United States General Accounting Office

GAO

Fact Sheet for Congressional Committees

April 1994

AIR TRAFFIC CONTROL

Status of FAA's Modernization Program

GAO/RCED-94-167FS

GAO

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

Resources, Community, and
Economic Development Division

B-247729

April 15, 1994

The Honorable Frank R. Lautenberg
Chairman
The Honorable Alfonse M. D'Amato
Ranking Minority Member
Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
United States Senate

The Honorable Bob Carr
Chairman
The Honorable Frank R. Wolf
Ranking Minority Member
Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
House of Representatives

This fact sheet is the fifth annual review requested by your Subcommittees of the Federal Aviation Administration's (FAA) comprehensive effort to modernize the nation's air traffic control system by acquiring new equipment, such as radars, computers, and communications systems. The fact sheet provides information on the status of modernization, giving special emphasis to 12 of the largest projects.

The modernization program began in 1981 under FAA's National Airspace System Plan, which was expanded in 1990 and renamed the Capital Investment Plan. Under both plans, projects have been funded largely through FAA's Facilities and Equipment appropriation. This appropriation increased from $260 million in fiscal year 1982 to $2.39 billion in fiscal year 1992, before falling to $2.35 billion and $2.12 billion in fiscal years 1993 and 1994, respectively. FAA is seeking $2.27 billion for fiscal year 1995, a 7-percent increase over the previous year's appropriation.

In summary, we found that:

-- FAA currently estimates that the cost of the modernization program from 1982 through 2001 will be

$36.2 billion. Last year, the agency's estimate for the cost of modernization for this same period of time was $34.1 billion. The $2.1 billion net increase over last year consists of $4.1 billion in increases for new and existing projects less $2.0 billion in reductions for other projects and budget items. Planned investments due to changes in FAA's plans for consolidating facilities are a major factor in the increase--accounting for $1.4 billion of the net change. Approximately $17.8 billion of the $36.2 billion has been appropriated; FAA plans to request the remaining $18.4 billion between fiscal years 1995 and 2001.

-- FAA had completed 54 projects in the Capital Investment Plan by the end of 1993, including 8 projects in the past year. These 54 projects account for approximately $3.0 billion, or 8 percent, of the total estimated cost of modernizing the air traffic control system through fiscal year 2001. Currently, the Capital Investment Plan includes 184 active or planned projects.

-- The unobligated balance in FAA's Facilities and Equipment account declined last year for the first time since fiscal year 1987. At the end of fiscal year 1993, $1.78 billion in appropriated funds remained unobligated, down about $200 million from the previous year. FAA estimates a sharp decline in this balance to $1.12 billion by the end of fiscal year 1994.

-- For the majority of the 12 major acquisitions that we reviewed in detail, changes in costs and schedules continued. Changes in the number of units FAA expects to purchase, software development issues, and site identification and preparation difficulties are three significant factors that led to cost and schedule changes over the past year. The combined estimated cost of the 12 projects declined by approximately $526 million, largely because FAA reduced the number of Microwave Landing Systems it plans to procure, thereby lowering the project's cost by $1.9 billion. Costs for eight projects rose by a total of $1.4 billion, including a $1.2 billion increase in the cost of the Advanced Automation System caused largely by continuing software development problems. When last year's annual fact sheet was issued, 4 of the 12 projects were scheduled to reach first-site implementation before the issuance of this year's fact sheet. However, only two of the four projects actually reached this milestone:

the Airport Surface Detection Equipment-3 and Mode Select radars.

-- Because of the $1.2 billion increase in the cost of the Advanced Automation System, the FAA Administrator formed a task force led by the Deputy Administrator to review the potential extent of further cost and schedule increases. The task force reported that under the "most likely" scenario, costs for the Advanced Automation System would increase by another $1 billion and a 20-month delay in a key initial segment of the project was likely. The Administrator is awaiting the results of other reviews of the Advanced Automation System project to determine its future course.

-- Despite the planned installation of several weather-related projects, FAA and the aviation industry have identified several additional high-priority needs. For two key new systems that FAA is developing to meet these needs--the Aviation Weather Products Generator and the Integrated Terminal Weather System--total estimated project costs have increased significantly. These increases have been identified as the systems have been defined in more detail during the early stages of the acquisition process.

Section 1 of this fact sheet provides background information on the air traffic control system and its modernization. Section 2 discusses the status of the overall modernization effort, emphasizing changes in cost estimates. Section 3 reviews in detail the changes from 1993 to 1994 in the costs and schedules for 12 major acquisitions, including the Advanced Automation System and the Microwave Landing System. Section 4 provides information on FAA's aviation weather program, including cost and schedule data on two key weather projects.

SCOPE AND METHODOLOGY

We conducted our review from October 1993 through March 1994, focusing on changes to the modernization program that have occurred over the past year. We obtained the information for this fact sheet by analyzing data from various sources. Information on the overall costs of air traffic control modernization, as well as on appropriations and obligations, were obtained from documents provided by FAA program management and budget officials. Cost and schedule information for individual systems was obtained from FAA program officials for each project and from FAA's System Engineering and Integration Contractor. We obtained other status information during interviews with FAA officials, including program managers, business managers, research and development officials, and officials from the Office of Independent Operational Test and Evaluation Oversight. We also obtained information from officials at the National Oceanic and Atmospheric Administration.

We are providing copies of this fact sheet to the Secretary of Transportation; the Administrator, FAA; and other interested parties. We will make copies available to others on request.

Please contact me on (202) 512-2834 if you have any questions. Major contributors to this fact sheet are listed in appendix I.

Kenneth M. Mead
Director, Transportation Issues

CONTENTS

ABBREVIATIONS

AAS	Advanced Automation System
ACCC	Area Control Computer Complex
AERA	Automated En-Route Air Traffic Control
AGFS	Aviation Gridded Forecast System
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ASDE	Airport Surface Detection Equipment
ASOS	Automated Surface Observing System

ASR	Airport Surveillance Radar
ATCBI	Air Traffic Control Beacon Interrogator
ATCT	Airport Traffic Control Tower
AWOS	Aviation Weather Observing System
AWPG	Aviation Weather Products Generator
CIP	Capital Investment Plan
CWP	Central Weather Processor
DT&E	Development Test and Evaluation
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
FSAS	Flight Service Automation System
GAO	General Accounting Office
GPS	Global Positioning System
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IOT&E	Office of Independent Operational Test and Evaluation Oversight, Federal Aviation Administration
ISSS	Initial Sector Suite System
ITWS	Integrated Terminal Weather System
LDRCL	Low Density Radio Communication Link
LINCS	Leased Interfacility NAS Communications System
LLWAS	Low Level Windshear Alert System
MCF	Metroplex Control Facility
MLS	Microwave Landing System
MWP	Meteorologist Weather Processor
N/A	not applicable
NAS	National Airspace System
NATCA	National Air Traffic Controllers Association
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OIG	Office of Inspector General
ORD	Operational Readiness Date
OT&E	Operational Test and Evaluation
PAMRI	Peripheral Adapter Module Replacement Item
PCB&T	Personnel Compensation, Benefits, and Travel
RCL	Radio Communication Link
RCR	Routing and Circuit Restoral
RML	Radar Microwave Link
RWP	Real-time Weather Processor
SEIC	Systems Engineering and Integration Contractor
SRS	Software Requirement Specification
TAAS	Terminal Advanced Automation System
TCCC	Tower Control Computer Complex
TDWR	Terminal Doppler Weather Radar
TRACON	Terminal Radar Approach Control
TSSC	Technical Support Services Contract
VSCS	Voice Switching and Control System
WARP	Weather and Radar Processor

SECTION 1

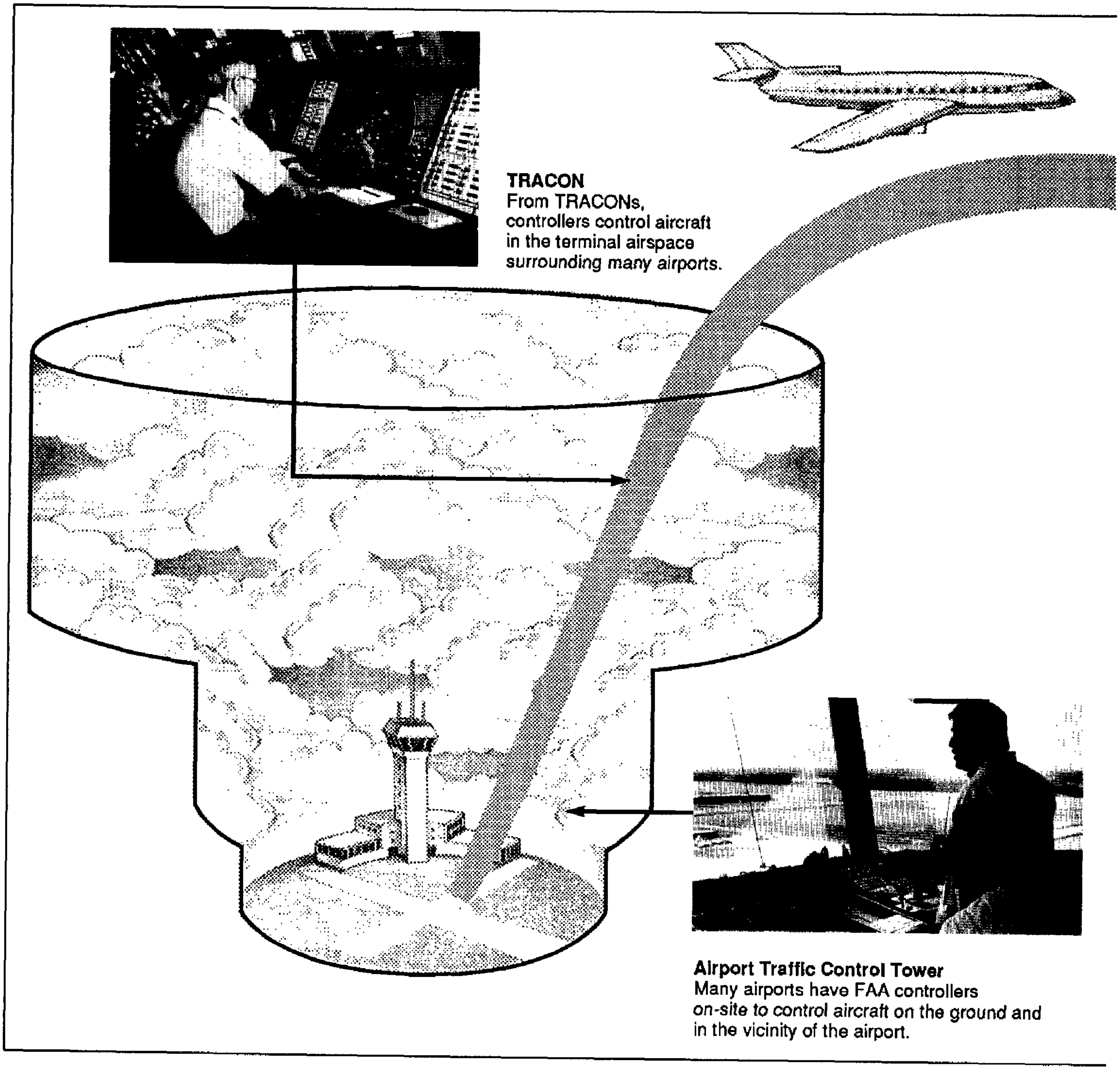
BACKGROUND ON THE U.S. AIR TRAFFIC CONTROL SYSTEM

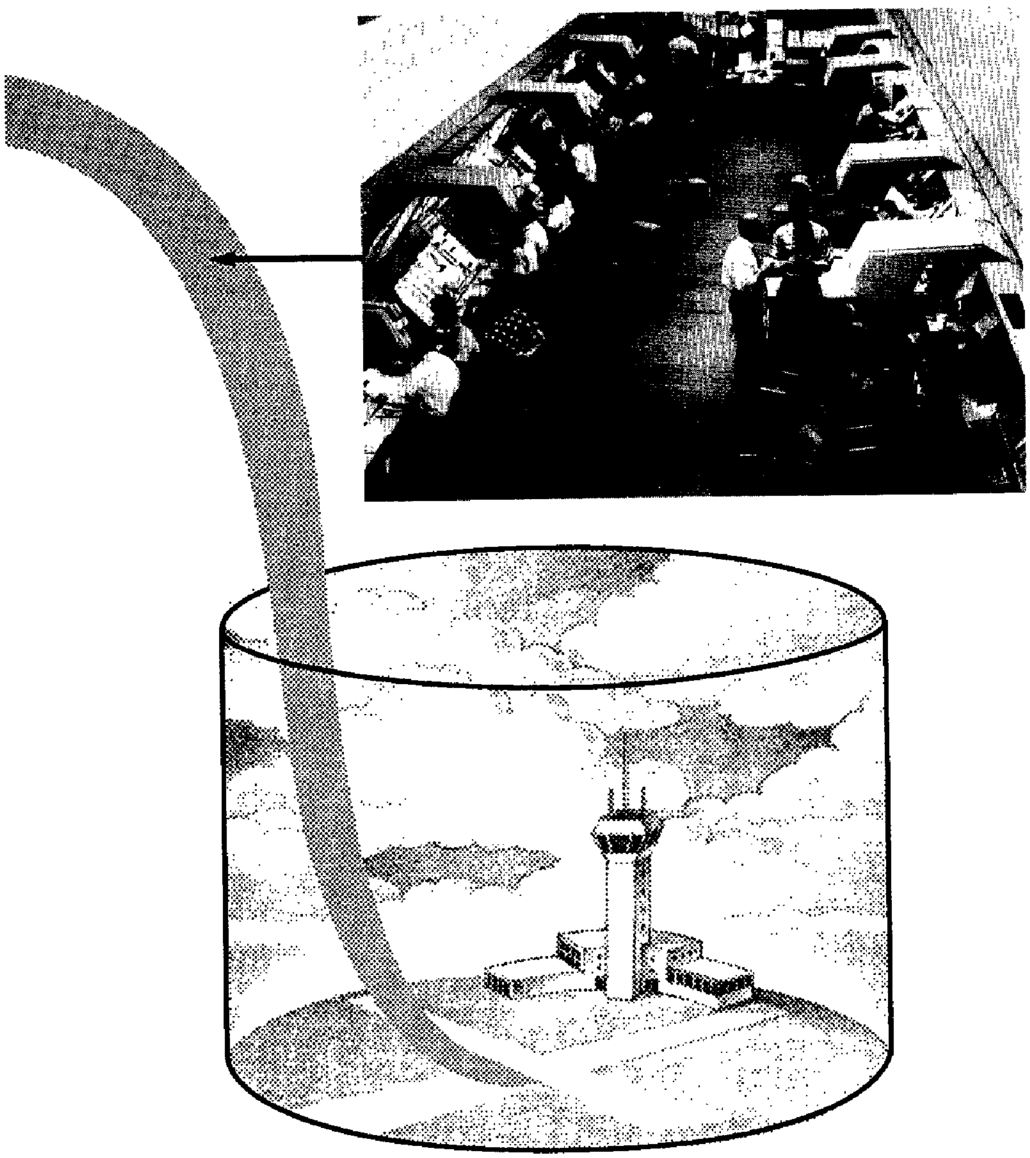
The Federal Aviation Administration's (FAA) mission is to promote the safe, orderly, and expeditious flow of aircraft. FAA uses a wide variety of equipment, facilities, and personnel to guide aircraft through the nation's airspace.

FAA's air traffic controllers maintain separation between aircraft and facilitate the efficient movement of aircraft through the air traffic system. FAA places its controllers primarily in three types of facilities: airport traffic control towers (ATCT), terminal-area facilities, and en-route centers. FAA controllers in the ATCTs control the movement of aircraft on the ground and in the vicinity of the airport. From terminal-area facilities--also known as Terminal Radar Approach Control (TRACON) facilities--controllers sequence and separate aircraft in terminal airspace, which extends from the point at which tower control ends to about 20 to 30 miles from the airport. From en-route centers--also known as Air Route Traffic Control Centers (ARTCC)--controllers assume control of aircraft outside of terminal airspace and maintain control until the aircraft enters terminal airspace at its destination. Figure 1.1 provides a general picture of how airspace is constructed and controlled.

