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Report to the Chairman, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, House of Representatives

July 1991

AVIATION ACQUISITION

Further Changes Needed in FAA's Management and Budgeting Practices

GAO/RCED-91-159

GAO

United States
General Accounting Office
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Resources, Community, and
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July 29, 1991

The Honorable William Lehman
Chairman, Subcommittee on Transportation
and Related Agencies
Committee on Appropriations
House of Representatives

Dear Mr. Chairman:

Since 1981, the Federal Aviation Administration (FAA) has been involved in a major effort to modernize the nation's air traffic control system by acquiring new systems capable of accommodating continued growth in air traffic without compromising air safety. This modernization effort—originally known as the National Airspace System Plan and now known as the Capital Investment Plan—has been financed primarily in FAA's Facilities and Equipment (F&E) appropriation account. This account grew from $350 million in fiscal year 1981 to over $2 billion in fiscal year 1991. For fiscal year 1992, FAA is requesting $2.7 billion in F&E funds.

Many of FAA's major modernization projects have experienced delays and cost overruns. To minimize such problems, the Office of Management and Budget (OMB) has established guidelines for the prudent acquisition of major projects. These guidelines allow agency heads to make "go/no go" decisions after evaluating projects' costs, schedules, and performance at four key decision points.

You were concerned that FAA's problems in modernizing its systems might have resulted from FAA's not having followed the OMB guidelines. In response to your request, we reviewed FAA's progress in incorporating federal acquisition principles in its acquisition process and FAA's budgeting procedures for its major acquisitions. Also, we briefly compared FAA's appropriation account structure with similar account structures in the Department of Defense (DOD) because DOD has a history of acquiring major systems. (See app. III for information on DOD.)

Results in Brief

Since early 1990, FAA has undertaken a number of acquisition reforms, ranging from appointing an Executive Director for Acquisitions to revising the agency's acquisition order to more closely comply with the OMB guidance. It is too early to assess the full impact of these reforms.

Nonetheless, they have already had the positive effect of postponing premature production contract awards for two projects.

Even though FAA's revised order is more closely aligned than its former procedures with OMB's phases and key decision points, several problems still exist in FAA's acquisition process. For example, a critical requirement for all projects, especially new ones, is a mission needs statement, which clearly demonstrates the purpose of the project, how it meets the agency's needs, and what risks it involves. However, FAA's fiscal year 1992 budget request included $116.7 million for 10 new projects that did not have approved mission needs statements at the time of FAA's budget submission to the Congress. FAA also does not have approved mission needs statements for ongoing projects. This practice runs counter to FAA's revised acquisition order.

Furthermore, FAA has not linked its budget with its process for acquiring major projects. According to agency officials, research and development activities should be budgeted in the Research, Engineering, and Development (RE&D) account, and production activities should be budgeted in the F&E account. If FAA followed these criteria, its budget requests for major systems would approximately parallel the phases of an acquisition strategy and correspond with budget preparation guidelines established by OMB. However, FAA has repeatedly ignored these criteria by budgeting development activities in its F&E account. For example, all five projects we reviewed for this report currently fund some development work in the F&E account.

Background

In 1976, OMB set forth in Circular A-109 the principal process for acquiring major systems in the federal government. Major system acquisitions are those acquisitions that are critical to the agency's mission, entail relatively high costs, and warrant special management attention. To avoid problems commonly experienced in acquiring major systems, such as committing funds for production before determining that the technical requirements of a project are attainable, A-109 recommends decision-making by top-level agency management at four critical stages, known as key decision points, in a major system's acquisition. A-109 also requires periodic reviews of a project's cost, schedule, and performance. These reviews serve as the basis for the project's advancement through the phases of a major acquisition, leading ultimately to the award of a contract for full production. These phases and key decision points are illustrated in figure I.1 in appendix I.

OMB Circular A-109 requires agencies to reflect their missions in their acquisition budgets and to prepare their budgets in accordance with the OMB guidance on budget preparation contained in OMB Circular A-11. Specifically, A-109 advises agencies to separate funding for research and development activities in accordance with A-11 guidance. Taken together, Circulars A-11 and A-109 link the budget and acquisition processes. These circulars require agencies to allocate funding for the acquisitions of major systems so as to avoid premature commitments to full-scale development and production. (App. I describes OMB Circulars A-109 and A-11 in further detail.)

FAA's air traffic control modernization effort includes 203 separate projects to upgrade air traffic control. These projects, including radars, computers, and communications networks, have an estimated total cost of $31 billion from fiscal year 1982 through fiscal year 2000.[1] Forty-four of these projects are designated as major acquisitions and are therefore subject to the OMB acquisition and budgeting policies described above. We focused our work on five of these major system acquisitions. (App. II contains detailed information on the five projects reviewed for this report.) FAA uses two appropriation accounts—RE&D and F&E—to fund these projects from development through commissioning of equipment. Together, these two appropriation accounts make up $2.9 billion, or 31 percent, of FAA's total budget request of $9.3 billion for fiscal year 1992.

Despite Changes, Some Management Practices Still Need Improvement

In response to earlier GAO recommendations for improving FAA's acquisition process and incorporating requirements of OMB Circular A-109,[2] FAA has recently implemented some changes. The position of Executive Director for Acquisitions was created in 1990 to head an acquisition office responsible for overseeing acquisition policy and monitoring independent operational testing and evaluation. In September 1990, the appointee to this position acknowledged in a special report that FAA lacked adequate policies and procedures to ensure effective management of major system acquisitions and identified these deficiencies as material weaknesses. Subsequently, in February 1991, FAA issued a revised order on major acquisitions that better reflects the phases and key decision points of OMB Circular A-109 and implements the 1990

[1]See Air Traffic Control: Status of FAA's Modernization Effort (GAO/RCED-91-132FS, Apr. 15, 1991) for more details on the major modernization projects.

[2]Aviation Acquisition: Improved Process Needs to Be Followed (GAO/RCED-87-8, Mar. 26, 1987).

revised Department of Transportation (DOT) order on major acquisitions.[3] FAA's new order requires independent operational testing and evaluation of systems so designated, regular progress reviews of each project with the FAA Administrator, and mission needs statements and acquisition plans for each new project.

