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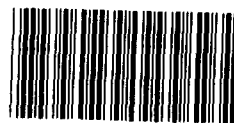
Before the Subcommittee on Transportation and  
Related Agencies, Committee on Appropriations,  
House of Representatives

For Release  
on Delivery  
Expected at  
11:00 a.m. EDT  
Monday,  
April 19, 1993

AIR TRAFFIC CONTROL

Uncertainties and Challenges  
Face FAA's Advanced  
Automated System

Statement of Kenneth M. Mead,  
Director, Transportation Issues  
Resources, Community, and Economic  
Development Division



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Mr. Chairman and Members of the Subcommittee:

We are pleased to testify today on the Advanced Automation System (AAS)--the largest project in the Federal Aviation Administration's (FAA) \$33 billion program to modernize the nation's air traffic control system. Conceived in 1983, AAS was initially estimated to cost a total of \$2.5 billion. That total cost rose to \$4.8 billion when the contract was signed with International Business Machines (IBM) in 1988. Today, FAA's estimate stands at \$5.1 billion.

Structured in five individual segments, AAS is being developed and implemented over a 20-year period using a "building block" approach. Segments one and two of AAS replace equipment that helps controllers separate aircraft en route between airports. The project's third segment replaces equipment relied upon by controllers to separate aircraft within 20-30 miles of airports. The fourth segment controls aircraft on the ground and in the immediate vicinity of an airport. The fifth and final segment of AAS combines equipment from segments one, two, and three into a single consolidated facility and provides new software that will permit controllers to grant aircraft more fuel-efficient routes. Only the first segment--the least complex of all the segments--has been completed.

FAA has established high expectations for the AAS project. It would replace aging and maintenance-intensive air traffic control equipment with more reliable systems. It would also provide new capabilities to make controllers more productive and allow airlines to fly more fuel-efficient routes. The need for more fuel-efficient routes has been heightened by the airline industry's recent financial problems. However, after investing \$2.7 billion over a 10-year period, FAA estimates that it is at least 3-1/2 years from fielding any major AAS equipment.

In our testimony today, we will describe the latest schedule delays and cost growth for AAS, the causes of these problems, the actions taken to address problems with the second segment of AAS and the challenges that still lie ahead for that segment, and the need to restructure AAS. This statement is based upon past reports and our ongoing AAS review for this Subcommittee. (See app. II for a list of related GAO products.)

In summary, we found the following:

- AAS schedule delays and cost growth have worsened over the past year. In March 1993, FAA and IBM acknowledged an additional 14-month delay to the second AAS segment--the Initial Sector Suite System (ISSS). ISSS has been the major thrust of FAA's and IBM's work to date and has had a history of development problems. With the recent delay, ISSS is now about 3 years behind milestones established in the 1988 contract. The third segment of AAS--the Terminal

Advanced Automation System (TAAS)--is now about 2 years behind the 1988 contract schedule. The final two segments of AAS--the Tower Control Computer Complex (TCCC) and Area Control Computer Complex (ACCC)--are in early stages of development. Their completion dates are uncertain. Although FAA's official estimate is \$5.1 billion for the entire AAS project, FAA officials acknowledged in March 1993 that this estimate may grow by at least \$235 million. In addition, delays in AAS have and will continue to force FAA to initiate costly interim projects to sustain the current air traffic control system. To date, these interim projects have cost about \$515 million, and FAA estimates that additional projects may cost another \$200 million.

- Several major factors have led to the schedule delays and cost growth. First, FAA and IBM agreed to an AAS plan that was too ambitious, and they significantly underestimated the technical challenge required to develop it. As a result, FAA and IBM set schedules that proved unrealistic when IBM encountered technical difficulties. Second, FAA did not provide the needed oversight of IBM's performance. For example, FAA did not have good quantitative information on IBM's progress in software development. Third, FAA has not effectively resolved some major requirement issues for the second segment of AAS. For instance, in areas such as electronic flight strip definition and controller screen display formats, ISSS issues remain unresolved.
- To address recent problems with ISSS, FAA and IBM announced in March 1993 a series of management initiatives that, in our view, are reasonable under present circumstances. These initiatives include increasing FAA and IBM top management oversight and establishing a structure for resolving requirements in a timely manner. While we are encouraged by the changes, we recognize that it will take time for these management initiatives to work. Meanwhile, FAA and IBM must overcome a number of major technical challenges with ISSS software. For example, the AAS contract requires the simultaneous operation of 210 ISSS work stations. As of February 1993, IBM had only 56 work stations operating together for short periods of time. We support FAA's decision to defer production of ISSS hardware until technical challenges with ISSS software are overcome. We will continue to track the progress of ISSS.
- Funding needs to fully implement AAS are uncertain at this time. The uncertainty stems from FAA's intention to restructure the project. There are three reasons for the restructuring. First, FAA now wants to scale back the facility consolidation strategy on which the AAS contract is based. For example, many facilities that would have been consolidated will remain separate. Second, FAA also