In addition to these three types of air traffic control facilities and controllers, FAA relies on other equipment and personnel to promote the safe and expeditious flow of aircraft. For example, flight service stations provide services, such as disseminating weather information, primarily to general aviation pilots. Throughout the country, long- and short-range radars track and identify aircraft, and a variety of systems are used to detect and relay weather information to controllers and pilots. Communication equipment is used to exchange voice and other data between pilots and air traffic controllers.

Figure 1.1: Three Main Types of Airspace and Their Associated Air Traffic Control Facilities





En-Route Center
From en-route centers, controllers assume control of aircraft leaving TRACON airspace. They maintain control until aircraft enter airspace controlled by a TRACON or other en-route center.

SECTION 2

INFORMATION ON THE OVERALL STATUS OF MODERNIZATION

This section discusses the status of FAA's entire air traffic control modernization program, including the costs projected for the projects in FAA's 1993 financial plan, the factors affecting these costs, and other issues related to modernization.

TOTAL ESTIMATED COST OF MODERNIZATION THROUGH 2001 STANDS AT $36.2 BILLION

FAA currently estimates that the cost of the modernization program for fiscal years 1982 through 2001 will total $36.2 billion. Last year, the agency's estimate for the same time period was $34.1 billion. Of the current estimate, $17.8 billion was appropriated from fiscal years 1982 through 1994; FAA projects that $18.4 billion will be needed from fiscal years 1995 through 2001.

The $2.1 billion net increase over last year in the estimated cost of modernization consists of $4.1 billion in increases for new and existing projects less $2.0 billion in reductions for other projects and budget items. Planned investments required by a change in FAA's plans for consolidating facilities account for $1.4 billion of the increases. The $2.1 billion net increase is not related to inflation, since FAA incorporates expectations for inflation when formulating estimates for the cost of each project. Table 2.1 shows the elements comprising the net increase.

For the purposes of this report, the "cost of modernization" means all Facilities and Equipment (F&E) appropriations from 1982 through 2001 for projects in FAA's financial plan. This plan contains funding primarily for projects in the Capital Investment Plan (CIP) but also for personnel compensation, benefits, and travel (PCB&T); for Technical Support Services Contract (TSSC) activities; and for some projects whose costs FAA has estimated even though it has not yet added the projects formally to the CIP.

The growth in costs represents the difference between FAA's October 1992 and November 1993 financial plans. In last year's report, we compared FAA's estimates through fiscal year 2000. This year, since FAA's estimates extend through fiscal year 2001 in both plans, we have been able to analyze costs through that year.

Table 2.1: Elements Comprising the Increase in the Estimated Cost of Modernization Through Fiscal Year 2001--A Comparison of the 1992 and 1993 CIP Financial Plans

Dollars in billions

Additions	Cost	
Estimated costs for 22 new projects in the 1993 CIP financial plan	+$1.6	
Increases in estimated costs of ongoing or planned projects that were in the 1992 financial plan	+$2.5	
Subtotal of Additions:		**+$4.1**
Reductions		
Reductions in estimated costs for projects that were in the 1992 financial plan	-$1.7	
Reductions in estimated costs for personnel and technical support services that are not allocated to specific projects	-$0.3	
Subtotal of Reductions:		**-$2.0**
Total (net change)		**+$2.1**

REVISING CONSOLIDATION PLAN SIGNIFICANTLY INCREASED ESTIMATED COSTS

In deciding to scale back its plans for consolidating air traffic control facilities, FAA significantly increased the estimated cost of modernization. Under a plan developed in 1983, FAA first proposed to consolidate all TRACONs (about 205 in total) into the nation's 22 en-route centers and the New York TRACON. However, in 1993 FAA submitted a revised plan to the Congress[1] that called for 22 en-route centers, 5 to 9 consolidated TRACONs

[1] Report to Congress: Plan for Limited Consolidation of the National Airspace System, report of the Secretary of Transportation to the House and Senate Committees on Appropriations pursuant to House Report 102-156 on the Department of Transportation Fiscal Year 1992 Appropriations Act (Sept. 1993).

(designated as "metroplex" facilities), and up to 187 unconsolidated TRACONs. This revised plan requires FAA to make additional investments (paid for through the F&E account) to construct, modernize, and support a much larger number of facilities than were envisioned under the previous plan. Approximately $1.4 billion of the $4.1 billion in cost increases is related to the revised consolidation plan. In our tables of the projects contributing the most to cost growth in the CIP (tables 2.2 and 2.3), those projects related to the consolidation decision appear in bold type.

EIGHT PROJECTS WERE COMPLETED IN 1993

One way to measure FAA's progress in modernizing the air traffic control system is to identify the number of projects that have been completed. FAA has completed 54 projects--including 8 in the past year. These 54 completed projects cost $3.0 billion, or approximately 8 percent of the total estimated cost of modernization through fiscal year 2001. The eight projects completed in 1993 cost $1.4 billion, almost half of the value of all projects completed to date. The largest completed project was "General Support" ($834.7 million), which comprised a variety of diverse support projects and has been superseded by a project called "Continued General Support." Two other large projects listed as complete are the Radar Microwave Link Replacement and Expansion ($268.4 million) and the Central Weather Processor ($135.4 million), both discussed in section 3. Currently, 184 active or planned projects remain in the CIP.

TWENTY-TWO NEW PROJECTS ADD $1.6 BILLION TO THE COST OF FAA'S 1993 CIP FINANCIAL PLAN

Our review of FAA's 1993 CIP financial plan identified 22 new projects estimated to cost $1.6 billion through 2001. Costs for five of these projects are in the CIP financial plan, but the projects have not yet been added formally to the CIP. The number of new projects formally added to the CIP has grown over the past 2 years--17 this year, 12 in 1992, and 5 in 1991. In table 2.2, we have listed the 10 largest new projects added to the 1993 CIP financial plan. (Those projects not yet formally added to the CIP have "6X-XX" as CIP numbers.)

Table 2.2: The 10 Largest New Projects Added to the 1993 CIP Financial Plan

Dollars in millions

Project name and CIP number	Estimated F&E cost
1. TRACON Automation System (62-25)[a]	**$320**
2. Replace Visual Approach Slope Indicator with Precision Approach Path Indicator (44-09)[b]	183
3. Next-Generation Very High Frequency Air/Ground Communications (6X-XX)[c]	160
4. Northern California Metroplex (32-36)[d]	**148**
5. Potomac Project Metroplex (32-34)[d]	**144**
6. Central Florida Metroplex (32-40)[d]	**142**
7. Atlanta Metroplex (32-38)[d]	**124**
8. Area Control Facility/Metroplex Control Facility Backup (6X-XX)[e]	78
9. New York Metroplex (32-42)[d]	**56**
10. Traffic Management System Sustainment (41-06)	53

Note: Costs are through 2001; **bold** type indicates projects related to the revised consolidation plan.

[a]Still largely undefined. Will provide automated work stations to TRACONs under the revised consolidation plan.

[b]Will replace runway lighting systems at many airports.

[c]Provides new, more modern transmitters and receivers. Replaces project 44-04, Air/Ground Radio Replacement.

[d]Consolidates TRACONs under FAA's revised consolidation plan.

[e]Will provide equipment and other items needed to allow an en-route center to control air traffic at a metroplex facility if the metroplex is out of service. Because a similar project was envisioned under the original consolidation plan, FAA does not consider the cost of this project as an additional cost of the new consolidation plan.

THE ESTIMATED COST OF MANY PROJECTS CHANGED SIGNIFICANTLY SINCE LAST YEAR

In addition to new projects, cost changes in existing projects--those that were in both the 1992 and 1993 CIP financial plans--have had a significant effect on the overall estimated cost of modernization. For projects that were in both of the plans, cost increases from 1992 to 1993 totaled $2.5 billion, while cost reductions totaled $1.7 billion. Table 2.3 shows the 10 projects with the greatest dollar **increases** in expected costs since last year, and table 2.4 shows the 10 projects with the largest dollar **decreases**. We limited our lists to project accounts and therefore did not include the $300 million reduction in PCB&T and TSSC costs noted earlier.

Table 2.3: The 10 Projects Whose Estimated Costs Have Increased the Most Since Last Year

Dollars in millions

Project name and CIP number	Cost increase	Percent increase
1. Compliance with occupational safety and environmental standards (46-26)[a]	$245	312%
2. Continued General Support (46-16)[b]	207	31%
3. Establish visual navigational aids for qualifiers (34-09)[c]	184	537%
4. Power Systems Sustained Support (46-07)[d]	183	190%
5. Air Traffic Control Tower/TRACON Modernization (42-13)[e]	**151**	**33%**
6. Air Traffic Control Tower/TRACON Replacement (42-14)[f]	**129**	**28%**
7. Establish air traffic control facilities resulting from Department of Defense base closures (32-28)[g]	123	77%
8. FAA Systems Architecture (56-61)[h]	104	3,477%
9. On-Site Simulation-Based Training Systems (56-29)[i]	103	182%
10. ARTCC Plant Modernization (26-09)[j]	100	28%

Note: Costs are through 2001; **bold** type indicates projects related to the revised consolidation plan.

[a]Reflects a new evaluation of old and new Occupational Safety and Health Administration and environmental requirements.

[b]Replaces General Support, project (26-16), and provides a variety of support services for modernization. Will also pay for the costs of leasing many systems that would formerly have been funded through FAA's Operations account.

[c]Provides new lighting and other equipment that will be required at some airports as satellites allow aircraft to land at a greater number of airports under conditions of poor visibility.

[d]Replaces old generators and provides new power capabilities for FAA facilities.

[e]Was previously in the financial plan. Cost estimates were reduced to a level needed to study alternatives and were later increased to incorporate the cost of the selected alternative. Approximately $92 million of this increase was required because of the new consolidation plan.

[f]Approximately $121 million of this increase attributable to the new consolidation plan.

[g]Includes estimated cost of new equipment and of other requirements for converting to civilian use former military air traffic control facilities designated to be closed in fiscal year 1995. Previous estimate included costs to convert bases to be closed before fiscal year 1995.

[h]Intended to ensure that standards and equipment are in place to allow the sharing of data coming from many new and existing sources. Project still early in development.

[i]Provides new equipment for training primarily TRACON and en-route controllers to use future controller work stations

[j]Provides new power systems for en-route centers.

Table 2.4: The 10 Projects Whose Estimated Costs Have Decreased the Most Since Last Year

Dollars in millions

Project name and CIP number	Cost decrease	Percent decrease
1. Microwave Landing System (MLS) - Phase II (34-07)[a]	-$240	-100%
2. Terminal Radar Digitizing, Replacement and Establishment (34-13)[b]	-198	-24%
3. Long Range Radar Improvements (44-40)[c]	-158	-84%
4. Air/Ground Radio Replacement (44-04)[d]	-104	-100%
5. Radio Control Equipment (25-08)[e]	-96	-26%
6. CIP Systems Engineering and Program Management Support (36-13)	-94	-10%
7. Airport Surface Traffic Automation (62-21)[f]	-92	-45%
8. Airport Surveillance Radar-9 (ASR-9) Modification for Low-Altitude Wind Shear Detection (64-13)[g]	-86	-97%
9. Additional Airport Surface Detection Equipment (ASDE) Replacement (34-14)[h]	-67	-100%
10. Sustain Remote Maintenance Monitoring System (46-01)	-60	-65%

Note: Costs are through 2001.

[a]Estimated cost reduced because of reduction in number of MLSs scheduled for purchase. MLS is discussed in more detail in section 3.

[b]Project largely deferred beyond 2001.

[c]Scope of project reduced in accordance with FAA's determination that use of satellites will lessen the need to upgrade long-range radars in U.S. interior.

[d]Replaced by Next Generation Very High Frequency Air/Ground Communications (see table 2.2).

[e]Reflects decision to use commercial off-the-shelf equipment.

[f]Number of sites reduced to include only the top 30 airports.

[g]Reduced while FAA evaluates alternatives.

[h]Project deleted following decision to procure any additional ASDE-3 radars through ASDE-3 project 24-14 (see section 3) rather than through a separate procurement effort. Costs for project 34-14, as stated in the 1992 CIP financial plan, reflected a $16 million bookkeeping error; this money should have been added to project 24-14. This mistake has been corrected in the 1993 financial plan.

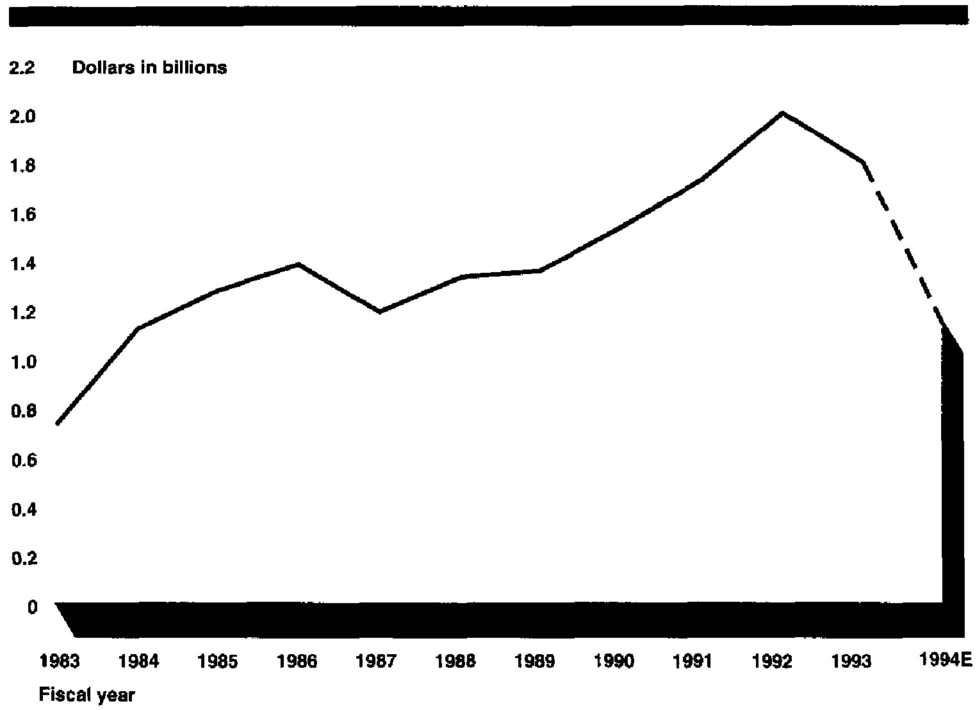
UNOBLIGATED F&E BALANCE DECLINED IN 1993 WHILE FIRST-YEAR OBLIGATIONS INCREASED

Consistent with the agency's projection last year, FAA's unobligated F&E balance dropped by 10 percent during the past year, from $1.98 billion to $1.78 billion. As figure 2.1 shows, this decline in the unobligated balance was the first since fiscal year 1987. Fiscal year 1993 obligations exceeded fiscal year 1992 obligations by $354 million, bringing total fiscal year 1993 obligations to $2.49 billion.

The amount of appropriated money that has actually been obligated can serve as a measure of progress in the modernization of the air traffic control system. Activities that result in the obligation of money include awarding contracts, placing orders, and receiving services. In the past, the Congress has considered FAA's rising unobligated balance to be a sign of problems and an indication of weaknesses in financial and program management. FAA has been able to reverse the rise of unobligated balances.