A mission needs statement is critical because it identifies the purpose of the project and indicates how the project meets the agency's needs. Specifically, it defines and identifies goals, capabilities, and required resources at an early stage in a project. It should cover such items as the capabilities of the desired system, the expected requisite resources, the potential risks, and the impact of disapproving the system. The mission needs statement is to be assessed, changed if necessary, and reaffirmed at each of the A-109 key decision points.

By requiring mission needs statements, acquisition plans, and regular briefings to assess projects as they move from one phase to the next, the acquisition office already has had an impact on certain ongoing projects. For example, the office delayed the award of the production contract for the Voice Switching and Control System (VSCS), which will improve airway facility communications, because the prototypes could not meet FAA's requirements. Consequently, FAA reassessed its acquisition and development strategy for VSCS. The acquisition office also brought to the attention of the Administrator problems concerning a major component of the Central Weather Processor (CWP), a system that will increase safety and reduce air traffic delays related to weather conditions. As a result, the request for proposal was postponed to permit review of the requirements for this component.

FAA Needs to Better Ensure Compliance With Acquisition Principles

While the new orders should help improve the acquisition process, they still do not clearly state to what extent certain acquisitions will be exempt from the A-109 process. Although the orders require every new major acquisition to have a mission needs statement, some acquisitions may not be required to follow each acquisition phase and key decision point in sequence. According to DOT officials, the A-109 guidelines may not be appropriate for some acquisitions, and for these acquisitions, the Department would determine on a case-by-case basis which aspects of A-109 are applicable. For the projects that FAA decides to exempt from

[3]FAA Order 1810.1E, Major Acquisitions (Feb. 7, 1991) and DOT Order 4200.14C, Major Acquisitions (Apr. 20, 1990).

each phase and key decision point, top management involvement is minimized and the risk of cost, schedule, and performance problems could increase.

Also, FAA is not enforcing an important change to its acquisition process. Both FAA's and DOT's revised orders state that no funding for a project will be included in the budget until the mission needs have been approved by the Office of the Secretary of Transportation (OST). Contrary to this requirement, FAA's fiscal year 1992 budget request included $116.7 million for 10 new projects that did not have approved mission needs statements at the time the budget request was submitted to the Congress. Subsequently, five of these projects have had their needs statements conditionally approved. Including new projects in the budget before approving mission needs runs counter to the orders.

The orders also say that ongoing projects must have their mission needs confirmed before they move to the next acquisition phase. This requirement affects two of the five projects we reviewed that have not yet moved into the production phase. The two projects do not have mission needs statements. Therefore, their mission needs must be approved before FAA can award production contracts for the projects.

FAA cannot reconfigure mature projects to fit the A-109 process, but some aspects of A-109 can be applied to all projects, especially those for which production contracts have not been awarded. The following examples illustrate the impact of FAA's not following the sequence of project steps as set forth in A-109:

- FAA is currently developing and testing two prototypes for the $141-million Precision Runway Monitor (PRM) system,[4] a project designed to make more efficient use of closely spaced parallel runways during conditions of reduced visibility and thereby increase airport capacity. Although one prototype has the potential to narrow the required runway separation from the current standard of 4,300 feet to 3,000 feet, FAA has tested both prototypes at only approximately 3,400 feet. FAA should have clearly defined its goal for runway separation at the beginning of the project before it selected test sites for the prototypes. If FAA wants to pursue the possibility of using runways with a separation of 3,000 feet or less, we believe, on the basis of discussions with agency officials, that the agency needs to build a new demonstration test site. This would

[4]The total costs cited for PRM and each of the other four projects discussed in this report are the sums of funds estimated for each in both the RE&D and F&E accounts.

incur additional costs and time delays; FAA has already received $69.7 million through fiscal year 1991 to develop alternative prototypes.

- FAA's failure to follow a prudent acquisition strategy has contributed to delays in the schedule for the $5.0-billion Advanced Automation System (AAS) project, which is designed to improve controller workstations and increase capacity to handle air traffic. Last year we reported that problems arose because FAA did not resolve development issues before committing the project to production.[5] FAA decided to select one contractor to develop, test, deliver, and implement the system, thereby combining development and full production phases rather than completing development work before awarding the production contract. After the contract was awarded, the AAS schedule slipped 19 months because FAA underestimated the time required to develop and test the software and incorporate new requirements. Substantial development work remains, and further delays are possible.
- FAA officials postponed award of the production contract for the $1.5-billion VSCS because system prototypes did not meet FAA's requirements. However, FAA plans to award the full production contract for VSCS in late 1991 before completing operational testing of prototypes. Because the acquisition schedules for VSCS and AAS are interrelated, FAA could incur contract extension costs on the AAS production contract if VSCS is not operational before the first delivery of the Initial Sector Suite System component of AAS, now scheduled for 1994. To meet AAS's schedule, FAA may award the VSCS production contract before completing the development and testing of prototype upgrades that satisfy the system's requirements.
- FAA is combining the full-scale development and full production phases of the $353-million Terminal Doppler Weather Radar (TDWR), a system to help increase safety and reduce air traffic delays related to weather conditions. Before operationally testing the units, the agency is proceeding with production of this system. Although FAA did test experimental prototypes, it did not use the same computer system and software for testing as it will use for the final production units. This project is vulnerable to cost and schedule changes because the units are being produced while software is being enhanced and testing remains to be done.
- In March 1991, the Administrator decided that work on the Real-time Weather Processor (RWP) component of the $186.3-million CWP should be temporarily stopped in order for the agency to address some of his concerns about RWP's requirements and capabilities. FAA still needs to address two issues before awarding a production contract. FAA must (1)

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

ensure that the final RWP software is transferable to the production hardware, which differs from the hardware now being tested, and (2) test the RWP equipment in an operational environment.

