have at this time.

Implementation Milestones for Major System Acquisitions

<u>System</u>	<u>Year of first-site implementation</u>			<u>Years Delayed (83 NAS to 91 CIP)</u>	<u>Year of last-site implementation</u>			<u>Years Delayed (83 NAS to 91 CIP)</u>
	<u>83 NAS</u>	<u>90 CIP</u>	<u>91 CIP</u>		<u>83 NAS</u>	<u>90 CIP</u>	<u>91 CIP</u>	
Advanced Automation System	1990	1992	1991	1	1994	2001	2001	7
Air Route Surveillance Radar (ARSR-4)	1985	1993	1993	8	1995	1996	1996	1
Airport Surface Detection Equipment (ASDE-3) Radar	1987	1991	1992	5	1990	1994	1994	4
Airport Surveillance Radar (ASR-9)	1985	1989	1989	4	1992	1992	1993	1
Automated Weather Observing System	1986	1989	1989	3	1990	1994	1997	7
Central Weather Processor	1990	1991	1991	1	1991	1996	1998	7
Flight Service Automation System	1984	1991	1991	7	1989	1995	1995	6
Microwave Landing System	1985	1997	1997	12	1999 ^a	2008 ^a	2008 ^a	9
Mode S	1986	1992	1993	7	1993	1996	1996	3
RML Replacement and Expansion	1985	1986	1986	1	1989	1993	1994	5
Terminal Doppler Weather Radar	^b	1993	1993	^b	^b	1996	1996	^b
Voice Switching and Control System	1989	1994	1995	6	1992	1996	1997	5
Average Delay (in years)				5.0				5.0

Note: The 1991 CIP schedule dates are preliminary.

^aThe last-site implementation date for is all 1250 Microwave Landing Systems. GAO/RCED-91-132FS reported 1990 CIP last-site implementation for the first 464 systems.

^bTDWR was not in the 1983 NAS Plan.

Source: Implementation dates for 1983 and 1990 are from FAA's 1983 NAS Plan and 1990 CIP, respectively. Implementation dates for 1991 are from the unpublished 1991 FAA CIP.

RELATED REPORTS AND TESTIMONIES

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

Airport Safety: New Radar That Will Help Prevent Accidents is 4 Years Behind Schedule (GAO/T-RCED-91-78, July 10, 1991).

FAA Budget: Key Issues in Facilities & Equipment and Operations Accounts Need Resolution (GAO/T-RCED-91-58, June 5, 1991).

Major Acquisitions: Top Management Attention Needed to Improve DOT's Acquisition Process (GAO/T-RCED-91-45, Apr. 24, 1991).

Air Traffic Control: Status of FAA's Modernization Effort (GAO/RCED-91-132FS, Apr. 15, 1991).

Air Traffic Control: The Interim Support Plan Does Not Meet FAA's Needs (GAO/RCED-90-213, Sept. 11, 1990).

Air Traffic Control: Continuing Delays Anticipated for the Advanced Automation System (GAO/IMTEC-90-63, July 18, 1990).

Air Traffic Control: Ineffective Management Plaques \$1.7-Billion Radar Program (GAO/IMTEC-90-37, May 31, 1990).

Issues Related to FAA's Fiscal Year 1991 Budget Request (GAO/T-RCED-90-66, Apr. 18, 1990).

FAA Encountering Problems in Acquiring Major Automated Systems (GAO/T-IMTEC-90-9, Apr. 26, 1990).

Air Traffic Control: Status of FAA's Efforts to Modernize the Air Traffic Control System (GAO/RCED-90-146FS, Apr. 17, 1990).

Issues Related to FAA's Modernization of the Air Traffic Control System (GAO/T-RCED-90-32, Feb. 27, 1990).

Aviation Weather: FAA Needs to Resolve Questions Involving the Use of New Radars (GAO/IMTEC-90-17, Oct. 12, 1989).

Air Traffic Control: FAA Needs to Implement an Effective Testing Program (GAO/IMTEC-89-62, Sept. 22, 1989).

Air Traffic Control: Continued Improvements Needed in FAA's Management of the NAS Plan (GAO/RCED-89-7, Nov. 10, 1988).

Microwave Landing Systems: Additional Systems Should Not Be Procured Unless Benefits Proven (GAO/RCED-88-118, May 16, 1988).