Figure 2.1 also shows that FAA projects a sharp decline in the unobligated balance over fiscal year 1994, to $1.12 billion. The agency expects obligations to rise from $2.49 billion this year to $2.78 billion. As FAA's Budget Office noted, one factor leading to the increase in obligations is that the Congress has limited F&E appropriations to 3 years in length, beginning in fiscal year 1992. Both the 5-year 1990 appropriations and the 3-year 1992 appropriations will expire by the end of fiscal year 1994.

Figure 2.1: FAA's Unobligated F&E Appropriations for Fiscal Years 1983-94

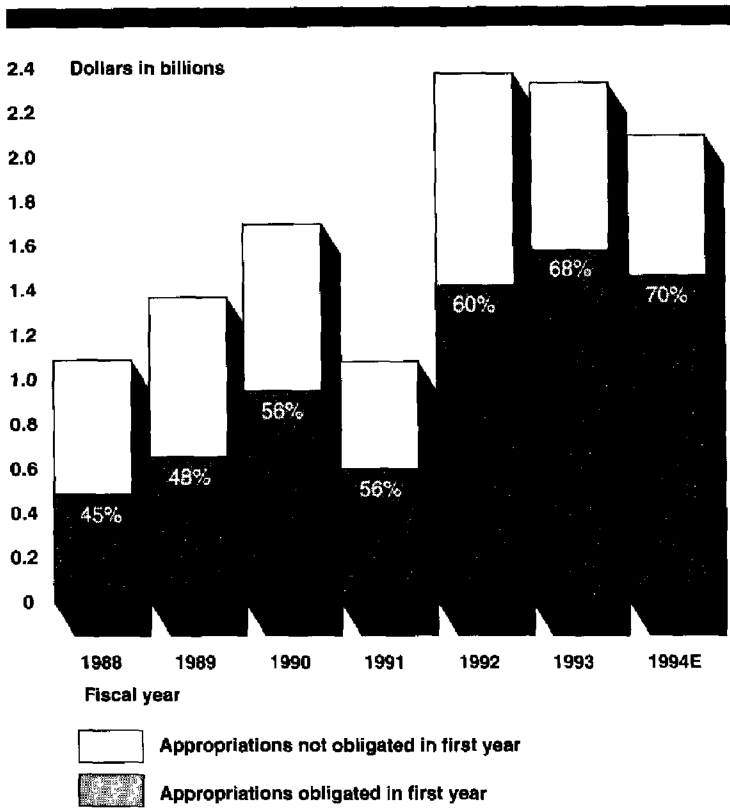


Note: Figure for 1994 is FAA's estimate.

Source: GAO's analysis of FAA's data.

The decline in unobligated F&E appropriations has been accompanied by an increase in the percentage of annual appropriations that are obligated in their first year, also known as "first-year obligations." On a fiscal year basis, the rate of first-year obligations increased from 56 percent in 1991 to 60 percent in 1992 to 68 percent in fiscal year 1993. Figure 2.2 shows the steady increase in first-year obligation rates since 1988.

Figure 2.2: F&E Appropriations and Percentage of First-Year Obligations



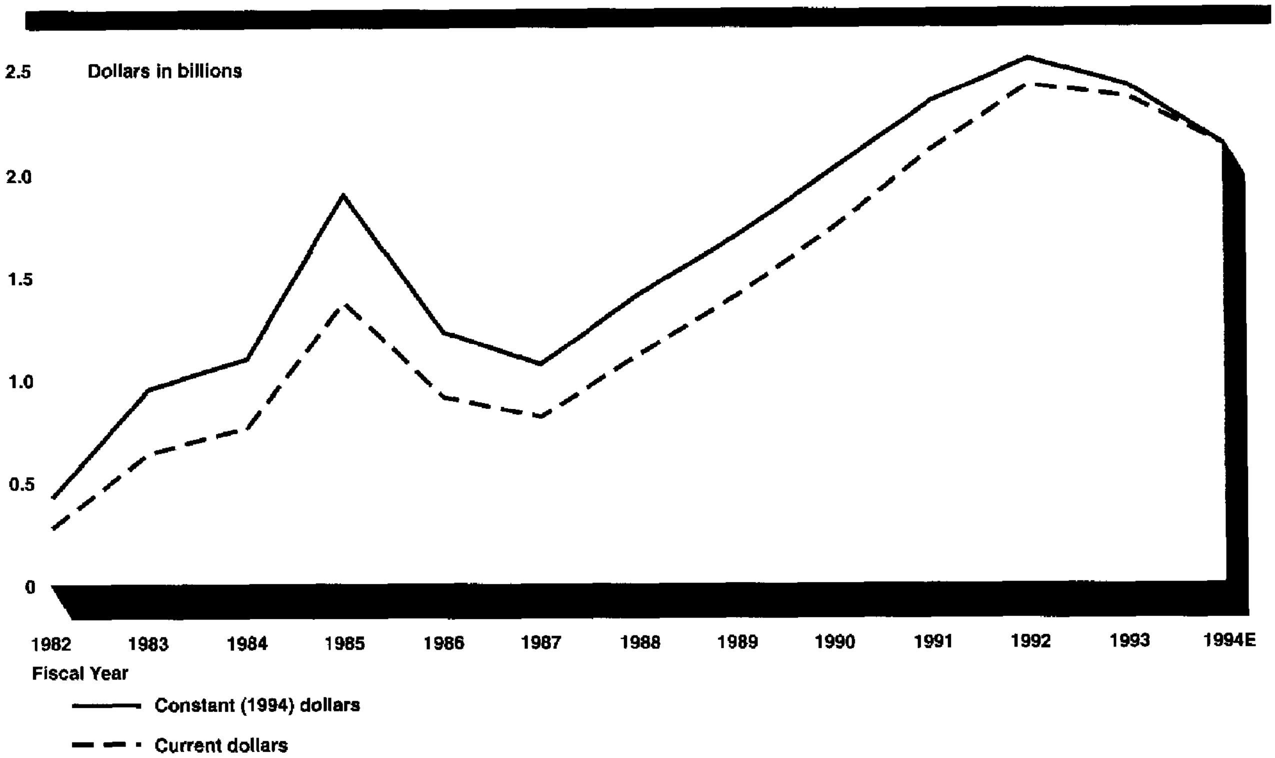
Note: Percentage figures indicate percentage of appropriations obligated in the first year of the appropriation cycle. Figure for first-year obligations for fiscal year 1994 is FAA's estimate.

Sources: GAO's analysis of data from FAA and part 6, page 696, of the record of the hearing before the Subcommittee on Transportation, House Committee on Appropriations, on the Department of Transportation and Related Agencies Appropriations for 1994.

F&E APPROPRIATIONS HAVE INCREASED SIGNIFICANTLY, BUT ARE NOW LEVELING OFF

As indicated in figure 2.3, FAA's F&E appropriations have increased significantly since fiscal year 1987; however, the F&E appropriation decreased in fiscal years 1993 and 1994. In constant 1994 dollars (calculated to remove the effect of inflation), the Congress has increased the F&E appropriation at an average annual rate of 21 percent since the early days of the modernization program in 1982. The F&E appropriation increased sharply between fiscal years 1982 and 1985. After a decline in fiscal years 1986 and 1987, the F&E appropriation again rose sharply--increasing at an inflation-adjusted average annual rate of 11 percent between fiscal years 1987 and 1994, despite an average annual decline of 8 percent during the last 2 years.

Figure 2.3: F&E Appropriations in Constant and Current Dollars, 1982-1994



Source: GAO's analysis of data from FAA's Budget Office.

SECTION 3

INFORMATION ON THE STATUS OF 12 MAJOR PROJECTS

This section provides information on changes in the costs and schedules for 12 of FAA's major acquisitions. These projects represent about $11.6 billion in F&E appropriations over their life spans. The 12 projects discussed in this section are the following:

1. Advanced Automation System (AAS)
2. Air Route Surveillance Radar-4 (ARSR-4)
3. Airport Surface Detection Equipment-3 (ASDE-3)
4. Airport Surveillance Radar-9 (ASR-9)
5. Automated Weather Observing System (AWOS) and Automated Surface Observing System (ASOS)
6. Central Weather Processor (CWP), redesigned this year and renamed Weather and Radar Processor (WARP)
7. Flight Service Automation System (FSAS)
8. Microwave Landing System (MLS)
9. Mode Select (Mode S)
10. Radar Microwave Link (RML) Replacement and Expansion
11. Terminal Doppler Weather Radar (TDWR)
12. Voice Switching and Control System (VSCS)

The cost estimates in this section, which we obtained from project officials, are the total estimated F&E cost of the projects and have been updated through March 1994 to reflect the most recent available information. As a result, some of these estimates differ from the November 1993 CIP financial plan estimates presented in section 2.

Over the past year, the net estimated F&E cost of the 12 projects declined by $526 million. For eight of the projects, costs rose by a total of $1.4 billion, led by a $1.2 billion increase in the cost of AAS resulting largely from delays and difficulties in developing software. The increase in the cost of AAS is to be absorbed by FAA's F&E budget over the next 5 fiscal years. The estimated costs for two projects decreased; most significantly, the cost for MLS decreased by $1.9 billion. This decrease stems from a significant reduction in the number of MLS units that FAA expects to purchase. Most of the funds for eliminated MLS units were scheduled to be appropriated after fiscal year 2001.

As a result of the $1.2 billion increase in the cost of AAS, the FAA Administrator formed a task force, led by the Deputy Administrator, to review the potential extent of further cost and schedule increases. The task force reported that under the "most likely" scenario, the system's cost would increase by another

$1 billion, and a 20-month delay in a key initial segment was likely. The Administrator is awaiting the results of other reviews of AAS to determine the project's future course.

For 9 of the 12 projects, implementation[2] at the first and/or last-site was delayed or became indefinite over the past year. For two projects, ASDE-3 and MLS, the last-site implementation date was moved forward. In both cases, this change was wholly or partially due to a reduction in the number of units FAA plans to purchase. The last-site implementation date for MLS was moved up by 6 years to 2002. At the time we issued our report last year, first-site implementation was scheduled for ASDE-3, Mode S, ARSR-4 and TDWR during the ensuing year. While this milestone was met for ASDE-3 and Mode S, it has not been met for TDWR and ARSR-4.

Software development and site preparation problems continue to cause schedule delays. In particular, software development issues have led to delays in AAS, ARSR-4, and VSCS. Modifying system software to meet the particular conditions of a site has slowed the implementation of ASDE-3. Site preparation problems have led to delays in TDWR and ARSR-4.

Information about each of the 12 projects (including changes in cost and schedule) is summarized in table 3.1 and presented in more detail in the text following the table.

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[2] "Implementation" is equivalent to "operational readiness demonstration" (ORD). In general, implementation is the milestone at which a project moves from F&E funding to the Operations budget. Implementation signifies that a system has been fielded and that the personnel who will use and maintain it are satisfied that it is ready for operation. Usually, commissioning soon follows implementation.

Table 3.1. Major System Summary

Project	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
		1993	1994	Change
Advanced Automation System (AAS)	- Replaces hardware, software, and controllers' work stations at en-route, terminal, and airport tower air traffic control facilities. - Designed to replace aging equipment, increase controllers' productivity, and accommodate projected growth in air traffic through the use of modern equipment and advanced software functions.	$4,703.4	$5,933.4	$1,230.0
Air Route Surveillance Radar (ARSR-4)	- Provides for long-range surveillance radar, en-route navigation, air defense, and drug interdiction. - Decreases costs by replacing older radars that have become difficult to maintain and reducing number of site operators required.	$383.1	$403.2	$20.1
Airport Surface Detection Equipment-3 (ASDE-3)	- Enables controllers at busy airports to monitor ground activity of aircraft and other vehicles under all weather conditions. - Increases surface safety and avoids collisions by replacing aging and less reliable ASDE-1 and -2 radar equipment.	$191.0	$223.8	$32.8
Airport Surveillance Radar (ASR-9)	- Provides highly accurate monitoring of aircraft movement/position within a 60-mile radius of the airport terminal. - Displays weather and aircraft information simultaneously. - Increases busy airports' safety by providing more accurate data to separate and control movement of aircraft in and out of airports.	$838.9	$833.9	($5.0)

2-year comparison of first- and last-site implementation schedules				Key progress and problem issues
	1993	1994	Change	
First-site:	10/91	10/91	None	- The estimated cost of AAS increased by a net $1.2 billion over the past year, largely because of delays and other problems associated with the key Initial Sector Suite System (ISSS) phase of the project. The contractor has had difficulty developing software and ensuring the system's stability. - FAA's decision to scale back the proposed consolidation of air traffic control facilities and estimates of further cost increases and schedule delays have created much uncertainty about the final stages of AAS.
Last-site:	12/02	Indefinite	N/A	
First-site:	01/94	09/94	+8 months	- First-site implementation slipped by 8 months to September 1994 because of delays in completing software and testing systems at the factory. - Plans to install an additional radar increased the estimated cost by $20.1 million. - Last-site implementation slipped by 6 months to September 1996 because delays occurred in site preparation and the contractor reassessed its ability to meet the production schedule.
Last-site:	03/96	09/96	+6 months	
First-site:	04/93	11/93	+7 months	- FAA implemented the first ASDE-3 at Seattle-Tacoma International Airport in November 1993. Although ongoing or planned airport construction is delaying the implementation of some units, the agency has advanced its estimate for last-site implementation to November 1995, in part because it has reduced the number of units it expects to purchase. - The cost of the ASDE-3 project increased by $32.8 million to $223.8 million over the past year. The cost change is due to modifications to ASDE-3 hardware and software for specific airports, software upgrades, site spares, and a request for equitable adjustment by the contractor.
Last-site:	07/96	11/95	-8 months	
First-site:	05/89	05/89	None	- ASR-9's costs declined because the costs of modifying ASR-9 transmitters were lower than expected, as were estimated costs for ASR-9 spare parts. - Availability remains an issue for ASR-9. From October 1992 through November 1993, ASR-9s had 849 hours of total unscheduled outages, resulting in an availability rate of 99.83 percent. Availability based on unscheduled outages for the unit itself--excluding external factors such as loss of commercial power--was 99.94 percent. The contract specifies 99.9-percent availability during the unit's service life but does not describe a specific method for calculating availability.
Last-site:	04/96	04/96	None	

3.1. Major System Summary (continued)

Project	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
		1993	1994	Change
Automated Weather Observing System (AWOS)/ Automated Surface Observing System (ASOS)	- Obtains data such as wind velocity, temperature, dew point, altimeter setting, cloud height, and visibility. - Processes and transmits weather data to pilots via a synthesized computer voice. - Improves safety at small, nontowered airports and reduces observation errors at larger airports.	$229.9	$244.4	$14.5
Central Weather Processor (CWP)/ Weather and Radar Processor (WARP)	- CWP has been replaced over the past year by a new project--the Weather and Radar Processor (WARP). - WARP will integrate CWP's Real-Time Weather Processor (RWP) and Meteorologist Weather Processor (MWP) II. - Will acquire, process and disseminate Next Generation Weather Radar (NEXRAD) data to FAA meteorologists and controllers.	CWP: $152.0 WARP: $0.0 TOTAL: $152.0	CWP: $79.2 WARP: $83.9 TOTAL: $163.1	CWP: ($72.8) WARP: $83.9 TOTAL: $11.1
Flight Service Automation System (FSAS)	- Provides pilots with automated weather data and simplifies flight plan filing. - Increases flight service efficiency and mitigates cost of additional staff and facilities to meet potential increases in demand for flight services.	$532.5	$550.9	$18.4
Microwave Landing System (MLS)	- Gives electronic guidance to aircraft for precision approaches and landings in any weather. - Promotes safety in bad weather and expands airspace capacity.	$2,623.7	$740.8	($1,882.9)

2-year comparison of first- and last-site implementation schedules 1993 1994 Change	Key progress and problem issues
First-site: 07/89 07/89 None Last-site: 05/97 Indefinite N/A	- Costs have increased by $14.5 million, partly because FAA now plans to procure an automated thunderstorm detection system to supplement ASOS weather observations. - FAA is currently restructuring the ASOS project to recognize a $10 million fiscal year 1994 budget reduction. - FAA has implemented 179 of the 200 AWOS units ordered thus far. Uncertainty over when the last ASOS segment of the project will be completed has made last-site implementation indefinite.
First-site: None 10/97 N/A Last-site: None 06/99 N/A (This is the schedule for WARP, which replaced CWP this year.)	- FAA has completed a mission need statement and proposed acquisition plan for WARP, but the agency has not yet submitted these documents to the Department of Transportation for approval. - FAA intends to award a full-scale development/limited-production contract for WARP in fiscal year 1995 and a full-production contract in fiscal year 1998.
First-site: 08/91 08/91 None Last-site: 06/94 09/94 +3 months[a] [a] This is the date for Model 1 full capacity FSAS. Last year, we used 1995, the date for consolidating Flight Service Stations.	- FSAS' costs increased by a net of $18.4 million. Increases of $31.3 million required primarily for a power system and computer support for the Automated Flight Service Stations were partially offset by $12.9 million in cost decreases. - FAA implemented the last of 21 Model 1 Full Capacity Flight Service Data Processor Systems in December 1993. In September 1994, FAA expects to implement Model 1 Full Capacity equipment at the last of 61 Automated Flight Service Stations.
First-site: 03/97 04/97 +1 month Last-site: 12/08 12/02 -6 years	- In 1993, FAA decided to procure 255 Category II and III MLSs, instead of the 1,250 MLS units it previously planned to acquire, because the agency now believes that the Global Positioning System may be able to provide differentially augmented guidance for Category I precision approaches to many U.S. runways. - This change reduced the estimated cost of the project by $1.9 billion but does not provide much short-term budgetary help to FAA because $1.6 billion of this amount was not expected to have been appropriated until after fiscal year 2001.