FAA Does Not Effectively Link Its Budget and Acquisition Processes

FAA does not link its budgeting with its process for acquiring major systems. According to FAA's Budget and National Airspace System Program Management Service Offices, criteria exist for budgeting the different phases of a project's acquisition process. According to these criteria—which are consistent with OMB Circular A-11 on budget preparation—all projects should first be budgeted in the RE&D appropriation account if they require any research and development. Projects should be budgeted in the F&E account when they are ready to enter production. Also budgeted in the F&E account are projects that do not require research and development. FAA budget officials said that this type of budgeting system is intended to help preserve the integrity of the appropriation accounts and show a system's logical progression from development through production. This system parallels the phases of a prudent acquisition strategy, allows for the application of the R&D categories designated in A-11, and identifies for the Congress and other decisionmakers the cost, schedule, and progress for a project that is being procured.

However, FAA exhibits a lack of discipline by not following A-11 or its own criteria for budgeting acquisition activities in the two accounts. FAA repeatedly has budgeted preproduction activities in its F&E account. All five projects we reviewed have received F&E funding for development activities. For example, FAA funds AAS in the F&E appropriation account, even though its software development has not been completed. In addition, FAA is still conducting prototype development for VSCS, even though the agency has funded the project in the F&E appropriation account since fiscal year 1989. FAA has also funded CWP and TDWR with F&E dollars while prototype development was still in progress.

Other examples further illustrate inconsistencies between the budgeting and the acquisition phases of FAA's projects:

- For PRM, FAA is requesting $15 million in the F&E account and no funds in the RE&D account in fiscal year 1992. Such budgeting suggests that PRM is ready to enter the production phase. However, this project is not ready for production. In fact, FAA acquisition officials recently indicated that the first phase of this project—determination of mission needs—remained to be completed.

- FAA has no criteria to define the appropriate account for funding the writing of software. As a result, software development has been inconsistently funded in either the RE&D or the F&E account. For example, FAA funded software development for TDWR in RE&D and software development for AAS in F&E. For AAS, software development has proven to be a major stumbling block, resulting in schedule delays.

Although FAA acknowledged in its fiscal year 1992 budget request that it was requesting F&E funding for development activities, it did not state the full extent to which F&E funds are being used for development activities. FAA's fiscal year 1992 budget justification identified seven projects with development activities totaling $97.3 million out of its $2.7-billion total F&E request. However, the budget justifications merely pointed out that these seven projects would be using F&E funds for development work and did not define what the agency means by development work or identify the projects' acquisition phases. None of the five projects we reviewed were included in this group of seven, even though all five have F&E funding requests for development work in fiscal year 1992.

According to FAA officials, the agency's reluctance to budget development activities in its RE&D account is related to its authorization ceiling for RE&D and the extent to which its RE&D requests have been reduced over the years. FAA officials told us that if all development work funded in the F&E account were moved into the RE&D account, the RE&D account would exceed its authorization. For both fiscal years 1991 and 1992, the RE&D authorization level was $260 million.[6] FAA's fiscal year 1992 budget request for RE&D is $210 million. Therefore, if FAA transferred the development activities budgeted at $97.3 million from the F&E account to the RE&D account, FAA's 1992 budget request for its RE&D appropriation would exceed the account's authorization. According to FAA officials, if all development activities—including those in such large projects as AAS—were funded in the RE&D appropriation, a significantly higher authorization would be needed. In addition, they pointed out that the agency's requests for higher RE&D funding levels over the past few years have been denied by both OST and OMB.

We believe that three options for solving this problem are available to FAA and the Congress:

- FAA could propose to the Congress a higher RE&D authorization level to allow all research and development activities to be funded in the RE&D

[6]P.L. 101-508, "Omnibus Budget Reconciliation Act of 1990," title 9-C, section 9202.

appropriation account. The F&E account would then be used only to fund production work. This approach would be consistent with the guidance in A-109 and A-11.

- FAA could propose a new appropriation account to be used exclusively for developing major system acquisitions. This new account would fund all FAA modernization research and development activities until a project was ready for full production. Once a project was ready for full production, it would be funded in the F&E account. The existing RE&D account would then be used for other research activities that normally do not result in system acquisitions, such as those FAA is now pursuing in aircraft noise, aviation security, and aviation medicine.
- FAA could maintain the current account structure and practice of funding development activities in both the RE&D and F&E accounts. The accounts should, however, be segmented into subaccounts corresponding to the five acquisition phases. The RE&D account would fund the initial development of a major acquisition, and the F&E account would fund full-scale development and production of the acquisition. This segmentation would enable FAA to clearly distinguish development activities from production work.

Conclusions

As a result of not following the acquisition phases, particularly the practice of committing projects to production before identifying and resolving their risks during development, FAA has lacked an effective tool to help it manage projects and reduce the potential for continued cost growth, schedule delays, and performance deficiencies. Furthermore, FAA has operated contrary to established governmentwide acquisition policy. Although following the OMB guidelines will not alone guarantee success in acquiring major systems, the guidelines can serve as a management tool to minimize risks, especially when the acquisition process is linked with the agency's budget. Specifically, separate accounting for development and production funds would enable FAA's top management, the Secretary of Transportation, and the Congress to examine an acquisition's progress, problems, and risks before allowing the project to advance to the next acquisition phase. This link would also strengthen FAA's capacity to implement and institutionalize the new acquisition order and procedures it has recently adopted. Enforcing these changes is needed to ensure prudent investment of funds and, ultimately, sound decision-making affecting the safety of the flying public and the efficiency of air travel.

Recommendations

We recommend that the Secretary of Transportation direct the Administrator, FAA, to take the following actions:

- Ensure that the agency consistently applies its new acquisition policy and procedures to its major system acquisitions. FAA should continually reconfirm the mission of its projects to help eliminate any uncertainty associated with product development, and it should clearly indicate the progress of its acquisition projects through its acquisition and budget documents.
- Work with the appropriate Committees of the Congress to develop and implement criteria for budgeting for major acquisition activities. These criteria should segment funding for major acquisitions according to the phases and milestones set forth in federal acquisition principles.

Agency Comments

We obtained oral comments from FAA and DOT officials and have included their comments where appropriate. Generally, FAA and DOT officials did not disagree with our recommendations. They did provide revised budget data and other factual clarifications, which we incorporated in the report. However, both FAA and DOT officials believed that we did not fully acknowledge the recent strides they have made to improve FAA's acquisition process and that we did not adequately explain their reasons for not yet having made other improvements. In response to these comments, we more clearly identified recent improvements in FAA's acquisition process and included the agencies' reasons for delays of planned actions. We continue to believe that additional actions to address the recommendations in this report will further improve the process.