wants to add advanced software functions, such as those that permit more fuel-efficient routes, to the second segment of AAS rather than waiting for the final segment as originally planned in 1988. Third, FAA now plans to change the design and quantities of equipment for the tower--TCCC--segment of AAS. We believe that restructuring is likely to affect AAS project costs and schedules, user benefits, equipment location, and FAA's contract with IBM. Consequently, it would be prudent to limit funding of FAA's effort this fiscal year to activities that would not constrain its choice of options. We believe that FAA's forthcoming justification for the restructuring of AAS would be most effective if it included--in quantitative terms--(1) the extent of problems with existing equipment and (2) the capabilities and user benefits that AAS segments and other automation efforts will offer over and above current equipment.

We would now like to discuss these four issues in more detail.

#### BACKGROUND

AAS will provide a new automation system that includes improved work stations for controllers, computer software, and processors. It is being developed to replace current equipment and to allow the air traffic control system to accommodate forecasted increases in traffic through the use of modern equipment and advanced software functions. AAS is a complex technological project containing several million lines of software code, an extensive computer-human interface, and stringent requirements for performance and reliability.

FAA's air traffic control mission is to promote the safe, orderly, and expeditious flow of aircraft. Air traffic controllers maintain separation between aircraft by utilizing information processed by computers and displayed on video screens at controllers' work stations. FAA uses three types of facilities to control aircraft: airport towers, terminal facilities, and en route centers. Airport towers control aircraft on the ground and in the vicinity of the airport. Terminal facilities sequence and separate aircraft from the point at which tower control ends to about 20 to 30 miles from the airport. En route centers assume control of the aircraft and maintain control until the aircraft enters terminal airspace at its destination.

The project was originally designed in 1983 to accommodate the consolidation of 230 terminals and en route centers into 23 facilities. Today, FAA is considering a much less ambitious consolidation strategy that would result in about 200 terminal and en route facilities.

In 1983, the total cost estimate for AAS was projected to be \$2.5 billion and completion was scheduled for 1996. When the contract with IBM was signed in 1988, FAA estimated the project would cost \$4.8 billion and be completed in 1998. Since that time, the projected costs have increased to \$5.1 billion, and the estimated completion date has slipped to 2002.<sup>1</sup> Appendix I provides FAA's figures on how the actual and estimated appropriations for AAS are currently allocated. As indicated in appendix I, about 47 percent of the estimated funds for AAS, or \$2.4 billion, have not yet been appropriated.

For fiscal year 1994, FAA has requested about \$456 million in funding for AAS. This budget request includes money needed for technical support contractors, field implementation support, building modernization linked to the AAS project, and training. The bulk of the request--about \$350 million--is to fund the AAS prime contract with IBM.<sup>2</sup>

#### AAS Will Be Implemented In Five Segments

As currently defined in the contract, FAA and IBM will develop the system in five segments. The first segment is the least complex segment known as the Peripheral Adapter Module Replacement Item (PAMRI). It replaces existing communications equipment that connect en route centers with external systems, such as radars. PAMRI is currently operational at all 20 of the nation's continental en route centers.

The second segment of AAS is ISSS. ISSS will also be installed at all en route centers. It will replace mechanical flight strip printers,<sup>3</sup> controller display screens, and associated display processing systems with state-of-the-art color displays called work stations, new software, and modern computer communications networks. ISSS will interface with the primary computer system used by en route centers, known as the Host

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<sup>1</sup>These cost estimates include actual and anticipated appropriations for FAA's Research, Engineering, and Development account and its Facilities and Equipment account.

<sup>2</sup>Requested contract funds include \$152 million for ISSS, \$89 million for TAAS, \$54 million for TCCC, \$27 million for ACCC, \$22 million for developing an advanced software function known as Automated En Route Air Traffic Control (AERA), and a \$6 million award fee.

<sup>3</sup>Flight strips provide controllers with basic air traffic information, such as aircraft routes, altitudes and air traffic clearances. A controller presently marks up the paper strips to record changes to information and to coordinate information with other controllers.

computer. ISSS is a critical segment of AAS because hardware and software being developed for later segments will be based upon ISSS. Thus far, most work by FAA and IBM has been on the ISSS segment of the project.