Table 3.1. Major System Summary (continued)

Project	Description and anticipated benefits	2-year comparison of total F&E cost estimates (In millions of current dollars)		
		1993	1994	Change
Mode Select (Mode S)	- Is a secondary surveillance radar that identifies, locates, and tracks aircraft by communicating with a device, called a transponder, installed in the aircraft. It also provides a message channel between the aircraft and ground facilities. - Improves safety by locating aircraft more accurately than current secondary surveillance radars.	$425.7	$438.2	$12.5
Radar Microwave Link (RML) Replacement and Expansion	- Replaces and expands aging RML. Consists of three CIP projects: (1) Radio Communications Link (RCL), (2) Low Density RCL (LDRCL), and (3) the Routing and Circuit Restoral (RCR) system. - Reduces costs and promotes safety by providing an effective voice and data service connecting en-route centers, long-range radars, and other air traffic facilities.	$313.3	$313.3	None
Terminal Doppler Weather Radar (TDWR)	- Detects windshear and microbursts around airports, as well as gust fronts, wind shifts, and precipitation. - Promotes safety by providing alerts of hazardous weather conditions in terminal areas and of changing wind conditions that influence runway usage.	$350.7	$373.3	$22.6
Voice Switching and Control System (VSCS)	- Replaces and improves voice ground-to-ground and air-to-ground communications at air traffic control facilities. - Increases controllers' efficiency in handling air traffic.	$1,407.0	$1,407.0	None

2-year comparison of first- and last-site implementation schedules 1993 1994 Change	Key progress and problem issues
First-site:[a] 10/93 03/94 +5 months Last-site: 12/96 12/96 None [a] Date for initial Mode S capability for terminal sites.	- FAA implemented a terminal interim beacon system, based on Mode S hardware, in May 1993, 1 month later than estimated last year. In March 1994, FAA implemented the first Mode S. - FAA has pushed back the schedule for many portions of the third phase of Mode S--the en-route Mode S systems. The estimated date for implementing the first en-route Mode S system was delayed by 5 months, to December 1994. However, the December 1996 date for implementing the last site has not been changed.
First-site: 05/86 05/86 None Last-site: Indefinite 12/96 N/A	- FAA completed the RCL portion of the project in November 1992. - Last year, FAA restarted the RCR segment of the project by deciding to pursue a six-site pilot network using equipment purchased through an existing U.S. Air Force contract. Initial testing of the pilot network was completed in January 1994. - FAA tentatively plans to install 12 more RCR systems in fiscal year 1994 and 6 more in fiscal year 1995.
First-site: 06/93 04/94 +10 months Last-site: 06/96 Indefinite N/A	- First-site implementation has been delayed to April 1994 because of problems found during operational testing, including damage to antennae motors from contaminants, computer operation problems, and unacceptably poor power levels from commercial power sources. - Last-site implementation is indefinite. FAA has had difficulties in finding and preparing sites that are available and appropriate. - The estimated cost of TDWR increased by $22.6 million to $373.3 million, partly because of additional site construction costs.
First-site: 02/95 04/95 +2 months Last-site: 03/97 06/97 +3 months	- FAA is allowed to order some VSCS full-production units; however, 18 to 20 percent of the software needs to be developed, integrated, and tested. - FAA is reviewing alternatives for emergency backup systems needed to avert catastrophic failure.

PROGRESS AND PROBLEMS ASSOCIATED WITH THE 12 MAJOR PROJECTS

The following summaries of the 12 major projects we reviewed identify changes in each project's cost and schedule, cite reasons for the changes, and describe the progress and problems encountered in each project since we issued our last report in April 1993.[3] We obtained the information on these projects from the respective program offices, other FAA officials, FAA's System Engineering and Integration Contractor, National Oceanic and Atmospheric Administration officials, and our April 1993 report.

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[3] Air Traffic Control: Status of FAA's Modernization Program (GAO/RCED-93-121FS, Apr. 16, 1993).

ADVANCED AUTOMATION SYSTEM (AAS)

VENDOR: International Business Machines Corporation (IBM), Rockville, Maryland
(Effective March 1, 1994, IBM sold the unit responsible for AAS to Loral Corporation; however, FAA is still working with IBM because the contract has not yet been novated.)

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$4,703.4	$5,933.4	+$1,230.0
Cumulative F&E appropriations through	$2,290.3	$2,583.5	+$293.2
Cumulative F&E obligations through	$2,260.0	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	10/91[b]	10/91[b]	None
Estimated last-site implementation as of	12/2002	Indefinite	N/A

N/A: Not applicable.

[a]Data will not be available until after fiscal year 1994.

[b]This was the implementation date for the first Peripheral Adapter Module Replacement Item. First-site implementation for the key Initial Sector Suite System is scheduled for October 1996.

Background

AAS is the largest project in FAA's modernization program. It is designed to replace aging equipment, increase controllers' productivity, and accommodate projected growth in air traffic through the use of modern equipment and advanced software functions.

FAA introduced the AAS project in 1983 and decided to pursue a two-phase acquisition strategy. First, the agency awarded competitive design contracts to IBM and Hughes Aircraft Company in 1984. FAA expended about $700 million during this first phase.[4] In July 1988, FAA awarded a contract to IBM to complete the second acquisition phase, namely, the development and production of AAS. Effective March 1, 1994, IBM sold the unit developing AAS (IBM Federal Systems Company) to Loral Corporation; however, FAA is still working with IBM because the contract has not yet been novated.[5]

The contract calls for AAS to be implemented in five distinct segments: (1) the Peripheral Adapter Module Replacement Item (PAMRI), (2) the Initial Sector Suite System (ISSS), (3) the Terminal Advanced Automation System (TAAS), (4) the Area Control Computer Complex (ACCC), and (5) the Tower Control Computer Complex (TCCC).

AAS Progress and Problems

During the past year, AAS' estimated F&E cost increased by a net of $1.2 billion, from $4.7 billion to $5.9 billion. Increases of $1.4 billion were offset by a reduction of $100 million in the estimate for the TCCC segment and a reduction of $92 million in project reserves. At the time of our review, cost growth totaling $741 million had been negotiated with the contractor but not yet approved.

The largest increases in the cost of AAS are (1) $501 million for contractor program engineering and support, required primarily because of delays and other problems with ISSS; (2) $350 million for devising a means of providing "continuous operations" to ensure the continued availability of AAS during a software upgrade or a reconstitution of its data base after a primary system failure or planned outage; (3) $145 million for additional costs of developing TAAS--a much more difficult and time-consuming task than originally estimated; (4) $100 million for ISSS software changes that have been consolidated into what are called "block updates;" (5) $100 million for the equipment and software needed to allow TAAS to fulfill its new role as an end-state system rather than a bridge during a transition to ACCC; (6) $92 million for implementing some

[4]About 60 percent of the funds expended during this first phase were appropriated through the Research, Engineering, and Development account.

[5]Generally, a novation substitutes a new party to a contract and discharges one of the original parties by agreement of all three parties. A novation also extinguishes an old obligation and establishes a new one.

portions of the Automated En-Route Air Traffic Control (AERA) services earlier than planned (an effort called "Early AERA"); (7) $91 million for purchasing additional equipment and services from the prime contractor to support AAS at the FAA Technical Center; and (8) $39 million for potential award fees added during negotiations last year to create incentives for the contractor.

Although FAA has not officially rescheduled the date for completing AAS--2002--the agency has not decided on the future composition of AAS. Therefore, no valid completion date exists.

As a result of cost and schedule problems, in late 1993 the FAA Administrator announced a major review of the AAS project. He placed the Deputy Administrator in charge of a task force to examine estimates of costs and schedules through the end of the project and to identify any areas posing a significant risk of incurring additional costs. The Deputy Administrator's task force reported in March 1994 that, if the project continued on its present course, AAS' F&E costs would range from $6.5 billion to $7.3 billion, and the final cost would most likely be $6.9 billion. The largest expected increase is in the ACCC segment. Additionally, the report stated that significant delays are still likely, including an additional 20-month slip in ISSS. In response to the Deputy Administrator's report, the FAA Administrator announced the formation of another internal FAA team to thoroughly evaluate all the elements of the project, including system requirements. FAA also expects the Center for Naval Analyses to report this April on ways to control AAS' costs and better manage the project.

The Department of Transportation's Office of Inspector General (OIG) also reported on AAS in March 1994. The OIG cited many of the same issues as the Deputy Administrator's task force report and our prior reports had identified as potential causes of future cost growth and schedule delays. Additionally, the OIG confirmed the existence of deficiencies in IBM's cost-estimating system, which the Defense Contract Audit Agency had documented in many reviews, and found that these deficiencies appear to be getting worse. Without a good cost-estimating system in place, the OIG reported, FAA may be making wrong decisions about contract proposals, the contractor may be submitting inaccurate estimates of the contract's completion date, and the contractor and its subcontractors may be proposing excessively high costs.

A discussion of the progress and problems associated with the individual segments of AAS follows.

PAMRI

PAMRI provides new communications computers to connect en-route centers with external systems, such as radars. The last of the 20 PAMRIs was implemented in May 1993. Because FAA needed additional radar display equipment to increase system redundancy, the agency introduced retrofits to PAMRI beginning in September 1992. The last retrofit was completed in September 1993, 4 months later than estimated last year.

<u>ISSS</u>

ISSS work stations will replace controllers' existing work stations at en-route centers and will provide new hardware and software, including radar displays, as well as higher-resolution screens and color capabilities. The critical design review for ISSS was completed in 1988. Nevertheless, serious technical problems remain, including (1) establishing system stability--consistent uninterrupted performance in which 210 separate work stations communicate in real time; (2) providing continuous operations to ensure the continued availability of AAS during a software upgrade or a reconstitution of its data base after a primary system failure or planned outage; (3) converting flight strips from a paper to an electronic format; (4) reducing software volatility (on average, every line of software needs to be rewritten once); and (5) resolving a large number of problems cited in "program trouble reports" for which no solution has been identified.

In November 1992, IBM announced a 14-month delay, from July 1993 to September 1994, in the estimated date for reaching a milestone labeled "government acceptance." In March 1993, FAA and IBM established a new schedule incorporating this delay. In these negotiations, a series of "checkpoints" and a plan for integrating various components of the system was developed. As of March 15, 1994, four of five checkpoints were completed, and the fifth was scheduled for completion on March 31, 1994. Formal testing at the FAA Technical Center is scheduled to start on June 6, 1994, and to finish on November 15, 1994. First-site implementation for ISSS is scheduled for October 1996 at Seattle.

In November 1993, the TRW Systems Integration Group completed an assessment of AAS' development. The group reported that the first ISSS can be implemented at the Seattle en-route center on schedule, but this implementation remains vulnerable to delay because of difficulties in (1) stabilizing the system, (2) obtaining timely agreement on requirements, and (3) agreeing on an approach for ensuring continuous operations. The report stated that progress depends on the contractor's success in finding and correcting problems in the memory management, performance, and fault tolerance aspects of the software's architecture.

The Deputy Administrator's task force reported that the likelihood of meeting the October 1996 date for first-site implementation of ISSS is remote. It projected a range of possible schedule delays, from 9 months to 31 months. The "most-likely" scenario projects a 20-month delay, under which the first ISSS would be implemented in June 1998. The task force believes that a delay of this length may be required to allow the development and testing of full ISSS capabilities. The task force projects an increase of $158 million in ISSS' estimated cost, which is not in the current $5.9 billion estimated cost for AAS.

TAAS

TAAS is intended to provide TRACON controllers with new work stations identical to the ISSS work stations, as well as with new hardware and software to perform TRACON functions. However, the expectations for TAAS changed greatly when FAA decided to scale back its plans for consolidating TRACONs. Originally, FAA had planned to consolidate 205 TRACONs into the nation's 22 en-route centers and the New York TRACON. Last year, FAA sent a plan to the Congress proposing a much more limited consolidation, under which TRACONs would not be consolidated with en-route centers, but some TRACONs would be brought together to form between five and nine "metroplex" facilities. Under this revised plan, the full version of TAAS would be installed in from one to nine metroplexes. FAA has not decided what types of systems it would install in the remaining TRACONs, but it might use TAAS consoles and perhaps TAAS software.

TAAS' development fell 7 months behind schedule when ISSS was delayed by 14 months. According to the AAS program office, the first TAAS system should be implemented in August 1997. However, the schedule for TAAS depends upon the progress of consolidation, including the construction of metroplex facilities. Tentative implementation dates for the new facilities extend from 1998 through 2003.

The November 1993 TRW report concluded that the schedule for preparing the first site for TAAS is very tight. According to the report, significant risks remain and TAAS' development must adjust to the changes in FAA's consolidation plan. The report noted that "TAAS is dependent on ISSS for its system services software, the most complex and problematical software in ISSS, and the focus of the ongoing ISSS stress and stability tests." The Deputy Administrator's task force projected a "most-likely" delay of 10 months for TAAS, including 5 months attributable to delays expected in ISSS. The remaining 5 months is projected as needed to develop and test additional software. The task force increased its estimate of TAAS' costs by $117 million--an increase that is not included in the current $5.9 billion cost estimate for AAS.

ACCC

For ACCC, as for TAAS, FAA's vision has changed dramatically since the AAS contract was signed in 1988. Originally, FAA viewed ACCC as the software that would tie ISSS and TAAS together in 23 consolidated facilities. Now that FAA no longer anticipates combining en-route centers and TRACONs, ACCC is viewed by the AAS program office as a series of software enhancements and integration efforts that will replace the existing Host computer and build upon the ISSS systems in the en-route centers. Among other things, FAA expects ACCC to enable it to bring in AERA services, which are designed to give controllers more tools to identify and resolve potential airspace conflicts.

The AAS program office has projected implementation for the first increment of ACCC in October 1997. The Deputy Administrator's task force estimated that the 20-month delay projected as "most likely" for ISSS would delay the initial implementation of ACCC by a similar length of time--to June 1999. The task force also projected an increase of almost $400 million in the cost of ACCC, to a total cost of over $1 billion for this segment of AAS. The increased costs are largely due to projected growth in software code consistent with IBM's experience with ISSS. In announcing the completion of the task force's report, the FAA Administrator said that he was suspending funding for ACCC until FAA could review AAS' requirements.