Scope and Methodology

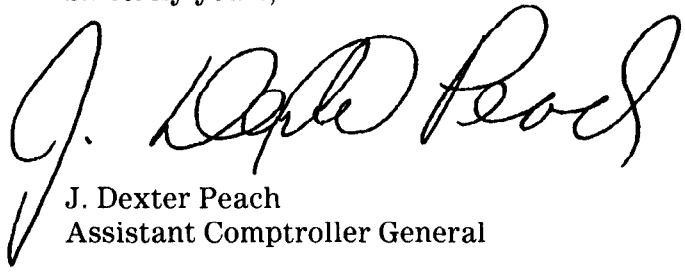
In conducting our review, we examined and analyzed pertinent system planning and budget documents and orders for major system acquisitions. At FAA we focused our work on five major system acquisitions—AAS, CWP, PRM, TDWR, and VSCS—which are all receiving RE&D and F&E funding in fiscal year 1991. FAA estimates that the total cost to acquire these five systems will be approximately $7 billion. (See app. II for more details on these five systems.)

In addition, we interviewed FAA program or project managers for these systems and budget and acquisition officials. We also interviewed OST and OMB officials about FAA's budget process for major acquisitions. To obtain information on DOD's process, we interviewed officials in DOD's acquisition office and reviewed internal directives on its acquisition process. We also obtained information on DOD's acquisition policies from our

National Security and International Affairs Division. We did not assess the extent to which DOD has followed its internal directives or complied with A-109. Our review was conducted between September 1990 and May 1991 in accordance with generally accepted government auditing standards.

We are also providing copies of this report to the Secretary of Transportation; the Administrator, FAA; and other interested parties. This work was done under the direction of Kenneth M. Mead, Director, Transportation Issues, who may be contacted at (202) 275-1000. Major contributors to this report are listed in appendix IV.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

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Abbreviations

AAS	Advanced Automation System
CIP	Capital Investment Plan
CWP	Central Weather Processor
DOD	Department of Defense
DOT	Department of Transportation
FAA	Federal Aviation Administration
F&E	Facilities and Equipment
GAO	General Accounting Office
MWP	Meteorological Weather Processor
NAS	National Airspace System
OMB	Office of Management and Budget
OST	Office of the Secretary of Transportation
OT&E	operational testing and evaluation
PRM	Precision Runway Monitor
R&D	Research and Development
RDT&E	Research, Development, Test and Evaluation
RE&D	Research, Engineering, and Development
RWP	Real-time Weather Processor
TDWR	Terminal Doppler Weather Radar
VSCS	Voice Switching and Control System

OMB Circulars A-109 and A-11

The Office of Management and Budget (OMB) evaluates, formulates, and coordinates management procedures and program objectives within and among federal departments and agencies. As part of its work, OMB issues circulars defining federal policy for certain specific subject areas. Circular A-109, establishing the executive branch's policy for major system acquisitions, and Circular A-11, providing guidance on federal budget preparations, are two such circulars.

OMB Circular A-109

In 1976, OMB issued a policy for all executive agencies to follow in managing their acquisition of major systems—OMB Circular A-109. A-109 defines a major system as a program (1) critical to fulfilling an agency's mission, (2) entailing the allocation of relatively large resources, and (3) warranting special management attention. The acquisition framework and policy established by A-109 are intended to reduce the potential for cost growth, schedule delays, and performance deficiencies and to avoid the premature commitment of major systems to production.

In accordance with Circular A-109, agency heads are to evaluate the cost, schedule, and performance of major projects at four critical points in their acquisition and affirm the need for the projects at each decision point. At each of the four key decision points, agency heads are to decide whether the projects are ready to move to the next phase of the acquisition process.

Acquisition Phases

The A-109 major system acquisition process is divided into five progressive phases. Passage from one phase to another is decided by the agency head. The five phases are (1) identification of mission needs, (2) identification and exploration of alternative design concepts, (3) demonstration of alternative design concepts, (4) full-scale development and limited production, and (5) full production. The relationships between the five phases and four key decision points of the A-109 process are shown in figure I.1.

Phase 1: Determine Mission Needs—The acquisition of a major system begins with identifying why the system is needed to support the agency's mission. The thinking and planning involved in this phase affect the character, the quality, and, ultimately, the cost of the major system that is procured.

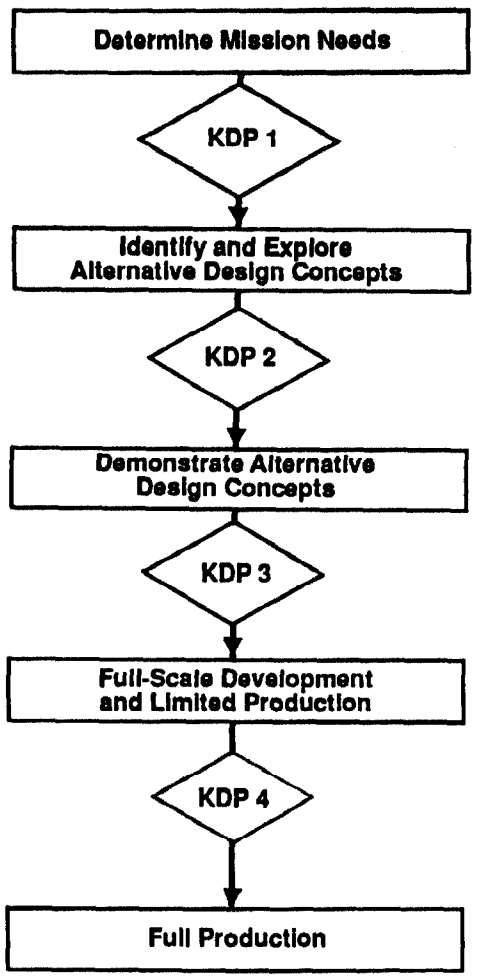
Phase 2: Identify and Explore Alternative Design Concepts—The agency solicits alternative system design concepts that might meet the identified need from a broad base of qualified firms. These firms submit their concepts in a form suitable for preliminary evaluation. The intent is to generate innovation and competition for the best system design to meet the mission needs.