The third AAS segment is TAAS. It is designed to replace existing Automated Radar Terminal Systems (ARTS), which are the main computer systems used at terminal facilities for controlling approaching and departing aircraft. TAAS will also provide new controller work stations to replace existing radar screens. TAAS will incorporate hardware elements (including work stations), networks, and software already developed for ISSS.

The fourth segment of AAS is TCCC. At selected airport towers, TCCC will replace radar displays and paper flight strip systems with new work stations for tower controllers.

The fifth and final step in the evolution to full AAS is ACCC. It is designed to replace the PAMRI and the Host computers used at en route centers and to consolidate en route (ISSS) and terminal (TAAS) systems into what FAA calls area control facilities. ACCC is also expected to provide AERA. FAA expects AERA to allow controllers to grant more fuel-efficient routes which may also result in passenger time savings as well as reduced aircraft fuel consumption.

#### SCHEDULE DELAYS AND COST GROWTH HAVE WORSENE

Since its conception in 1983, the AAS project has experienced significant schedule delays and cost growth. The schedule delays became more pronounced in 1992. Schedule delays have led FAA to initiate costly interim projects.

#### Schedule Delays Have Continued

The AAS project continued to experience schedule delays in 1992. As a result, FAA and IBM agreed in March 1993 to an additional 14-month delay in the second segment of AAS. This brought the total delay in this segment to about 3 years beyond milestones set in the 1988 contract. In March 1993, FAA officials also indicated that the third segment--TAAS--will be delayed an additional 7 months, for a total delay of about 2 years from the milestone set in the contract. TCCC and ACCC are in the early stages of development. Their completion dates are uncertain.

#### The Cost of AAS Has Grown

FAA's official March 1993 estimated total cost for AAS is \$5.1 billion, an increase of 6 percent since 1988. However, recent AAS problems have caused FAA to identify a potential \$235 million in additional project costs. These additional costs are mainly due to FAA and IBM underestimating the work needed to produce ISSS and

TAAS. FAA officials told us they hope to offset the \$235 million cost increase with other actions. However, they did not provide us with any specifics as to how they will accomplish this.

FAA is also considering other changes to AAS which may alter the agency's total cost estimate for the project. For example, FAA plans to change the design and quantities of equipment for the tower (TCCC) segment. Also, likely changes to FAA's facility consolidation plan would require FAA to exercise some contract options not yet factored into its cost projections for AAS. FAA is unsure whether these changes will increase or decrease costs for AAS.

#### Delays In AAS Have Led to Costly Interim Projects

Because of delays in AAS, FAA has been forced over the years to start some costly interim projects to sustain and enhance current hardware and software. For example, FAA initiated a \$435 million Interim Support Plan in 1987 to bridge the gap between current and future automation systems at terminal facilities. In 1992, FAA began an \$80 million project to buy advanced versions of ARTS to install at some of its larger terminal facilities. Over the past few months, FAA also initiated additional plans for three projects, costing over \$200 million, to sustain its en route centers until AAS can be installed. FAA has not included costs for these interim projects in the \$5.1 billion estimate for AAS even though AAS delays have caused the need for these projects.

#### SEVERAL MAJOR FACTORS HAVE LED TO CURRENT PROBLEMS

Several major factors have led to current problems with the AAS project. In 1988, FAA and IBM agreed to an AAS plan that was too ambitious and established schedules that proved to be unrealistic when IBM encountered technical difficulties. Also, FAA did not exercise adequate oversight of IBM's progress in software development. In addition, FAA has not been decisive in resolving basic requirements issues.

#### The Plan for AAS Was Overly Ambitious

In our opinion, one of the major causes of current AAS problems is that the initial plan was overly ambitious. In the early 1980s, FAA decided to replace the fundamental hardware and software in en route facilities, terminals, and airport towers with one large project to be implemented over a period of 13 years. This project was to have been incorporated within a consolidation plan that would have affected every en route and terminal facility in the country. However, later events show that both FAA and IBM underestimated the effort required to replace key hardware and software components throughout the air traffic control system.



As a result of their misjudgment of the effort required for AAS, FAA and IBM set schedules which could not be met after IBM encountered technical difficulties. The issue of unrealistic schedules was highlighted in an April 1992 report done at the request of the House Committee on Appropriations by the Volpe National Transportation Systems Center.<sup>4</sup> The Volpe report stated that overly aggressive schedules were overtaken by factors such as unresolved requirements and design and software rework.