In revising its plans for ACCC, FAA last year announced its decision to introduce some AERA benefits earlier than anticipated, through an effort called "Early AERA." As noted above, "Early AERA" is projected to add $92 million to the cost of AAS. FAA currently plans to introduce Early AERA in December 1997. However, the Deputy Administrator's task force estimated that Early AERA's first-site implementation would be delayed by 11 months to November 1998.

<u>TCCC</u>

TCCC will replace hardware and software at selected airport traffic control towers. However, during the past year, FAA significantly curtailed its plans for TCCC. The AAS contract calls for 150 TCCCs and includes an option to purchase an additional 108. FAA reviewed its need for the 108 optional systems (whose total contract price was $113.6 million) and determined that it would not purchase them. Thus, FAA eliminated the cost of this option from its estimate of AAS' total costs. However, the Deputy Administrator's task force has projected approximately $130 million in additional TCCC costs for the remaining 150 systems.

FAA plans to phase in TCCC by introducing a relatively basic version, called TCCC Type 3, and gradually upgrade it at each site to a more sophisticated Type 2 or Type 1 version. After conducting the critical design review for TCCC Type 3 in October 1993, FAA found that IBM had presented a good design that could readily be upgraded to a Type 2 or Type 1 system. Although the critical design review conference was completed in October 1993, 122 "action items" were open and only 55 had been closed as of December 1993. The Deputy Administrator's task force projected that a Type 3 TCCC would be implemented at the first site in October 1996 and a Type 2 or Type 1 within another 2 years thereafter. The task force reported that these schedules could be met, since much of the TCCC software is off-the-shelf. However, the task force noted that planned software development efforts to meet computer-human interface requirements may delay the implementation of a Type 2 or Type 1 TCCC.

AIR ROUTE SURVEILLANCE RADAR (ARSR-4)

VENDOR: Westinghouse Electric Company, Baltimore, Maryland

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$383.1	$403.2	$20.1
Cumulative F&E appropriations through	$329.7	$360.1	$30.4
Cumulative F&E obligations through	$275.5	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	01/94	09/94	+8 months
Estimated last-site implementation as of	03/96	09/96	+6 months

[a]Data will not be available until after fiscal year 1994.

Background

ARSR-4 is a long-range primary surveillance radar that is intended to track en-route aircraft and weather by emitting radio signals that are reflected back to the radar. Data from ARSR-4 will then be transmitted to air traffic control facilities, such as en-route centers. FAA is planning to procure 40 ARSR-4 units[6] through a project jointly funded by the Department of Defense. Thirty-nine of these radars will be placed along the perimeter of the United States and will assist in en-route navigation, air

[6]This includes an ARSR-4 that was added to the project over the last year and will be located in northern Maine.

defense, and drug interdiction. One radar will be used for field support and training.

ARSR-4 Progress and Problems

The estimated total cost of the ARSR-4 project increased by $20.1 million over the past year because a 40th radar, which will be located in northern Maine, was added to the project.

ARSR-4 is currently undergoing development test and evaluation (DT&E) at the factory. The contractor completed, with some open issues, the software performance qualification testing and system qualification testing portions of DT&E in October 1993. Field DT&E was completed in January 1994 at the first site in Mt. Laguna, California. Ongoing and future DT&E activities include reliability testing, electromagnetic interference testing, a maintainability demonstration, and tests of the system under various environmental conditions. According to the program manager for ARSR-4, all portions of DT&E are expected to be completed in June 1994. The next phase of testing, operational test and evaluation (OT&E), is expected to begin at the Mt. Laguna site in April 1994 and to end in July 1994, according to the program manager.

During the past year, ARSR-4's first-site implementation was delayed by 8 months, from January to September 1994 because, according to the program manager, the software performance and system qualification performance portions of DT&E took 12 months to complete rather than the 6 months originally anticipated. The program manager stated that the delay in factory testing resulted from (1) errors in the software that appeared when the software was integrated with the system's hardware and (2) difficulties with the test software that is built into the radar to identify and communicate information about problems within the radar.

ARSR-4's last-site implementation slipped by 6 months, from March 1996 to September 1996. According to program officials, this slip occurred primarily because (1) FAA was behind schedule in preparing some sites and (2) Westinghouse reassessed its ability to meet the production schedule.

Originally, FAA planned to replace 10 older ARSR-3s with 10 ARSR-4s and then move the ARSR-3s to the interior of the United States to replace still older radar systems or to provide coverage at new sites. However, according to the business manager, FAA is reviewing the funding for this project. One option being considered is dismantling and storing these 10 ARSR-3 radars, rather than relocating them.

AIRPORT SURFACE DETECTION EQUIPMENT-3 (ASDE-3)

VENDOR: Norden Systems, Inc., Norwalk, Connecticut

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$191.0	$223.8	$32.8
Cumulative F&E appropriations through	$191.0	$216.8	$25.8
Cumulative F&E obligations through	$154.1	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	04/93	11/93	+7 months
Estimated last-site implementation as of	07/96	11/95	-8 months

[a]Data will not be available until after fiscal year 1994.

Background

ASDE-3 is a ground radar designed to provide surveillance of aircraft and vehicles operating on the surface of airports under all weather conditions, including rain and fog. FAA developed these radars to replace the aging and less reliable ASDE-2 radars with technology that better meets controllers' needs. Last year, the Congress provided funding to purchase 11 ASDE-3s in addition to the 33 in the original project.[7]

[7]The original project included ASDE-3s for 29 airports (three of which were to receive two ASDE-3s) and the FAA Academy.

ASDE-3 Progress and Problems

The first ASDE-3 was implemented at the Seattle-Tacoma International Airport in November 1993. Last year, FAA planned to implement the first ASDE-3 at the Greater Pittsburgh International Airport in April 1993, but this implementation has not occurred because of continuing technical problems at that site. FAA expects to implement the last ASDE-3 in November 1995, 8 months sooner than estimated last year, partly because FAA (1) has reduced the number of ASDE-3 units to be delivered and (2) now expects to be able to install two ASDE-3s per month. The ASDE-3 program office expects ongoing or planned airport construction projects to delay the installation of ASDE-3s at eight airports--including O'Hare, Newark, and La Guardia--but believes that FAA can meet the last-site implementation date by revising the schedules for implementing ASDE-3s at other airports.

During the past year, the cost of the ASDE-3 project increased by $32.8 million, from $191.0 million to $223.8 million. This increase is due to modifications to ASDE-3 hardware and software that will be required to meet unique needs at specific airports ($8.0 million), software upgrades ($2.6 million), site spares ($2.0 million), and requests from Norden for equitable adjustments for changes in hardware and software from 1986 to 1992 ($14.0 million). Also, costs have grown by $7.0 million for site preparation and for auxiliary items required by the decision last year to procure additional ASDE-3s.[8]

Last year, the Congress directed FAA to procure 11 additional ASDE-3s, at a cost of $49.5 million. However, because of delays in FAA's preparation of a new contract, the ASDE-3 production line was closed before FAA could contract for the 11 additional ASDE-3s. Consequently, per-unit costs increased, and FAA had sufficient funds to procure only seven additional ASDE-3s.

Although ASDE-3 has technical problems, FAA plans to proceed with its installation. As we have previously reported, the radar splits the image of some aircraft on the ground, so that a single aircraft, or target, appears as a broken image of two or more targets on the controller's display. Despite this "target-splitting" problem, FAA believes that the radar will significantly increase controllers' current abilities to track aircraft and vehicles on airport runways during periods of low visibility.

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[8]According to FAA, $800,000 in ASDE-3 funds was rescinded in fiscal year 1993 as part of a $48 million package of FAA rescissions.

Several problems continue to affect ASDE-3's implementation and cost.

-- First, FAA discovered that technicians servicing the radar were coming into contact with cadmium dust from the radar's antenna pedestal. Because of concerns that this dust created a health hazard for the technicians, FAA stopped using the radar, replaced components made with cadmium, and developed new maintenance procedures for ASDE-3. These changes cost about $200,000 and delayed implementation by about 4 months.

-- Second, during testing at the Greater Pittsburgh International Airport in May 1993, FAA discovered that controllers could inadvertently make keyboard entries that would shut down the radar's display during routine operation. This problem, which was solved by revising the ASDE-3 software, delayed implementation by several months and cost FAA an additional $200,000.

-- Lastly, during testing at the Atlanta International Airport, controllers discovered that ASDE-3 creates "ghost-targets." This occurs when energy from the radar is reflected off buildings or other objects and the radar identifies a target in the runway that is not actually there. Sometimes, the ghost target is stationary and predictable, but at other times it moves about the ASDE-3 display. Because airports are laid out differently, the ghost target problem at each airport will differ and will require a unique solution. Although FAA will not have solutions for all sites for 2 to 3 years, it plans to deploy the radar with this problem. However, controllers are concerned about this problem, and FAA's Air Traffic Requirements unit has promised representatives of the National Air Traffic Controllers Association (NATCA) that the agency will not commission additional ASDE-3s until the issue of the ghost targets has been fully explored.

AIRPORT SURVEILLANCE RADAR (ASR-9)

VENDOR: Westinghouse Electric Corporation, Linthicum, Maryland

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$838.9	$833.9	-$5.0
Cumulative F&E appropriations through	$769.1	$813.4	$44.3
Cumulative F&E obligations through	$739.6	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	05/89	05/89	None
Estimated last-site implementation as of	04/96	04/96	None

[a]Data will not be available until after fiscal year 1994.

Background

ASR-9 is a primary surveillance radar system that enables air traffic controllers to monitor aircraft and weather within a 60-mile radius of the system's site. A primary surveillance radar system tracks aircraft and weather by emitting radio signals that are reflected by all of the aircraft and weather conditions present in the area covered by the system.

FAA is procuring 124 ASR-9 radars, and the Department of Defense is funding an additional 10 ASR-9s. Besides these radars, this project includes installation, spare parts, and ancillary equipment, such as automation, communication, and display systems. FAA is installing 28 ASR-9s at new locations and replacing 96 aging radars, including 40 ASR-4/5/6s (the oldest ASRs) and 56 ASR-7/8s.

FAA will use the 56 displaced ASR-7/8s to replace the remaining ASR-4/5/6s.

ASR-9 Progress and Problems

During the last year, the total estimated cost of the ASR-9 project decreased by $5 million, to $833 million. According to the business manager for ASR-9, this decrease occurred because the cost of modifying the system's radar transmitter was lower than expected and an improvement in reliability reduced the estimated cost of spare parts.

The last-site implementation date of April 1996 remains unchanged from last year. As of March 17, 1994, 134 ASR-9s had been accepted in the factory.[9] Of these, 114 systems had been delivered--8 fewer than expected as of March 17, 1994--and 20 systems remained in storage. Also, only 77 systems had been commissioned--18 fewer than scheduled.

Data from FAA's System Maintenance unit indicates that the availability of the ASR-9 may be a problem. According to these data, 849 hours of unscheduled outages were recorded for ASR-9s from October 1992 through November 1993, which results in an availability rate of 99.83 percent when calculated on this basis--below the 99.9-percent rate specified in the ASR-9 contract. According to a NATCA official, when an ASR-9 becomes unavailable, air traffic controllers must rely on less sophisticated nonradar communications to direct aircraft toward and away from an airport. Moreover, when controllers do not have overall confidence in a system's availability, they tend to require aircraft to maintain greater separation. The NATCA official added that this tendency increases the margin of safety but slows the flow of air traffic.

The basis for calculating availability is not clearly defined. According to the program office, the ASR-9 contract defines availability in the greatest detail, characterizing it as "the probability of specified operability at any instant in time over the service life of the equipment. Allowed preventive maintenance times shall not be counted as unavailable periods provided the requirement to reach an operable state is always met." On the basis of this definition, we included all unscheduled outages of ASR-9s in our calculation of availability. However, the program office has interpreted the definition to include only unscheduled outages of the ASR-9 units themselves and to exclude outages caused by external factors, such as loss of commercial power and weather

[9]According to FAA officials, the agency accepts ASR-9s in the factory when they pass final tests designed to ensure that the system meets manufacturing standards and operates according to contract specifications. The 134 ASR-9s accepted include 10 for the Department of Defense.

effects. Using this latter measure, the program office calculated that the ASR-9s were available 99.94 percent of the time during the 14-month period noted above.

To address previous commissioning problems and improve the ASR-9's safety, reliability, and availability, FAA modified the system's operation and components and made more spare parts available. In May 1993, FAA authorized the full production of modified transmitter components; by March 17, 1994, 28 of the modified transmitters had been installed in the ASR-9 radars.

Delays in commissioning the ASR-9 have slowed the relocation of the ASR-7/8s because a radar cannot be relocated until its replacement has been commissioned. As of March 17, 1994, FAA had relocated 44 out of 56 ASR-7/8s. FAA expects to complete the relocation program by 1996.

AUTOMATED WEATHER OBSERVING SYSTEM (AWOS)

VENDORS: Qualimetrics, Inc., Sacramento, California (AWOS), AAI Corporation, Hunt Valley, Maryland (ASOS), and Commpower, Inc., Camarillo, California (ADAS)

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$229.9	$244.4	$14.5
Cumulative F&E appropriations through	$170.3	$190.2	$19.9
Cumulative F&E obligations through	$156.5	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	07/89	07/89	None
Estimated last-site implementation as of	05/97	Indefinite	N/A

N/A: Not applicable.

[a]Data will not be available until after fiscal year 1994.

Background

AWOS uses automated sensors to measure wind velocity, temperature, dew point, altimeter setting, cloud height, and visibility. After gathering the information, the system disseminates it to pilots via computer-generated voice. FAA has procured 200 AWOS units primarily for airports without towers or human weather observers. AWOS equipment is available commercially and was procured to fill an immediate need for automated weather information during the development of the more sophisticated Automated Surface Observing System (ASOS). In addition to obtaining the same weather information as AWOS, ASOS identifies types and amounts of precipitation and displays weather information for use in airport towers. FAA provides funds, under the AWOS project's umbrella, to a joint program administered by the National Oceanic and Atmospheric Administration (NOAA) to procure, install, and maintain 537 ASOS units at both nontowered and towered airports. FAA is also procuring the AWOS Data Acquisition System (ADAS) under the AWOS project's umbrella. Each ADAS will acquire weather information from up to 137 AWOS and ASOS units, process this information, disseminate it to a variety of weather information users via the National Weather Network, and archive weather data products. FAA plans to install 25 ADAS units at its en-route centers and at two different facilities that provide hardware and software support.

AWOS/ASOS/ADAS Progress and Problems

In the last year, costs have grown and implementation schedules have slipped for the overall AWOS project (including ASOS and ADAS). Further cost increases and schedule delays are likely in view of revisions to the ASOS project resulting from a budget reduction and an anticipated renegotiation of the ASOS contract. Because of this uncertainty, the date for implementing the project at the last site is currently indefinite.

The total estimated cost for the overall AWOS project increased to $244.4 million in fiscal year 1994. This $14.5 million increase over the previous fiscal year's estimate occurred because (1) FAA decided to procure an automated thunderstorm detection system to supplement ASOS weather observations (an $8 million increase); (2) the financial responsibility for purchasing modems for ASOS was transferred from another FAA unit to the program office (a $5.5 million increase); and (3) FAA decided to make the message formats generated by AWOS, ASOS and ADAS compatible with international reporting standards (a $1 million increase). The status of the three AWOS components (AWOS, ASOS and ADAS) is described below.

AWOS

FAA has received all 200 AWOS units ordered thus far. As of January 1994, FAA had installed 184 units and implemented 179 of them. The date for implementing the last AWOS has slipped by 9 months, from March to December 1994, largely because changes in Alaskan site locations and in state regulations caused FAA to miss the seasonal window for preparing sites there.