Phase 3: Demonstrate Alternative Design Concepts—Once alternative system design concepts are selected, the project is advanced to the demonstration phase. Before awarding a contract for further development, however, the agency must reaffirm its mission needs and project objectives. An agency head must decide whether to pursue alternative concepts or proceed with a single concept.

Phase 4: Full-scale Development and Limited Production—Alternative system(s) can enter full-scale development, including limited production, only after the agency's mission needs and program objectives have been reaffirmed and demonstration results verify that the chosen system(s) design concepts are sound. Agency head approval is again required for the project to move into full-scale development and limited production.

Phase 5: Full Production—Before approving a system's entry into full production, the agency head must reaffirm mission needs and program objectives, and system performance should be satisfactorily tested under operational conditions. This operational testing should be conducted independently of the agency's development and user organizations.

Figure I.1: A-109 Major System Acquisition Process



Phase 1: Determine Mission Needs
- Identify Mission Needs and Develop Mission Needs Statement
- Develop Program to Satisfy Needs

Key Decision Point 1
Approval of the mission needs statement starts the major system acqusition process by granting authority to explore alternative system design concepts.

Phase 2: Identify and Explore Alternative Design Concepts
- Identify Alternative Design Concepts
- Select Most Promising Design Concepts For Further Exploration

Key Decision Point 2
Advancement to a competitive test / demonstration phase may be approved when the agency's mission needs and program objectives are reaffirmed and when alternative systems design concepts are selected.

Phase 3: Demonstrate Alternative Design Concepts
- Design and Fabrication (normally involves a prototype)
- Test and Evaluation

Key Decision Point 3
Following reconfirmation of mission needs and program objectives and verification that the chosen system design concept(s) is sound and risks are acceptable, the agency head may authorize the next phase.

Phase 4: Full-Scale Development and Limited Production
- Full-Scale Development
- Independent Tests of System Performance
- Demonstration in Expected Operational Environment
- Limited Production

Key Decision Point 4
Following satisfactory test results and reconfirmation of mission needs and program objectives, the agency head may authorize full production.

Phase 5: Full Production
- Full Production
- Deploy Systems into Operational Use

Source: OMB.

OMB Circular A-11

OMB Circular A-11 provides detailed instructions and guidance to executive branch departments and agencies for preparing annual budgets. For the purposes of this letter, we will narrowly discuss A-11's reporting requirements for agency budget preparation for research and development (R&D) activities.

A-11 requires that an agency's total R&D budget be broken into funding categories. According to the A-11 reporting criteria, these categories are basic research, applied research, and development. Basic research is defined in A-11 as "systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind." Applied research is defined as "systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met." Development is defined as "systematic use of the knowledge and understanding gained from research for the production of useful materials, devices, systems, or methods, including the design and development of prototypes and processes."

A schedule summarizing R&D activities is required annually for each agency whose R&D levels exceed $10 million. The schedule is to contain budgeted levels for obligations, budget authority, and outlays and is to include projections for future years' needs.

Descriptions and Funding Histories of Five FAA Modernization Projects

The following are general descriptions, funding histories, and brief discussions of the current A-109 phases for the five Federal Aviation Administration (FAA) modernization projects we evaluated.

Advanced Automation System

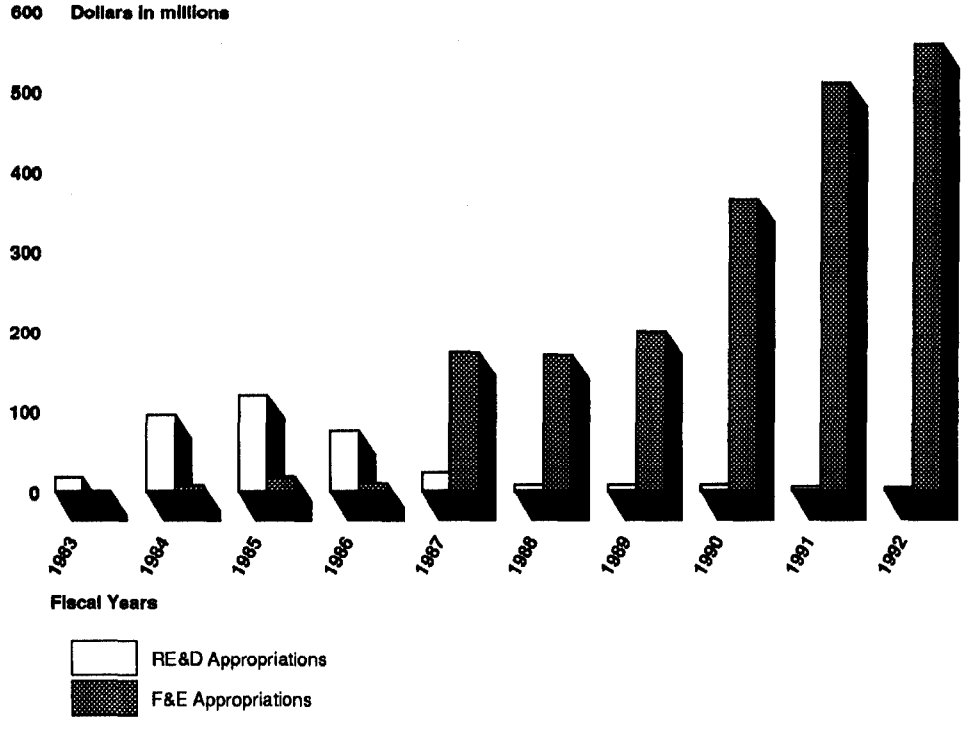
According to FAA, the Advanced Automation System (AAS) will significantly upgrade air traffic control capability and is the cornerstone of FAA's national air space modernization efforts. It will provide the foundation for the Automated En-route Air Traffic Control system and is the key system through which the benefits of the Next Generation Weather Radar, the Mode S surveillance and communication system, and the Central Weather Processor will be realized.

AAS will also contribute to the operational, cost, and expandability goals of FAA's modernization. Operationally, the system will improve air traffic control efficiency and safety and increase airspace system capacity. AAS is also expected to decrease maintenance costs by providing highly reliable hardware and software and thereby reducing the need for maintenance staff. In addition, the system will provide the computer capacity needed to support facility consolidation. Finally, AAS can be expanded to meet future growth requirements.