#### FAA Did Not Provide Adequate Oversight

FAA did not assign sufficient staff or implement adequate quantitative measures for assessing the progress of IBM's software development efforts. This has prevented FAA from having necessary oversight of IBM's performance.

Concerned about FAA's oversight of IBM's software development efforts, the April 1992 Volpe report recommended that FAA increase the number of staff positions within the project office's software development branch from three to between six and eight people. FAA has subsequently added two staff members to this branch.

The Volpe report also noted that the official progress reports did not provide a realistic assessment of the amount of software development completed and remaining. For example, Volpe pointed out that measuring software development in terms of software builds--increments in which the software is built and tested--did not provide an adequate measure of progress. FAA and IBM indicated as recently as last summer they were making good progress with ISSS because they were working on the last software build. However, they did not acknowledge that much of the software code for the most difficult functions remained unwritten and untested. FAA still has a very limited capability for providing information on the real progress of software development. When we asked for such documentation in March 1993, an FAA project official stated that this information was not yet available, but the agency was trying to develop such performance measures.

#### FAA Has Not Effectively Resolved Some Major Requirements Issues

FAA has experienced difficulty in resolving requirements for ISSS, which has contributed to the problems experienced by the project. The Volpe report addressed the issue of unresolved requirements. The report said that, in areas such as electronic flight strip definition and controller screen display formats, the lack of resolution of requirements issues implied high schedule and

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<sup>4</sup>"An Assessment of the Status and Technical Risk of Federal Aviation Administration's Advanced Automation System Software Development" (IR-MA-1298-2), Volpe National Transportation Systems Center and Intermetrics, Inc., April 1992.

technical risk for ISSS. According to IBM project officials, the lack of clarity and decisiveness by FAA in resolving requirements issues is an important contributing factor to the AAS schedule problems. The Volpe report recommended that FAA enhance the process for resolving ISSS requirements issues.

MANAGEMENT INITIATIVES ARE ENCOURAGING  
BUT ISSS TECHNICAL CHALLENGES REMAIN

FAA implemented in March of this year a series of management initiatives to address ISSS problems identified in 1992. These initiatives include increasing top-level attention to the project and establishing a structure for resolving requirement issues in a timely manner. It will take time for the initiatives to work. Meanwhile, FAA and IBM must overcome a number of technical challenges. Until ISSS is successfully tested, additional schedule delays and cost increases may occur.

Management Initiatives Implemented to Address ISSS Problems

In March 1993, FAA acknowledged that it had not been exercising sufficient, continuing top-level management focus on the project, including providing adequate attention to requirements issues, and that it generally took too long to respond to technical issues.

To address these problems, FAA instituted three management-related initiatives. First, the agency elevated the AAS project by naming a program director to oversee AAS who now reports directly to the Administrator. The program director for AAS is the former program manager of AAS. However, he is now empowered to make decisions on issues affecting requirements, except where schedule or cost of the project will be affected by a requirements change. As a result, the program director is accountable for cost containment and keeping the project on schedule. The FAA's Acquisition Review Council, chaired by the Administrator, is responsible for reviewing the status of the AAS project at least every 2 weeks, and more often if necessary. The Council is also responsible for ruling on requirements changes that impact on ISSS cost or schedule.

Second, FAA is in the process of establishing separate program managers for each of the four remaining segments of the AAS project. The former deputy program manager for AAS has been selected as the ISSS program manager.

Third, FAA established a dedicated ISSS team on-site at IBM. The team includes representatives from Air Traffic and Airway Facilities organizations within FAA, as well as a contracting officer. The team is fully empowered to resolve technical problems as they arise, eliminating the decision-making delays of the past

where it took too long for the agency to come to grips with such problems.

IBM also took action in March 1993 to address the ISSS problems. The Chief Executive Officer of IBM's Federal Systems Company assumed the role of AAS program manager. He became personally involved to ensure that AAS met its technical, schedule, and cost milestones. IBM also focused its management attention on fixing the ISSS schedule problems, eliminated inefficiencies in its test organization, and limited software changes to those that are mandatory. Moreover, IBM integrated additional diagnostic and simulation tools with plans to continue expanding this capability.

These management initiatives implemented by FAA and IBM will take time to work. We believe that these initiatives are reasonable under present circumstances. They facilitate decision-making, but they will not necessarily resolve technical challenges.