In the past, a contractor maintained the AWOS sites. However, when a cost-effectiveness study showed that FAA's site technicians could do the job more economically, FAA officials decided not to renew the existing site maintenance contract. According to the AWOS program manager, FAA is training its site technicians and is preparing to procure spare parts and testing equipment by the end of March 1994 so that it can take over most site maintenance responsibilities effective April 1, 1994. However, the program manager said that after April 1, 1994, some degradation of site maintenance is likely until FAA's maintenance capabilities are in place. He estimated that full maintenance capabilities would be in place by September 1994.

ASOS

Having procured 352 ASOS units and installed 261, FAA commissioned[10] its first two ASOS units in November and December 1993 and plans to commission about 160 units in 1994. Commissioning at the first site occurred 4 months later than planned because of delays in establishing telecommunication lines.

At this time, FAA does not know when the last ASOS will be commissioned--or when the entire AWOS project will be completed--because the agency is stretching out the ASOS project schedules in response to a $10 million reduction in the project's fiscal year 1994 appropriation. To date, FAA has postponed the procurement of 106 ASOS units from fiscal year 1994 to fiscal year 1996. As a result, the last unit's commissioning will be delayed.

FAA is having NOAA renegotiate the ASOS contract and is redefining the project's cost and schedule estimates to reflect the 2-year procurement delay. Also to be negotiated at this time is the additional cost of redesigning ASOS tower equipment. FAA is procuring an integrated display system for use in towered airports so as to not overload tower personnel with a variety of different display systems. Testing for this system, which is being developed by the ASOS prime contractor, is scheduled to begin in September 1994. The program manager stated that the precise impact on cost and schedules of renegotiating the contract and restructuring the ASOS project will not be known until the end of March 1994.

ADAS

While 11 of the 25 ADAS units have been installed, ADAS is not yet operational because several systems with which it must interface are not yet in place. The program office estimates that ADAS' first-site implementation will occur in January 1995.

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[10]NOAA, the sponsor of ASOS, uses terminology that differs somewhat from FAA's to track and describe the progress of its acquisitions. For ASOS, commissioning is the step that moves a system from a test state to an operational state. Data and information generated from this system become official at commissioning.

CENTRAL WEATHER PROCESSOR (CWP)/
WEATHER AND RADAR PROCESSOR (WARP)

VENDORS: None selected yet

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change	
Total estimated F&E cost as of	$152.0	$ 79.2	-$72.8	(CWP)
	$ 0.0	$ 83.9	$83.9	(WARP)
	$152.0	$163.1	$11.1	(Total)
Cumulative F&E appropriations through	$79.2	$79.2	$0.0	(CWP)
	$ 0.0	$ 1.4	$1.4	(WARP)
Cumulative F&E obligations through	$77.7	[a]	[a]	(CWP)
	$ 0.0	[a]	[a]	(WARP)

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	[b]	10/97	[b]
Estimated last-site implementation as of	[b]	06/99	[b]

[a]Data will not be available until after fiscal year 1994.

[b]This is the schedule for WARP, which replaced CWP this year. Last year, the first-site implementation date for CWP was August 1991; an official last-site implementation date had not been set.

Background

In October 1993, FAA decided to replace CWP with WARP. Integrating some components of CWP, WARP is an automated processing system that will acquire, process, and disseminate Next Generation Weather Radar (NEXRAD) data to FAA's meteorologists, air traffic controllers, and traffic management specialists. WARP will integrate CWP's Real-time Weather Processor (RWP) system and Meteorologist Weather Processor follow-on system (MWP II). The prototype software developed for RWP will be furnished to future contractors for use at their discretion in WARP. Eventually, WARP will replace CWP's MWP I, which is under a lease contract with the Harris Corporation until 1995. FAA plans to extend this lease contract to ensure the availability of weather data until WARP is implemented. FAA plans to procure and install up to 26 WARP units, including 1 at each en-route center. First-site implementation for WARP is scheduled for 1997.

CWP/WARP Progress and Problems

During the last year, the total estimated F&E cost of CWP decreased by $72.8 million, from $152 million to $79.2 million, because CWP was discontinued and replaced by WARP. The $77.7 million that was obligated for CWP included the costs for the installation of MWP I and for the hardware platform and software for RWP.

In October 1993, FAA decided to merge MWP II and RWP to form WARP. The total estimated F&E cost for WARP is $83.9 million, of which only $1.4 million has been appropriated. These funds are for activities that precede the solicitation of the contract.

FAA has completed a mission need statement and a proposed acquisition plan for WARP, but the agency has not yet submitted these documents to the Department of Transportation for approval. Because the system consolidates functional requirements for MWP and RWP, FAA intends to award a full-scale development/limited-production contract for WARP in fiscal year 1995 and a full-production contract in fiscal year 1998.

FLIGHT SERVICE AUTOMATION SYSTEM (FSAS)

VENDOR: E-Systems, Inc., Garland, Texas

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$532.5	$550.9	$18.4
Cumulative F&E appropriations through	$379.8	$381.6	$1.8
Cumulative F&E obligations through	$345.0	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first site operational as of	08/91	08/91	None
Estimated last site operational as of[b]	06/94	09/94	+3 months

[a]Data will not be available until after fiscal year 1994.

[b]This is the estimated last-site implementation date for Model 1 Full Capacity. In last year's report, we estimated that last-site implementation would occur when flight service stations were consolidated.

Background

FSAS improves pilots' access to national aeronautical and meteorological information, simplifies flight plan filing, and consolidates, automates, and improves other flight service station functions.

FAA has taken a phased approach to automating flight service stations. A 1981 contract with E-Systems called for a Model 1 and a Model 2 system. Model 1 systems were commissioned between 1986 and 1987. FAA never implemented any Model 2 systems. In 1987, the agency replaced this project with one called Model 1 Full Capacity, which increased the system's capacity but did not add new functions. As currently configured, the system consists of 61 Automated Flight Service Stations, 21 Flight Service Data Processor Systems, and 2 Aviation Weather Processors.

In addition to the systems noted above, five related projects are included under the FSAS umbrella. Two projects focus on power, ventilation, and heating. Three other projects are designed to support or replace pieces of equipment that were obtained under the original 1981 FSAS contract and are now nearing the end of their life expectancy. The Operational Supportability and Implementation System (OASIS) is intended to alleviate problems in supporting Automated Flight Service Stations, such as supplying spare parts and maintaining the systems. A standardized Graphic Weather Display System is designed to replace aging and deteriorating weather graphics equipment in each Automated Flight Service Station. NextGen is designed to replace current flight service automation system equipment at Flight Service Data Processor Systems and Aviation Weather Processors.

FSAS Progress and Problems

During the last year, FSAS' total estimated costs have increased; however, as discussed below, total estimated costs could decrease if FAA approves pending financial baseline changes. FSAS' schedules have not changed.

According to FAA, the total estimated cost of the project increased by a net of $18.4 million, from $532.5 million to $550.9 million. This change resulted from two increases totaling $31.3 million and four decreases totaling $12.9 million. The increases include (1) $8.3 million for the Power Conditioning System and (2) $23.0 million for OASIS, of which $14.8 million is for validated requirements. The decreases include (1) $1.7 million in FSAS; (2) $1.0 million in Automated Flight Service Stations (reflecting a budget reduction); (3) $2.8 million in the Graphic Weather Display System, which will now be acquired in combination with OASIS; and (4) $7.4 million in NextGen, pending finalization of requirements.

Last year we reported four pending financial baseline change notices totaling $74.5 million. Only one of the four--$14.6 million for OASIS--was approved and is reflected in the new baseline. This year, two new pending financial baseline change notices could reduce FSAS' costs from $550.9 million to $543.5 million. One of these changes, an $8.2 million reduction in OASIS' costs ($23 million minus $14.8 million), would realign OASIS' costs with estimates approved by FAA's Acquisition Review Committee. However, the other change, a $0.8 million increase in the cost of the Graphic Weather Display System, would reduce the net decrease to $7.4 million.

Implementation of Model 1 Full Capacity Flight Service Data Processor Systems and Automated Flight Service Stations is almost complete. FAA implemented the last of 21 Model 1 Full Capacity Flight Service Data Processor Systems in Minneapolis in December 1993. In addition, 59 of the 61 Automated Flight Service Stations have been commissioned with Model 1 Full Capacity equipment. Last-site implementation remains scheduled for September 1994. Furthermore, FAA has consolidated and relocated staff for 242 Flight Service Stations; the agency plans to complete the consolidation of the remaining 76 Flight Service Stations in 1995 and 1996 if sufficient "permanent change of station" and contract weather funds are available.

As we have reported for the past 2 years, FAA has been concerned about its ability to sustain Automated Flight Service Stations after 1995--that is, to support hardware, obtain spare parts, and overcome the operating system's limitations. Initially, FAA planned to purchase hardware replacements for Automated Flight Service Stations. Then, in November 1992, the agency considered leasing these replacements because officials concluded that leasing would provide many benefits, such as making state-of-the-art equipment more readily available. FAA now plans to integrate the Graphic Weather Display System with OASIS for Automated Flight Service Stations and to purchase, rather than lease, the necessary hardware, software, and data stream. In a benefit-cost analysis, FAA estimated that purchasing instead of leasing OASIS would save $24.6 million over 5 years. In this analysis, FAA also estimated that purchasing an integrated system would cost $11.3 million less than buying OASIS and the Graphic Weather Display System separately.

Currently, initial delivery of the integrated system is expected in October 1996. Between the end of 1995 and the delivery of the integrated system, FAA plans to resolve the shortfall in the hardware of Automated Flight Service Stations by replacing it with comparable hardware from Flight Service Data Processor Systems. FAA officials expect the OASIS contractor to develop and integrate commercial off-the-shelf software to emulate existing Automated Flight Service Station functions, address unmet operational requirements, and provide a standardized weather graphics capability for all 61 Automated Flight Service Stations. FAA has not received approval from the Congress to proceed with the integrated OASIS project. If this approval is not granted, FAA plans to proceed with the single OASIS project.

MICROWAVE LANDING SYSTEM (MLS)

VENDORS: Wilcox Corporation, Kansas City, Missouri
Allied-Signal Aerospace Company's Bendix Communication Division, Baltimore, Maryland, and
Raytheon Corporation, Marlboro, Massachusetts

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$2,623.7	$740.8	-$1,882.9[a]
Cumulative F&E appropriations through	$300.2	$341.4	$41.2
Cumulative F&E obligations through	$288.9	[b]	[b]

SCHEDULE[c]

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	3/97	4/97	+1 month
Estimated last-site implementation as of	12/08	12/02	-6 years

[a]Approximately $1.6 billion of this reduction was to have been appropriated after fiscal year 2001.

[b]Data will not be available until after fiscal year 1994.

[c]Consistent with our previous annual reports, these dates are for Category II and III MLSs. FAA has implemented 10 Category I MLSs since 1988.

Background

MLS is designed to allow aircraft to land under poor weather conditions. FAA considers the MLS technically superior to the current Instrument Landing System (ILS) because MLS allows aircraft to fly a variety of advanced approach procedures, such as steep-angle and curved approaches. Moreover, unlike ILS, MLS can be used in more locations because it does not experience signal interference or frequency congestion problems and can provide precision approaches in mountainous areas where other precision approach systems cannot be used. Under the terms of an international agreement through the International Civil Aviation Organization (ICAO), FAA must install 167 MLSs on international runways by January 1, 1998. ICAO will reevaluate this date at a meeting in 1995.

MLS Progress and Problems

Significant changes during the past year have affected MLS' cost and schedule. Until recently, FAA planned to spend an estimated $2.6 billion by the year 2008 to purchase a total of 1,283 MLSs, including 1,250 Category II and III systems and 33 Category I systems.[11] In mid-1993, however, FAA decided to procure only 255 Category II and III systems. This decision reduced the cost of the MLS project by $1.9 billion to $741 million and advanced the date for implementing the last system to 2002, 6 years earlier than estimated last year. The cost reduction does not provide much short-term budgetary help to FAA because $1.6 billion of the $1.9 billion reduction was not expected to be appropriated until after fiscal year 2001.

Category II and III MLSs

FAA decided to reduce its procurement of Category II and III MLSs from 1,250 to 255 systems because it believes that the Global Positioning System (GPS) may be able to provide differentially augmented guidance for Category I precision approaches to many U.S. runways. Originally, FAA planned to replace all ILSs with Category II and III MLSs because these systems could provide Category I, II, and III service. However, since GPS may permit Category I precision approaches, FAA decided to procure only 255 Category II and III MLSs. FAA plans to install 167 of these systems on international runways to meet the ICAO commitment; however, it cannot complete the installation by January 1, 1998, as currently required. The remaining systems will be located on other new or existing U.S. runways that qualify for Category II or III service. All 255 systems are scheduled to be installed by 2002.

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[11]An MLS is categorized by different minimum standards of height and visibility for the safe descent of aircraft using the system. Category I equipment allows aircraft to descend to a height of 200 feet above the ground when the runway visual range is at least 1,800 feet. Category II equipment allows aircraft to descend to a height of 100 feet above the ground when the runway visual range is at least 1,200 feet. Category III equipment does not have a height minimum. Instead, it has three subcategories requiring a runway visual range of at least 700 feet, 150 feet, and 0 feet.

Contracts were awarded to Wilcox and Raytheon in June 1992 for each to independently design, construct, test, and deliver six Category II MLSs equipped with an upgrade kit for Category III operations. A protest to the contracts, which was denied, delayed the schedule by 2 months. Both companies have completed, with some delays, the development of their software requirement specifications (SRS). An SRS establishes the allocation of software functions satisfying specified performance requirements. Currently the first of the 12 Category II/III systems is scheduled to be installed in early 1997.

Raytheon has finished developing its SRS and has completed the software specification review and preliminary design review. According to the Landing Systems program manager, any problems associated with initially developing the SRS will not affect Raytheon's schedule for delivering the MLSs, even though the preliminary design review date slipped by 3 months from the date established in the contract.

Wilcox has completed its SRS, 2 months behind schedule, and has completed its software specification review. Wilcox had some problems developing its network logic schedule--a list of activities and milestones that are used to monitor the critical path of the developmental work. According to the program manager, this problem was corrected in December 1993 and will not affect Wilcox's delivery schedule. FAA expects to complete the preliminary design review for the Wilcox Category II and III MLS in May 1994, 14 months later than specified in the 1992 contract and 6 months later than estimated last year.

FAA plans to make an MLS full-production and deployment decision in 1997. This decision will occur after the agency determines whether (1) GPS will replace MLS for all levels of precision landing,[12] in which case further MLSs may not be needed, or (2) MLS will still be used for Category II and III services.

Category I MLSs

FAA plans to use GPS to provide Category I precision landing services at many locations where MLSs were originally scheduled to be installed. However, the agency has purchased 33 Category I MLSs, which it is now installing. To date, it has installed 10 of these systems. Four Hazeltine systems, from a terminated contract, are operational at FAA's Technical Center in Atlantic City, New Jersey.[13] Three Wilcox systems are operational at John F. Kennedy

[12]FAA plans to make this decision in 1995.

[13]Until this year, we have reported on two Hazeltine Category I MLSs. However, in 1992, Scantek completed two Hazeltine Category I MLSs, which were installed at FAA's Technical Center.

Airport in New York; Midway Airport in Illinois; and Wichita Mid-Continent Airport in Kansas.[14] Three Bendix systems have been installed and are operating, but have not yet been accepted or commissioned by FAA, at Valdez Airport in Alaska; Andrews Air Force Base in Maryland; and Pangborn Memorial Airport in Washington.

FAA has had some problems with the 26 Category I MLSs that are being developed by Allied-Signal's Bendix Communications Division. Bendix was scheduled to begin delivering these systems in the summer of 1992, but the company had some difficulties with the power supply, which it resolved in the summer of 1993. Nevertheless, these difficulties delayed Bendix's delivery of the first Category I MLS by almost a year and a half. The Valdez MLS was delivered in November 1993 and declared operational on December 1, 1993. Since then, the two other MLSs have been installed and are operating. A total of 19 Bendix systems have completed factory acceptance.