About $1.8 billion has been appropriated through fiscal year 1991 for AAS. FAA estimates that project costs will total about $5.0 billion. The funding history for AAS is shown in figure II.1 and table II.1.

The Office of the Secretary of Transportation (OST) conditionally approved a memorandum in 1988 marking key decision point 4 for AAS. According to the Circular A-109 definitions of the phases of a major system acquisition, AAS should, then, be in phase 5 (full production). However, we estimate that AAS is in phase 4 because, for the key component of the system, the software is still being developed and no operational testing of a prototype has been done.

Figure II.1: Appropriations for AAS



1992 funding is requested

Source: GAO analysis of FAA data.

Table II.1: Appropriations for AAS

Dollars in millions

	Fiscal year									
Account	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992[a]**
RE&D	17.0	95.0	120.3	75.5	22.9	7.7	7.4	7.5	5.0	4.2
F&E	0.0	7.1	17.6	10.2	173.7	170.0	200.0	365.0	510.0	557.8

[a]Fiscal year 1992 funding is requested.
Source: GAO analysis of FAA data.

Voice Switching and Control System

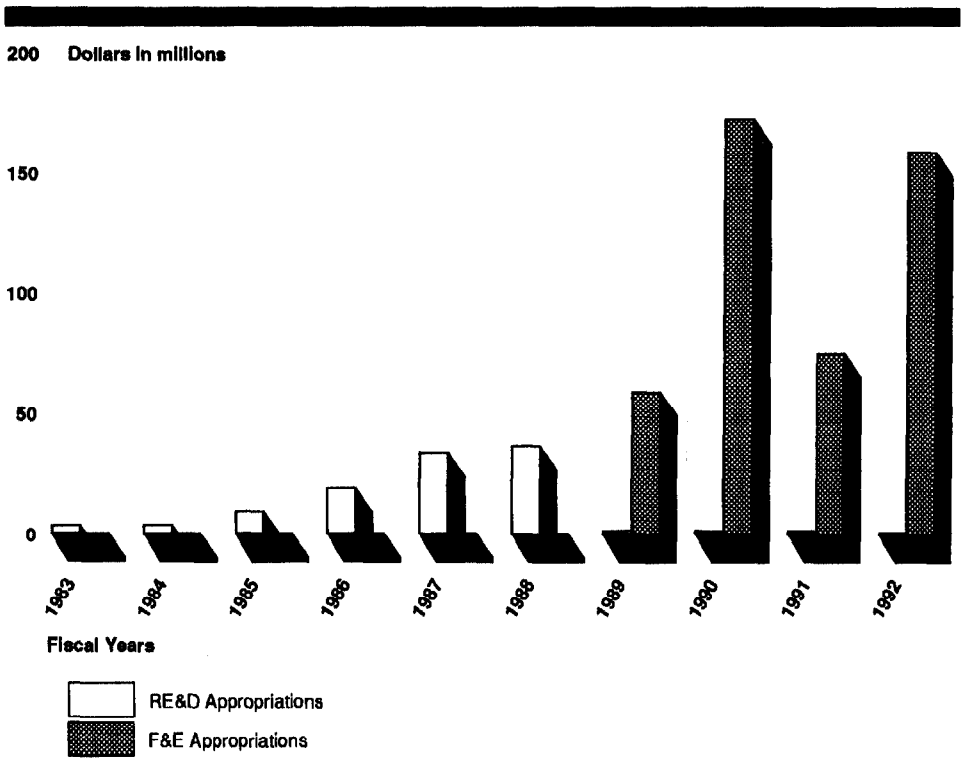
The Voice Switching and Control System (VSCS) will provide the voice communications switching system for major FAA control facilities. VSCS will provide an integrated system for the operation and management of ground-to-ground and air-to-ground voice communications for air traffic

control. VSCS is designed for rapid reconfiguration of voice communication resources and is critical to increasing controller productivity as well as reducing costs for leased services.

About $415 million has been appropriated through fiscal year 1991 for VSCS. FAA estimates that project costs will total about $1.5 billion. The funding history for VSCS is shown in figure II.2 and table II.2.

OST approved a memorandum in 1985 marking key decision point 3 for VSCS. According to Circular A-109 definitions of the phases of a major system acquisition, VSCS should currently be in phase 4 (full-scale development and limited production). However, we estimate that VSCS is in phase 3 because two contractors are developing the VSCS prototypes.

Figure II.2: Appropriations for VSCS



1992 funding is requested

Source: GAO analysis of FAA data.

Table II.2: Appropriations for VSCS

Dollars in millions

	Fiscal year									
Account	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992[a]**
RE&D	3.4	3.5	9.3	18.9	33.4	36.4	1.5	1.2	1.1	0.6
F&E	0.0	0.0	0.0	0.0	0.0	0.0	59.0	172.3	75.0	159.1

[a]Fiscal year 1992 funding is requested.

Source: GAO analysis of FAA data.