#### Technical Challenges Lie Ahead for ISSS

FAA and IBM cannot be certain that ISSS is truly under control--and that schedule delays and cost increases will not recur--until all technical challenges are overcome and the system is fully tested. Two of the major technical challenges that IBM has experienced during ISSS development are discussed below.

- System stability. A senior AAS project official described stability of the system as the most important issue facing ISSS at this time. The AAS contract requires ISSS to sustain 210 work stations simultaneously while operating at peak load. IBM had only been able to reach a level in which 56 work stations operate together for short periods of time, as of February 1993.
  
- Reconstitution of the Host computer data base. Under ISSS, the Host computer will continue to supply flight data and other information to the ISSS work stations. These work stations will have their own processors which controllers will be able to use to store and update data. However, should the Host computer become inoperative and be unable to process and communicate data, the work station processors will be able to operate independently. The problem occurs when the Host computer is reactivated because it will have a different set of flight data than will exist in the work station processors. Because of the inconsistencies in the databases of the Host and the work station processors, they will not be able to work together upon reactivation of the Host. At the March 10, 1993, House Subcommittee on Aviation hearing on AAS, IBM acknowledged that it did not know how to address this problem, but it is convinced that a solution will be found.

Development problems such as those cited above have prevented FAA and IBM from testing ISSS. As a result, no significant testing has been completed to date. According to an FAA official, FAA's acceptance of ISSS is currently planned for September 1994. Thereafter, ISSS will be subjected to one year of operational testing at FAA's test center, followed by an additional year of field testing before the system becomes operational. What such testing will find is unknown. However, as the FAA Acting Administrator pointed out at the March 10, 1993, hearing, operational testing of ISSS will highlight some aspects of the system that may need refining or changing before full-scale deployment can begin.

Knowing that technical challenges remain, FAA has deferred its production decision on ISSS hardware. We support this decision. Until ISSS software is successfully tested, FAA does not need to acquire large quantities of ISSS hardware.

#### FUNDING NEEDS FOR LATER SEGMENTS ARE UNCERTAIN

At this time, the total funding needs to fully implement AAS are uncertain because FAA intends to restructure the AAS project. We believe that the restructuring--which FAA has yet to announce--will have implications for project costs and schedules, user benefits, equipment location, and FAA's contract with IBM. Consequently, it would be prudent to limit funding of FAA's effort this fiscal year to activities that would not constrain its choice of options.

FAA intends to restructure AAS for three reasons-- implementation of a new consolidation strategy, potential acceleration of the schedule for advanced software functions, and a reduction in the number of towers receiving TCCC equipment. First, full-scale consolidation of en route centers and terminals has been the foundation of the AAS contract. FAA planned to consolidate over 230 air traffic control facilities of varying sizes into 23 area control facilities. However, after extensive study, FAA concluded in March 1993 that a major shift in policy regarding consolidation of air traffic control facilities is warranted. Concerns over safety in the event of a catastrophic failure of an area control facility and analysis of other factors have convinced FAA that significantly less consolidation should be adopted. Therefore, FAA and the Department of Transportation recently recommended to the Office of Management and Budget that consolidation now consist of (1) keeping the 22 existing en route centers,<sup>5</sup> (2) creating nine large terminal facilities, and (3) keeping about 170 unconsolidated terminal facilities. Limited consolidation would represent a change in several technical and

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<sup>5</sup>This includes 20 en route centers in the continental United States and one facility each in Alaska and Hawaii.

cost assumptions upon which TAAS and ACCC were based. For example, FAA will install TAAS at only the nine large terminal facilities rather than in 23 area control facilities as originally contracted for with IBM. Moreover, FAA has yet to decide whether TAAS or some other automation system will be installed at the 170 non-consolidated terminals.

Second, in recognition of the airline industry's recent financial problems, FAA is attempting to expedite the implementation of advanced software functions originally scheduled to be implemented with the final segment of AAS. Most importantly, FAA is exploring ways to add AERA--which could permit controllers to grant aircraft more fuel-efficient routes--to ISSS. This is a high-priority item for FAA because it offers significant benefits to the airline industry. If expediting AERA is technically feasible, this would be a positive step for helping the airline industry. However, we caution that this expedited version of AERA will not be available until at least late 1996 when ISSS is scheduled to be operational.

Third, under the terms of the 1988 AAS contract, 258 of the current 435 airport towers were designated to receive full TCCC. However, under FAA's limited consolidation proposal, FAA would install full TCCC at fewer sites. FAA would install full TCCC at 80 airport towers and a less capable TCCC at 105 towers. FAA has not determined what to do at the remaining 250 towers.