The last of the 26 Bendix systems is now planned to be installed and operational by July 1995, 6 months behind the original schedule. All 33 Category I MLSs will be used in tests designed to evaluate the economic and operational advantages of MLS as well as develop advanced approach procedures. FAA does not plan to procure any more Category I MLSs.

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[14]Until this year, we have reported on two Category I MLSs made by Wilcox. FAA recently purchased a third Wilcox system that it had been leasing.

MODE SELECT (MODE S)

VENDORS: Joint venture of Paramax Systems Corporation, Paoli, Pennsylvania and Westinghouse Electric Corporation, Linthicum, Maryland

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$425.7	$438.2	$12.5
Cumulative F&E appropriations through	$403.1	$413.2	$10.1
Cumulative F&E obligations through	$386.3	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Current estimated first site implementation[b]	10/93	03/94	+5 months
Current estimated last site implementation[c]	12/96	12/96	None

[a]Data will not be available until after fiscal year 1994.

[b]First-site implementation of initial Mode S capability for terminal sites.

[c]Last-site implementation of Mode S for en-route sites.

Background

Mode S is a secondary surveillance radar. A secondary surveillance radar--or air traffic control beacon interrogator (ATCBI)--identifies, locates, and tracks aircraft by using its signals to interrogate equipment (transponders) on board the aircraft. Consequently, it can detect only aircraft equipped with transponders. Mode S is expected to be about four times more accurate than the secondary surveillance radars currently being operated by FAA. Also, it is designed to interrogate up to 700 aircraft individually and has a data communications channel that permits the ground-to-air exchange of aviation-related information, including weather and air traffic control data.

In terminal and en-route sites, FAA currently has 392 secondary surveillance radars, including 167 ATCBI-5s, 85 ATCBI-4s, and 140 ATCBI-3s, the oldest secondary surveillance radars. Because of limitations in the associated automated radar data processing equipment, each radar can interrogate only up to 250 aircraft. To replace most of the oldest ATCBIs, which use technology from the 1960s, FAA awarded a procurement contract in October 1984 for 137 Mode S systems, including installation and spare parts. FAA plans to implement 108 of these systems at terminal sites and 25 at en-route sites. Four systems will be used for training and technical support.

Mode S Progress and Problems

During the last year, the cost of this project increased and the schedule was delayed; however, the first Mode S system for terminal sites was implemented, and the date for implementing the last system at an en-route site was not changed. The total estimated cost of the project increased by $12.5 million, largely because FAA approved the procurement of supplemental equipment for testing Mode S in the field. Also, the cost could increase by an additional $12.9 million if FAA approves new system requirements in fiscal years 1995 and 1996 and anticipated claims by the contractor in fiscal year 1996. Some of the potential new system requirements include system enhancements required for AAS.

As we reported last year, the software that supports the Mode S enhancements and en-route surveillance functions is still under development; therefore, FAA will continue to use an incremental strategy to implement the system. First, to replace aging secondary surveillance radars, FAA is implementing an interim beacon system, which is based on the Mode S hardware. According to FAA, this interim system will be only as accurate as current secondary surveillance radars, and it will not have either the capacity to interrogate aircraft selectively or a data communications channel. FAA is now implementing about 50 interim systems in terminal sites equipped with ASR-9 primary surveillance radars. The agency implemented the first interim system in May 1993, 1 month behind last year's projected schedule.

Second, FAA will incrementally upgrade the terminal interim beacon systems to full Mode S capability. In August 1993, the agency completed the operational test and evaluation (OT&E) of the initial Mode S upgrade for terminal sites. After fixing problems identified during this testing, FAA completed the final OT&E in December 1993. As a result of the testing, a number of minor changes were made to the Mode S software that, for example, optimize the system's recovery after power and component failures and increase the reliability of the Mode S/ASR-9 interface. FAA implemented the first terminal Mode S system in March 1994, 5 months later than estimated last year. This system will be able to interrogate up to 400 aircraft selectively and to operate a data communications channel at 75 percent of its specified capacity. By March 1995, the agency plans to upgrade this terminal Mode S to its full capability. This terminal system will be able to interrogate up to 700 aircraft selectively and to operate its data communications channel at full capacity. Also, the system will incorporate specific data link applications software. In addition, it will contain the Surveillance Advanced Message Formats and the Integrated Radar Beacon Tracker software necessary to interface with the TAAS segment of AAS.

Third, FAA will implement a Mode S system for en-route sites using a back-to-back antenna. This back-to-back antenna will enable the system to update target positions in about 6 seconds instead of 12 seconds, and it will increase the capacity of the data communications channel. FAA is simultaneously developing two software versions for the en-route Mode S to ensure timely deployment of the system. One version will support the system using one side of the back-to-back antenna as a single-face antenna; the other will support the system using both sides of the back-to-back antenna. If problems prevent the deployment of the back-to-back software, the agency will initially deploy the single-face software.

Over the past year, FAA has pushed back its schedule for many portions of this third phase of Mode S. The date for completing OT&E of the en-route Mode S system was delayed by 6 months to October 1994. The first-site implementation date for this system is now December 1994, 5 months later than scheduled last year. The OT&E of the Mode S with a back-to-back antenna is estimated to be completed by December 1995, 12 months later than expected. The first-site implementation date of the en-route Mode S was also delayed by a year, to February 1996. However, last-site implementation is still scheduled for December 1996. According to project officials, the delays affecting the en route Mode S system stem from the schedule slippage in the OT&E of the terminal version of the system.

RADAR MICROWAVE LINK (RML) REPLACEMENT AND EXPANSION

VENDORS: American Telephone and Telegraph (AT&T) Technologies, Greensboro, North Carolina (RCL segment)
Alcatel, Inc., Richardson, Texas (LDRCL segment)
Network Equipment Technologies (NET) Federal, Inc., Vienna, Virginia (RCR segment)

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$313.3	$313.3	None
Cumulative F&E appropriations through	$283.3	$293.8	+$10.5
Cumulative F&E obligations through	$277.1	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	05/86	05/86	None
Estimated last-site implementation as of	Indefinite	12/96	N/A

N/A: Not applicable.

[a]Data will not be available until after fiscal year 1994.

Background

The purpose of the RML Replacement and Expansion project, also known as the Radio Communications Link (RCL) project, is to convert FAA's aging "special purpose" RML system into a "general purpose" system for data, voice, and radar communications among en-route centers and other major FAA facilities, such as en-route radar sites. As such, RCL is to serve as the primary vehicle, or backbone, for transmitting radar, interfacility computer data, and pilot-to-controller and controller-to-controller voice communications.

This project consists of three segments that are listed under three separate Capital Investment Plan (CIP) project numbers: (1) the RCL Backbone Network, (2) Low Density RCL (LDRCL) Phase I,[15] and (3) Routing and Circuit Restoral (RCR). To maintain comparability with our previous reports on the status of FAA's modernization program, we will discuss each of these three segments. RCL, the main component of the program, was completed in 1992 and is operational. It consists of microwave transmitters and signal repeaters that have been installed and accepted at 818 sites. LDRCLs are low-to-middle capacity versions of RCL for areas with low volumes of communications traffic. RCR is to provide equipment for rerouting communications between en-route centers in the event of a catastrophic failure between two points in the network.

Both RCL and RML use microwave technology. However, while RML was used primarily for remote radar communications, RCL provides enough capacity to carry voice and data communications and to reduce the use of leased lines. In addition, RCL added 400 sites to complete a nationwide network and will transmit both analog and digital data, whereas RML equipment can carry only analog data. In FAA's view, RCL will greatly reduce the maintenance costs associated with RML.

The traffic that can be carried on the RCL network can also be carried on FAA's new Leased Interfacility National Airspace System Communications System (LINCS). According to the Director of FAA's Transmission Maintenance Organization, LINCS is intended to provide an inexpensive transmission alternative for requirements that will not be best served by RCL. Under the LINCS program, FAA signed a contract with MCI Corporation in May 1992 to lease lines at guaranteed rates.

<u>RML Replacement and Expansion Progress and Problems</u>

The total estimated F&E cost of the three combined segments of this project remains the same as last year--$313.3 million; however, schedules for two of the segments have slipped. The status of the three segments and issues relevant to each are described below.

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[15]LDRCL has a subsequent phase to meet anticipated air traffic control requirements. To be consistent with past reports, the information presented here does not incorporate information on this later phase.

RCL

According to the RCL business manager, FAA completed RCL in November 1992. FAA considers the completion of RCL a major accomplishment. In addition to carrying virtually all of the communications traffic that ran on the old RML, RCL is carrying critical and noncritical voice and data traffic. The total estimated F&E cost for the RCL backbone is $268.4 million.

LDRCL

According to project officials, FAA plans to install LDRCL microwave transmitters and signal repeaters at 83 sites. The project manager said that about half of the equipment has been ordered and about 30 percent of the ordered equipment has been installed. LDRCL's OT&E has been completed. According to the LDRCL project manager, the first site became operational in December 1993, 5 months later than projected last year. Last-site implementation has been postponed from April 1995, as estimated last year, to December 1996. This slippage occurred primarily, the business manager said, because FAA-wide budget reductions have affected the project. The total estimated F&E cost for LDRCL is $33.5 million.

RCR

FAA stopped work on the RCR component last year because officials believed that they would not receive an affordable bid to complete the RCR project. They decided instead to go forward with a pilot RCR network, using equipment purchased through a U.S. Air Force contract with NET Federal, Inc. Because RCL does not provide alternate routing capabilities without RCR, FAA is currently analyzing locations and requirements to determine whether LINCS or RCL with RCR is more cost-effective as a transmission vehicle. FAA will use the results of the pilot network to help with that analysis. The pilot network is composed of six en-route centers, and the equipment for the network has been installed at each. According to the business manager, FAA's initial testing phase was completed in January 1994. FAA tentatively plans to install 12 RCR systems in fiscal year 1994 and 6 in fiscal year 1995. According to FAA officials, these dates could change, depending on the availability of money and assessments of the ability of LINCS to meet particular needs. The total estimated F&E cost for RCR is $11.4 million.

TERMINAL DOPPLER WEATHER RADAR (TDWR)

VENDOR: Raytheon Company, Sudbury, Massachusetts

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$350.7	$373.3	$22.6
Cumulative F&E appropriations through	$337.6	$343.4	$5.8
Cumulative F&E obligations through	$311.9	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	06/93	04/94	+10 months
Estimated last-site implementation as of	06/96	Indefinite	N/A

N/A: Not applicable.

[a]Data will not be available until after fiscal year 1994.

Background

TDWR is a weather radar designed primarily to detect hazardous weather conditions--such as wind shear and microbursts--around airports and to send this information to air traffic controllers. Additionally, TDWR can detect gust fronts, wind shifts, and precipitation. The radars themselves are designed to be stationed off-site from the target airport so that they can detect wind shear all around that airport. FAA is procuring 47 TDWR systems.

TDWR Progress and Problems

FAA's current total estimated F&E cost has increased by $22.6 million to $373.3 million. This increase includes (1) $9.6 million to contractors for additional site construction costs; (2) $6.0 million for FAA's share of an increase in the cost of the prime contract; (3) $4.6 million for a revised strategy for procuring spare parts, as described below; (4) $1.4 million for integrating TDWR systems with Low Level Windshear Alert Systems; and (5) $1.0 million for new TDWR software and a display that will show the direction of a detected storm.

TDWR's estimated first-site implementation date has slipped from June 1993 to April 1994. This delay was caused by problems found during operational testing at an early installation site. These problems include damage to the antennae motors from contaminants, computer operation problems, and unacceptably poor power levels from commercial power sources.

Last-site implementation for TDWR is currently indefinite. According to the program manager, FAA has encountered land acquisition problems because local citizens have objected to the location of some of the radar sites. In addition, FAA found that some of the sites had severe environmental contamination. Overall, the program manager said more than a third of the planned radar sites have had to be relocated because of land acquisition problems.

To reflect a change in FAA's logistics policies, the program office modified its strategy for procuring spare parts for TDWR. This change required the program office to purchase additional spare parts for TDWR and increased the project's cost by $4.6 million.

Separately, FAA estimates that it saved $2.2 million by ordering early the spare parts that it expected to purchase for the first 8 years from Raytheon. Ninety-nine percent of the parts have been delivered. However, ordering early has some risk because the radar had not yet undergone operational testing. Test results might require changes to the system and its spares.

VOICE SWITCHING AND CONTROL SYSTEM (VSCS)

VENDOR: Harris Corporation, Melbourne, Florida

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$1,407.0	$1,407.0	None
Cumulative F&E appropriations through	$714.2	$921.7	$207.5
Cumulative F&E obligations through	$686.2	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	02/95	04/95	+2 months
Estimated last-site implementation as of	03/97	06/97	+3 months

[a]Data will not be available until after fiscal year 1994.

Background

VSCS is designed to replace existing communication systems with an expandable, highly reliable system for both ground-to-ground and air-to-ground communication. VSCS is an integral part of FAA's plans for modernizing the air traffic control system because it provides the communication capabilities for the new ISSS work stations being purchased under the AAS contract. Intended to increase controllers' efficiency, VSCS will allow safer handling of anticipated increases in air traffic. In addition, VSCS is designed to allow automatic changes (also called "simultaneous reconfiguration") of voice radio frequencies for controllers while at the same time accommodating changes to the airspace sections controlled by ISSS work stations. Currently, this is done manually by changing existing wiring.

VSCS was originally designed as a stand-alone system that could support 430 controller positions. Such a large capability was required to accommodate the proposed consolidation of TRACONs into en-route centers. As noted in section 2, this consolidation plan was revised last year; TRACONs will not be consolidated with en-route centers under FAA's revised plan.

After developing prototypes for 5 years, FAA awarded a contract to the Harris Corporation on December 31, 1991, to complete the VSCS project and deliver at least 25 VSCS production systems. The contract required Harris to upgrade its prototype system, which could support 60 controller positions, to a full-production 430-controller-position system suitable for implementation with ISSS within 30 months.

The system will be delivered to the field in two phases. During the first phase, Harris is to develop, in several increments, an initial system to be installed in the existing M-1 consoles now used by air traffic controllers. This system is being tested at FAA's Technical Center and at the Seattle en-route center. First-site implementation is scheduled for Seattle in April 1995. During the second phase, Harris is to develop the primary system with appropriate software to interface with FAA's ISSS. First-site implementation for this phase is scheduled for Seattle in August 1995.

VSCS Progress and Problems

According to VSCS program officials, project costs have increased and FAA's project schedule has slipped by 10 months since the contract was signed. Program officials were able to absorb about $182 million in additional contract costs because FAA overestimated the costs of the contract before signing a final agreement with Harris in December 1991. These additional costs were needed to address problems in software development and changes in requirements, which also affected Harris' delivery schedule. The VSCS program manager stated that FAA has not identified any additional costs that would require the total cost estimate for VSCS to increase.

FAA has changed its schedule to compensate for Harris' software development and integration problems. The most recent change occurred in August 1993, when FAA modified milestones for delivery and testing of hardware and software. Problems identified during operational testing in July and August 1993 included system instability, defects in system self-diagnosis and fault tolerance, and isolated cases of undesirable audio feedback.

A team of experts from universities, support contractors, and industry organizations assessed VSCS' fault tolerance and reported in January 1993 that Harris had developed a body of software with the potential for latent, undetected faults that could cause operational problems in the field. This potential could prevent FAA from meeting its system reliability requirement and does not preclude a catastrophic failure of the entire VSCS. FAA has authorized Harris to perform an in-depth study to determine how to implement the team's recommendations. The study is due in April 1994. According to FAA officials, Harris has already taken steps toward resolving this problem, such as enhancing its software quality assurance program. While VSCS was designed to be a stand-alone system, FAA is now evaluating alternative emergency backups to prevent a catastrophic failure, including a back-up air-to-ground hard wire system.