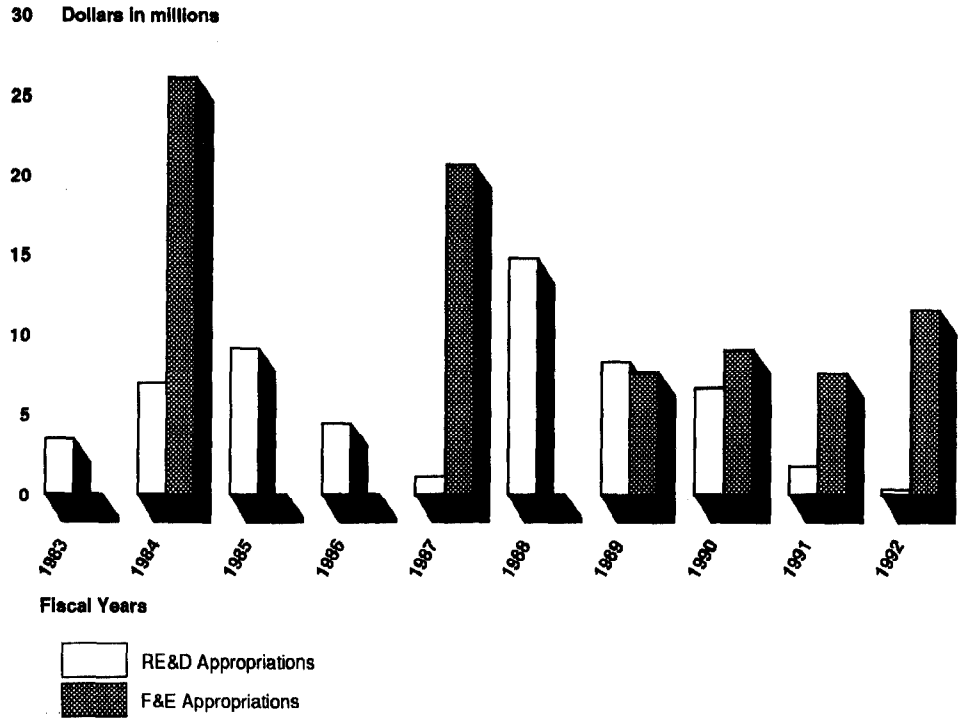
Central Weather Processor

The Central Weather Processor (CWP) consists of two components, a meteorological weather processor (MWP) and a real-time weather processor (RWP). MWP will enable meteorologists at major FAA control facilities to use commercially available weather information. RWP will provide real-time weather information to air traffic controllers. MWP and RWP will receive weather information from various sources, including weather radars, meteorological satellites, and the National Weather Service.

About $127 million has been appropriated through fiscal year 1991 for CWP. FAA estimates that project costs will total about $186.3 million. The funding history for CWP is shown in figure II.3 and table II.3.

OST approved a memorandum in 1985 marking key decision point 3 for CWP. According to Circular A-109 definitions of the phases of a major system acquisition, CWP should currently be in phase 4 (full-scale development and limited production). However, we estimate that the RWP component of CWP is in phase 3 because the RWP prototype and software are being developed and no operational testing has begun on the RWP system.

Figure II.3: Appropriations for CWP



1992 funding is requested

Source: GAO analysis of FAA data.

Table II.3: Appropriations for CWP

Dollars in millions

	Fiscal year									
Account	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992[a]**
RE&D	3.4	6.9	9.1	4.4	1.1	14.7	8.3	6.6	1.7	0.3
F&E	0.0	26.0	0.0	0.0	20.6	0.0	7.6	9.0	7.5	11.5

[a]Fiscal year 1992 funding is requested.

Source: GAO analysis of FAA data.

Terminal Doppler Weather Radar

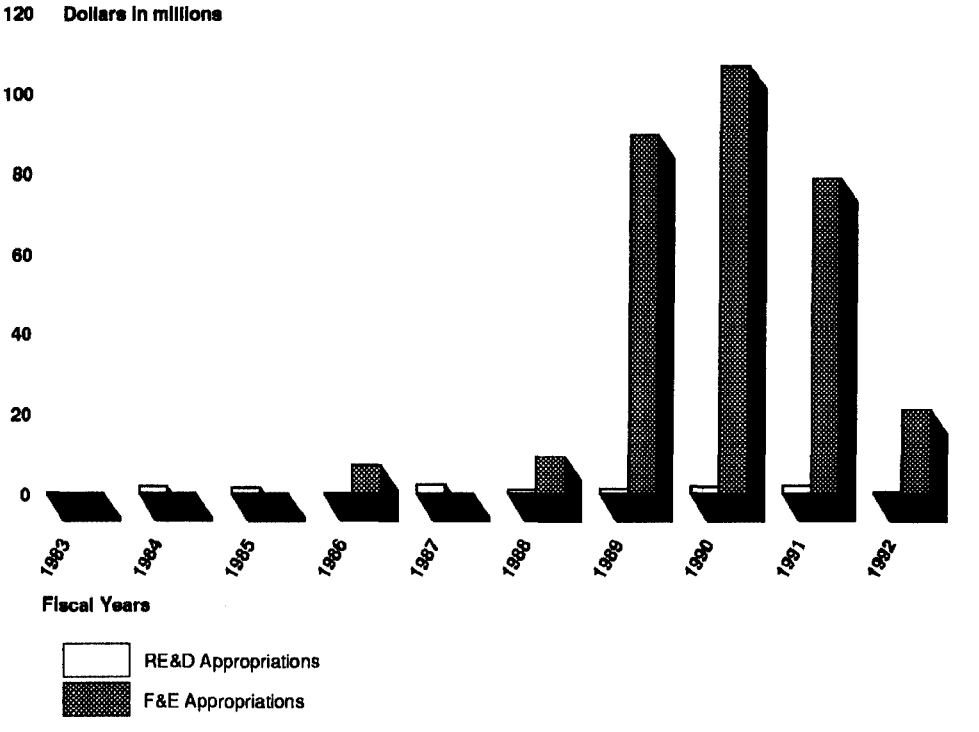
The Terminal Doppler Weather Radar (TDWR) is designed to develop a reliable automated system for detecting low-altitude wind shear in airport terminal areas. The system will warn pilots to avoid or prepare for wind shear on approach or departure. In addition, TDWR will give alerts of other hazardous weather conditions in the terminal area and provide

advanced notice of changing wind conditions to permit timely change on active runways.

About $304 million has been appropriated through fiscal year 1991 for TDWR. FAA estimates that project costs will total about $353 million. The funding history for TDWR is shown in figure II.4 and table II.4.

OST approved a memorandum in 1987 marking key decision point 4 for TDWR. According to Circular A-109 definitions of the phases of a major system acquisition, TDWR should currently be in phase 5 (full production). However, we estimate that TDWR is in phase 4 because FAA has tested experimental radars but has not operationally tested production units.

Figure II.4: Appropriations for TDWR



1992 funding is requested

Source: GAO analysis of FAA data.

Table II.4: Appropriations for TDWR

Dollars in millions

	Fiscal year									
Account	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992[a]**
RE&D	0.0	1.8	1.6	0.0	2.3	1.0	1.4	1.9	2.0	0.5
F&E	0.0	0.0	0.0	7.0	0.0	9.5	89.4	107.0	78.7	21.0

[a]Fiscal year 1992 funding is requested.
Source: GAO analysis of FAA data.