FAA's forthcoming justification for its restructuring of AAS would be most effective if it included two elements. One element is a description of the extent of problems with existing equipment. For example, FAA's original justification for AAS cited in 1981 that then-existing equipment would not be capable of handling air traffic beyond the late 1980s. However, FAA now estimates that existing equipment will be able to handle air traffic through the year 2000 and perhaps beyond given recent and planned enhancements to the systems. The second element is a description of the capabilities and user benefits that AAS and other automation enhancements will offer, in quantitative terms, over and above current equipment. In October 1992, we asked FAA for data on such capabilities. After 6 months, FAA provided mostly qualitative descriptions of the added capabilities. For example, FAA said ACCC and associated software would allow controllers to grant more user-preferred routes but the agency did not identify how many more. Also, FAA said AAS would increase system reliability. However, the agency did not identify for us how much system reliability would be increased by AAS. Information on the condition of existing equipment and additional capabilities provided by AAS segments would help the Executive branch and Congress make decisions on the future of the project.

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In summary, we believe that recent management initiatives to address ISSS development problems are reasonable under current circumstances. However, it will take some time for these changes to work. For ISSS to be successful, FAA and IBM must address numerous technical challenges. However, we are still concerned about the uncertainty that surrounds the last three segments of AAS. Less consolidation, a desire to implement advanced software earlier, and less tower modernization will have implications for AAS project costs and schedules, user benefits, equipment location, and FAA's contract with IBM. We believe that continued support should hinge on FAA's successful demonstration that AAS technical challenges can be met and the quality of the agency's justification for restructuring and proceeding with AAS.

AAS ACTUAL AND PROJECTED APPROPRIATIONS  
(Dollars in millions on a fiscal year basis as of 3/1/93)

ITEM	1982-88		1989-93		1994- completion		Total cost	
	RE&D	F&E	RE&D	F&E	RE&D	F&E	RE&D	F&E
1. Design competition phase	417	277					417	277
2. Acquisition phase:								
Prime Contract:								
PAMRI						10		10
ISSS						450		450
TAAS						460		460
TCCC						424		424
ACCC/AERA						244		244
Not segmented		60		1,229		232		1,520
Total prime		60		1,229		1,820		3,108
Tech. support		20		234		256		509
Implementation support		22		94		212		328
Training				7		60		67
En-route center modernization				348		66		414
FAA in-house			19				19	
Subtotals	417	379	19	1,912	0	2,413	436	4,704
Total project	796		1,931		2,413		5,140	

- Notes: (1) Columns may not add due to rounding.  
(2) Funding for AAS has been provided through both the Research, Engineering and Development (RE&D) and Facilities and Equipment (F&E) accounts.

Source: FAA's Advanced Automation Project Office

RELATED GAO PRODUCTS

Air Traffic Control: Advanced Automation System Problems Need to Be Addressed (GAO/T-RCED-93-15, Mar. 10, 1993).

Transportation Issues (GAO Transition Series) (GAO/OCG-93-14TR, Dec. 1992).

Air Traffic Control: Justifications for Capital Investments Need Strengthening (GAO/RCED-93-55, Jan. 14, 1993).

Air Traffic Control: Advanced Automation System Still Vulnerable to Cost and Schedule Problems (GAO/RCED-92-264, Sept. 18, 1992).

FAA Budget: Key Issues Need to Be Addressed (GAO/T-RCED-92-51, Apr. 6, 1992).

Air Traffic Control: Status of FAA's Modernization Program (GAO/RCED-92-136BR, Apr. 3, 1992).

Air Traffic Control: Software Problems at Control Centers Need Immediate Attention (GAO/IMTEC-92-1, Dec. 11, 1991).

Air Traffic Control: FAA Can Better Forecast and Prevent Equipment Failures (GAO/RCED-91-179, Aug. 2, 1991).

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

Air Traffic Control: FAA's Advanced Automation System Contract (GAO/IMTEC-91-25, Mar. 5, 1991).

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

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

Federal Aviation Administration's Advanced Automation System Investment (GAO/T-IMTEC-88-3, Apr. 12, 1988).

Air Traffic Control: FAA's Advanced Automation System Acquisition Strategy Is Risky (GAO/IMTEC-86-24, July 8, 1986).

GAO Questions Key Aspects of FAA's Plans to Acquire the Multi-Billion Dollar Advanced Automation System and Related Programs (GAO/IMTEC-85-11, June 17, 1985).



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