FAA completed the OT&E of VSCS' hardware/software upgrade increment in December 1993. The final report for this test--prepared by the Voice Switching Automation Division at FAA's Technical Center--recommended a full-production decision for the VSCS hardware but concluded that the current VSCS system is not stable enough for operational use. The report stated that improvements are needed to meet requirements for reliability in the field, system performance, and maintenance; furthermore, according to the report, additional work and retesting are necessary before VSCS is suitable for operation.

In a recent assessment of the hardware/software upgrade test, FAA's Office of Independent Operational Test and Evaluation Oversight (IOT&E) determined that VSCS is potentially operationally effective and suitable. Hence, the Office recommended a full-production decision for VSCS' hardware only. However, the Office identified significant implementation risks stemming from (1) the immaturity of the system's development, (2) a large potential backlog of software problems, (3) inadequate maintenance capabilities, and (4) installation of software changes.

FAA sought full-production authority from the Department of Transportation in March 1994. The Department--through its Transportation Systems Acquisition Review Council--withheld authority for full production until satisfactory completion of testing of the final M-1 version of VSCS, which is scheduled for January 1995. However, the Council authorized FAA to order one full-production VSCS per month contingent on the approval of the FAA Acquisition Executive, who is Chairman of FAA's Acquisition Review Committee.

Although FAA is allowed to order some full-production VSCS units, approximately 18 to 20 percent of the system's software still needs to be developed, integrated, and tested. For example, critical components--such as the capability for automatically changing voice frequencies, the additional software development required for first-site implementation, and the configuration of hardware and software for interfacing with ISSS--have not undergone OT&E. According to a September 1993 internal evaluation, if further difficulties arise after the full-production decision, controllers will be forced to accept a system that does not fully satisfy operational requirements, or the VSCS schedule will be further delayed. Completion of operational testing of the ISSS-compatible version of VSCS is scheduled for June 1995.

According to FAA, the number of VSCS units specified in the contract has been revalidated and did not change as a result of modifications to FAA's consolidation plan. The current total estimated F&E cost includes 25 VSCS systems--22 for en-route centers, 1 for the New York TRACON, 1 for the FAA Technical Center, and 1 for the FAA Academy. FAA's contract with Harris provides an option to purchase 18 additional systems, costs of which vary from $13 million to $24 million each, depending on their size.

SECTION 4

INFORMATION ON AVIATION WEATHER PROJECTS

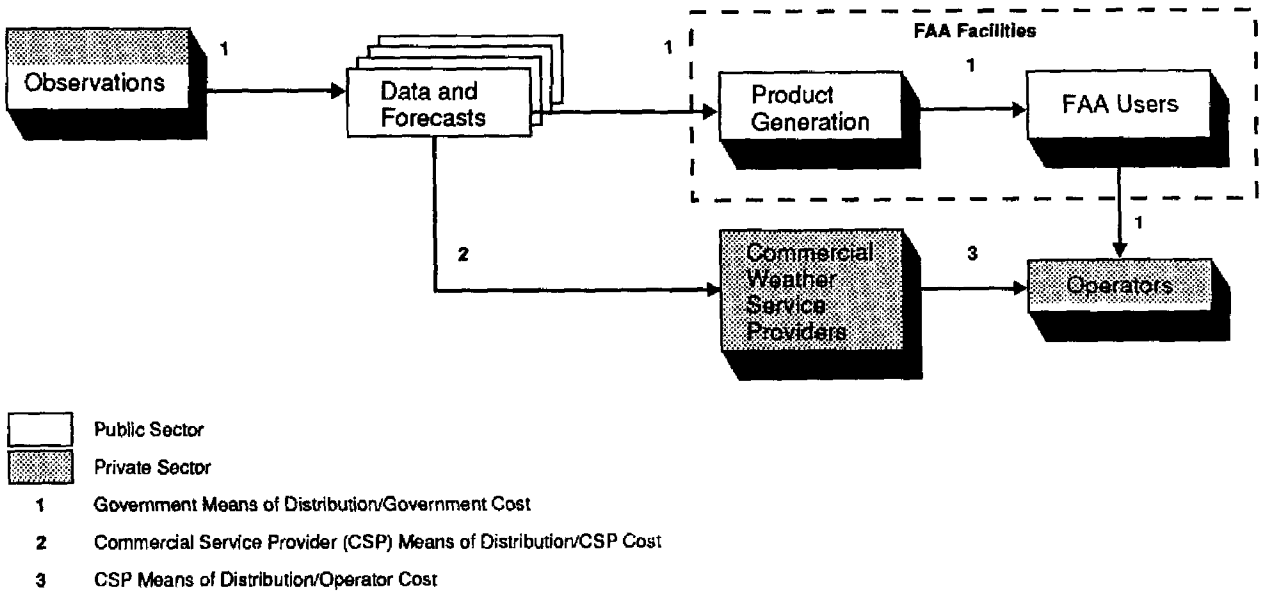
According to FAA, today's aviation weather system is imprecise, provides weather information on geographic areas that are too large to be useful, and often overpredicts or entirely misses adverse weather conditions. As a result, unfavorable weather conditions negatively affect both the safety and the efficiency of the air traffic control system. Currently, according to FAA, weather is directly related to 40 percent of all accidents and 50 percent of all aviation fatalities. Sixty-five percent of the reported air traffic control system delays exceeding 15 minutes are attributable to weather. These weather-related delays cost the airline industry at least $1.7 billion a year.

In the 1980s, both FAA and the National Weather Service (NWS) instituted modernization programs to upgrade existing aviation weather systems and provide new tools for detecting, forecasting, and disseminating information about the weather (e.g. the Terminal Doppler Weather Radar, the Central Weather Processor, and the Automated Weather Observing System, all described in section 3).

Despite the ongoing and planned installation of new tools for detecting and forecasting weather conditions, FAA has identified high-priority unmet needs for both internal (air traffic controllers) and external (general aviation and airline pilots) users of the air traffic control system. These needs include improving (1) the detection of precipitation intensity, (2) the timeliness and geographical specificity of weather alerts, (3) the detection and forecasting of turbulence, and (4) the dissemination and communication of weather information.

FAA is now seeking ways of transferring weather responsibilities to the private sector and has asked industry representatives to recommend changes in the roles of government and the private sector. (Figure 4.1 depicts today's roles and responsibilities.) Over the past several years, the private sector has rapidly increased its technical ability to generate and disseminate information about the weather. At the same time, according to FAA, federal funding for weather services is expected to decline. Therefore, FAA has sought comment from the aviation industry on areas in which the federal government's responsibility for generating and disseminating information about the weather could be transferred to commercial service providers.

Figure 4.1: Aviation Weather Services--Roles and Responsibilities



Source: Briefing by FAA Flight Standards Service, Technical Programs Division, at National Aviation Weather Users Forum, December 1, 1993.

FAA is developing two major weather systems--the Aviation Weather Products Generator (AWPG) and the Integrated Terminal Weather System (ITWS)--to meet the needs of air traffic controllers in en-route centers and TRACONs, respectively. These two systems are designed to integrate data from several existing and planned weather systems and to present the data to controllers in a useable format. Both are also expected to predict future weather conditions--a capability that should prove valuable for controllers.

The remainder of this section provides cost and schedule information on AWPG and ITWS and discusses the progress and problems associated with these two projects over the past year.

AVIATION WEATHER PRODUCTS GENERATOR (AWPG)

VENDORS: National Center for Atmospheric Research, Boulder, Colorado
National Oceanic and Atmospheric Administration Forecast System Laboratory, Boulder, Colorado

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$103.9	$142.4	$38.5
Cumulative F&E appropriations through	$26.1	$36.4	$10.3
Cumulative F&E obligations through	$26.1	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	09/96	09/96	None
Estimated last-site implementation as of	Indefinite	Indefinite	N/A

N/A: Not applicable.

[a]Data will not be available until after fiscal year 1994.

Background

AWPG is a software development effort designed to provide aviation weather services by using a new generation of weather observing systems and a new NWS supercomputer. NWS will generate an aviation weather forecast data base, called the Aviation Gridded Forecast System (AGFS), which will provide forecast data in 1-hour increments. AWPG will use AGFS' forecasts to depict weather graphically for air traffic controllers. AWPG is expected to provide near-real-time, short-range forecasts of hazardous airspace. AWPG's weather forecasts and products will be transmitted directly to air traffic controllers at en-route centers and at the Air Traffic Control System Command Center and to specialists at flight service stations. AWPG will help eliminate the need for intervening meteorological interpretation. FAA, the National Oceanic and Atmospheric Administration's Forecast System Laboratory, and the National Center for Atmospheric Research have been developing algorithms for AWPG since 1991.

AWPG Progress and Problems

The total estimated cost for AWPG has increased substantially. FAA's official estimate of AWPG's total F&E costs through fiscal year 2001 grew from $103.9 million in the October 1992 CIP financial plan to $142.4 million in the November 1993 plan.[1] A recent benefit-cost study for AWPG estimated that the total cost of the project, through fiscal year 2007, will be $313.1 million. The study notes many costs that do not appear to be included in the current CIP financial plan estimate. According to FAA and System Engineering and Integration Contractor (SEIC) officials who develop the financial plan estimates, the next plan update will reflect many of the additional costs identified in the benefit-cost study. AWPG project officials noted that the October 1992 baseline number was a rough cost estimate developed when the project's mission need statement was prepared, whereas the more recent cost estimates reflect knowledge gained during the project's development. AWPG program officials expect that the project's total estimated cost will rise--but not to the $313.1 million estimate. They are analyzing the cost savings that could be realized through advances in technology and a change in acquisition strategy.

Despite the increase in AWPG's estimated cost, FAA still expects benefits to outweigh costs. Overall, AWPG is expected to generate present value benefits valued at $707.1 million at a cost of $158.1 million (both in constant 1992 dollars)--a benefit-to-cost ratio of 4.5 to 1. These benefits, to airlines and passengers, are expected to accrue primarily from reductions in air traffic delays.

The schedule for implementing AWPG has not changed during the past year; however, demonstration and validation of the AWPG concept has been delayed by 4 months. FAA expects to provide AWPG services in September 1996 at flight service stations and in September 1998 at en-route centers. Enhancements are also planned for AWPG. FAA has not yet scheduled the project's completion.

AWPG is currently in the third of five phases for major acquisitions: demonstration and validation of alternative concepts. The Department of Transportation approved the project's entry into this phase in May 1993; however, delays in upgrading an

[1]Section 2 provides more information on the CIP financial plans.

NWS computer program and budget reductions postponed the completion of this phase by 4 months, from September 1995 to January 1996.

During 1993, FAA completed preliminary testing of AWPG prototypes developed by the National Center for Atmospheric Research--a federally funded nonprofit laboratory. The prototypes were tested at the Denver en-route center, the Denver automated flight service station, and the FAA Technical Center.

FAA originally planned to transfer its responsibility for developing AWPG to a private vendor at the end of the demonstration/validation phase but now intends to do so sooner in order, according to project officials, to conserve funds during this fiscal year. Expediting the transfer also makes sense, project officials believe, because the private sector will be more motivated to deliver products at an earlier date. During 1993, FAA entered into cooperative research and development agreements with four commercial weather service providers. During 1994, FAA will prepare for the final demonstration/validation testing scheduled for 1995. To help reduce risk, FAA will also continue to receive advice on AWPG from an independent panel of scientific experts from academia, government, and industry.

INTEGRATED TERMINAL WEATHER SYSTEM (ITWS)

VENDOR: Massachusetts Institute of Technology (MIT) Lincoln Laboratories, Boston, Massachusetts

FINANCIAL INFORMATION

Dollars in millions	FY 1993	FY 1994	Change
Total estimated F&E cost as of	$81.9	$138.9	$57.0
Cumulative F&E appropriations through	$14.5	$23.5	$9.0
Cumulative F&E obligations through	$14.4	[a]	[a]

SCHEDULE

	FY 1993	FY 1994	Change
Estimated first-site implementation as of	09/99	09/99	None
Estimated last-site implementation as of	09/2000	09/2000	None

[a]Data will not be available until after fiscal year 1994.

Background

FAA is developing ITWS to take advantage of improved weather data that new systems are expected to generate and to combine data from a variety of sources. FAA is now deploying a number of weather sensors, such as the Terminal Doppler Weather Radar (TDWR), for terminal area facilities. The Automated Surface Observing System (ASOS), developed by NWS, will also more frequently update terminal weather observations.

Besides these planned improvements in sensors, FAA believes that other improvements are required to meet aviation users' needs in terminal areas. These improvements include (1) providing information to new terminal automation systems on changing weather environments; (2) facilitating the flow of air traffic by predicting short-term changes in weather that will affect the rate at which an airport can accept aircraft; (3) developing clearer radar displays of the location and intensity of precipitation in order to reduce the need for controllers to interpret these displays; and (4) providing controllers with products that anticipate the occurrence, growth, and movement of hazardous weather phenomena, such as microbursts and storm cells.

FAA expects that ITWS will upgrade TDWR's hardware and software to provide these improvements and take advantage of the data provided by new systems. FAA plans to buy 47 systems to be deployed at the same locations as planned for TDWR (45 operational sites and 2 support sites). FAA has contracted for early ITWS development with MIT's Lincoln Laboratories via an interagency agreement with the U.S. Air Force.

ITWS Progress and Problems

The total estimated cost for ITWS has increased significantly. FAA's official estimate of ITWS' total F&E costs has grown from $81.9 million in the October 1992 CIP financial plan to $138.9 million in the November 1993 plan. As is the case with AWPG, the latest benefit-cost study for ITWS contains a much higher cost estimate--$254.2 million. FAA and SEIC budget officials said that they would increase the estimated cost for ITWS in the next update of the CIP financial plan. ITWS project officials noted that the more recent estimates reflect a better definition of the project that evolved as the concept was explored and alternatives were analyzed.

Despite the increase in the project's estimated cost, FAA still expects that the benefits of ITWS will exceed the costs. The present value of the benefits, in constant 1992 dollars, is estimated to be $960.9 million, whereas the present value of the costs is expected to be $160.3 million--an estimated benefit-to-cost ratio of 6 to 1. The benefits are largely expected to accrue to passengers and airlines from reductions in air traffic delays.

In May 1993, the Department of Transportation approved ITWS' entry into the "demonstration and validation of concepts" acquisition stage. During the earlier concept exploration phase, FAA analyzed three alternative ways to meet the ITWS project's needs: (1) incorporating ITWS' functions into the Tower Control Computer Complex segment of the Advanced Automation System, (2) assigning ITWS' functions to an augmented TDWR, and (3) purchasing a new system to host ITWS' functions. The TDWR option was chosen as the most viable in terms of cost, schedule, and risk. FAA plans to begin full-scale development in January 1995, 4 months later than estimated last year. This delay is due to budget reductions and the time needed to prepare documents for entering into full-scale development. FAA estimates that it will begin implementing ITWS in September 1999 and complete the project in 2000.

In 1993, FAA conducted the preliminary demonstration and validation of the ITWS prototype at Orlando, Florida, and Dallas/Ft. Worth, Texas. Delta Airlines noted that it avoided five or six aircraft diversions from Orlando because it had the prototype ITWS display in its dispatch office. Delta estimated that ITWS could avoid between 200 and 400 diversions per year. The cost of a diversion can range from a few thousand dollars to over $100,000.

FAA faces a challenge in developing ITWS interfaces with other systems for data input and output. Eleven interfaces have been identified. Project officials said that they had successfully demonstrated full integration of all sensors during the 1993 tests. Additionally, they noted that ITWS' algorithms and FAA's overall approach had been approved by a panel of independent scientists. Further demonstration/validation activities for ITWS are planned for 1994 at Orlando and at Memphis, Tennessee. If delays in testing TDWR preclude testing ITWS at Memphis, FAA will seek an alternative test site.

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