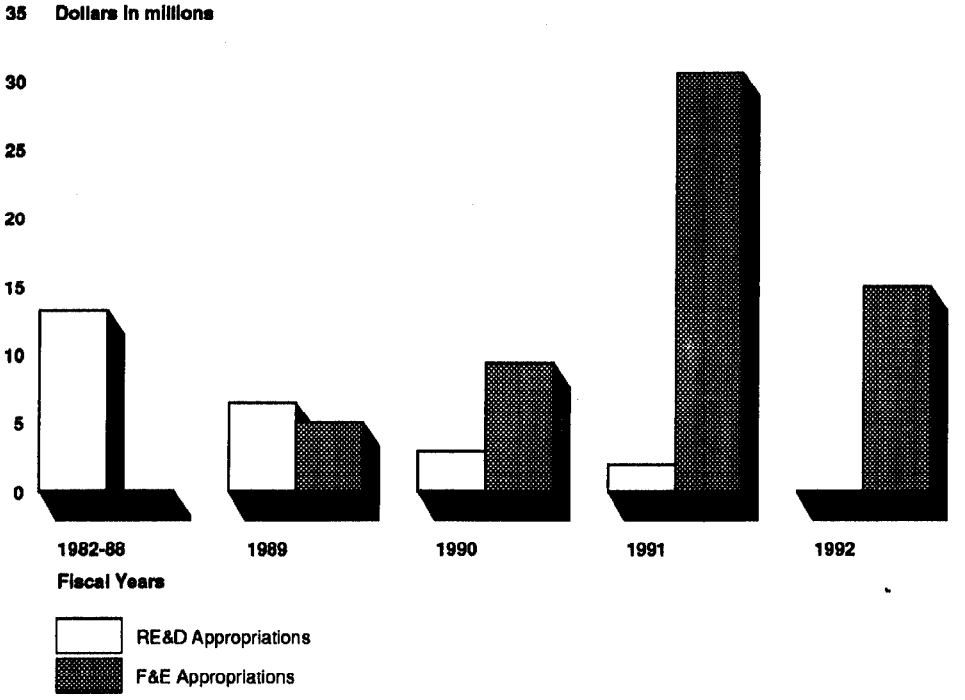
Precision Runway Monitors

To alleviate delays, the Precision Runway Monitor (PRM) program will introduce an improved surveillance radar, which is designed to allow simultaneous approaches to closely spaced parallel runways during bad weather. Traffic at airports with close parallel runways slows down when pilots and controllers cannot maintain visual contact and must instead rely on radar. PRM will provide radar hardware and associated procedures to controllers and pilots that should bring runway acceptance and departure rates on closely spaced parallel runways during bad weather closer to rates during good weather, thereby increasing airport capacity.

About $69.7 million has been appropriated through fiscal year 1991 for PRM. FAA estimates that project costs will total about $141 million. The funding history for PRM is shown in figure II.5 and table II.5.

FAA has not yet had to submit key decision point memorandums to OST for approval of PRM because the project was not designated a major system acquisition until 1990. Even though FAA is testing two radar systems for PRM, FAA's acquisition office is now requiring a mission needs statement to define the project's requirements. Theoretically, a mission needs statement occurs during the first phase of the acquisition process.

Figure II.5: Appropriations for PRM



1992 funding is requested

Source: GAO analysis of FAA data.

Table II.5: Appropriations for PRM

Dollars in millions

	Fiscal year				
Account	**1982-88**	**1989**	**1990**	**1991**	**1992[a]**
RE&D	13.25	6.5	2.9	2.0	0.0
F&E	0.0	5.0	9.4	30.6	15.0

[a]Fiscal year 1992 funding is requested.

Source: GAO analysis of FAA data.

DOD and FAA Budgetary Account Structures and a Comparison to the A-109 Acquisition Process

Despite some well-publicized problems in its procurement activities, the Department of Defense (DOD) has adopted a budgetary account structure that parallels the phases in OMB Circular A-109. Like FAA, DOD uses different appropriation accounts to fund research and development (R&D) work and procurement work. Roughly corresponding to FAA's RE&D appropriation account are DOD's Research, Development, Test and Evaluation (RDT&E) accounts, and corresponding to FAA's F&E account are its Procurement accounts.

However, compared with FAA's account structure, DOD's account structure is more closely aligned with OMB acquisition guidance in three respects. First, DOD's budget policies require that R&D activities be identified in its appropriation account in accordance with OMB Circular A-11. DOD incorporates detailed internal subdivisions within its RDT&E accounts for tracking a project's development. These five DOD internal subdivisions are as follows:

- 6.1 - Basic research,
- 6.2 - Exploratory development,
- 6.3 - Advanced development,
- 6.4 - Engineering development, and
- 6.5 - Management and support.

These five categories approximately coincide with the A-109 phases. In contrast, FAA has no comparable subdivisions in its RE&D account.

Second, DOD has separate testing and evaluation accounts and legislatively mandated operational testing and evaluation (OT&E) of major projects before they can go to production. In contrast, FAA does not have a legislatively mandated OT&E process and historically has awarded production contracts before OT&E has begun. DOD's OT&E office reports to the Secretary of Defense, whereas FAA's OT&E office only recently began reporting to the Executive Director for Acquisition. Before FAA's new acquisition order was issued, FAA's OT&E office reported to the projects' program offices.

Third, DOD has criteria for funding projects in different appropriation accounts. Specifically, DOD's policies stipulate that all the phases of a major system's development be funded in its research and development accounts and that the procurement accounts be used only for full production. Furthermore, in DOD, salaries and costs for facilities construction and developmental testing are funded in specific individual

accounts. FAA funds facilities construction in its F&E account, some developmental testing costs in its F&E account, and salaries in its RE&D, F&E, or Operations account.

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Related GAO Products

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

FAA Procurement: Competition for Major Data Processing Project Was Unjustifiably Limited (GAO/IMTEC-90-71, June 11, 1990).

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

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

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

Aviation Acquisition: Improved Process Needs to Be Followed (GAO/RCED-87-8, Mar. 26, 1987).

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