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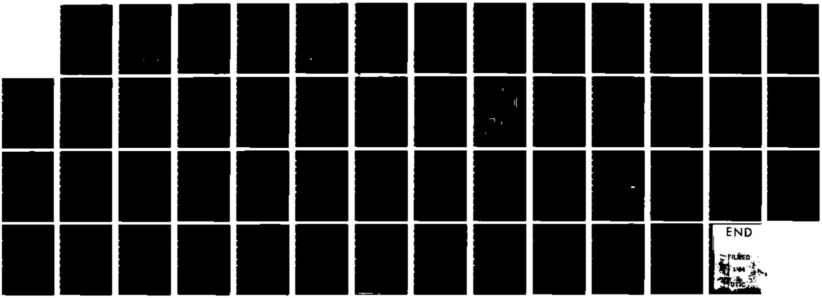

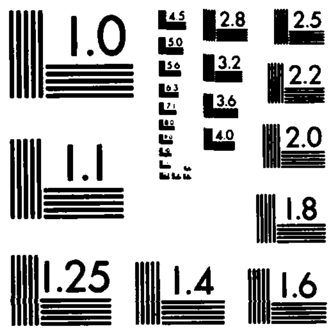

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Washington, D.C. 20591

Advanced Automation Program

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Program Master Plan

September 21, 1983

U.S. Department of Transportation
Federal Aviation Administration

NOTICE

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16. Abstract

The Program Master Plan describes the approach to be used for implementation of the Federal Aviation Administration Advanced Automation Program. It presents the program mission needs and objectives, and describes the technical plan, management approach, acquisition strategy, contractor support program schedule, and funding plan for implementation of the program. Accordingly, it is the top level program document, stating FAA plans and policies for program execution. It will be supplemented by supporting documents that define the specific plans and mechanisms for program management, implementation, transition and control.

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Recommendation

It is recommended that this plan be approved and that work be authorized to proceed.

[illegible]
Program Manager

[illegible] 83
Date

Concurrence

Neal A. Blake
for Associate Administrator for
Development and Logistics

Sept 20, 1983
Date

Approval

This plan for implementation of the Advanced Automation Program is approved and work is authorized to proceed. Key Decision and other approvals will be required in accordance with Section 6.0. Program status reports shall be provided to the Administrator every 6 weeks. If the total estimated cost of the program changes by more than 10 percent or the scheduled date for any Administrator controlled decision milestone changes by more than 3 months, a special review will be required for the Administrator.

[illegible]
Administrator

Sept. 21, 1983
Date

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Program Master Plan is to describe the approach to be used for the implementation of the Federal Aviation Administration Advanced Automation Program. This plan complements five other top level FAA documents that define roles, responsibilities and requirements for implementation of the Air Traffic Control Advanced Automation Program. These documents are:

1) National Airspace System Plan;
2) Systems Requirements Statement for the Advanced Automation Program;
3) Mission Need Statement, Advanced Automation Program;
4) Advanced Automation Program Office Order; and
5) Program Manager's Charter for the Advanced Automation Program.

This Program Master Plan presents the program mission needs and objectives, and describes the technical plan, management approach, acquisition strategy, contractor support, program schedule, and funding plan for implementation of the program. Accordingly, it is the top-level program document, stating FAA plans and policies for program execution. It will be supplemented by supporting documents that define the specific plans and mechanisms for program management, implementation, transition, and control. The types of supporting documents currently planned are described in Section 1.6.

1.2 Mission Needs

The FAA is responsible for the management and operation of the National Airspace System (NAS) in a safe and efficient manner. This system is the busiest in the world, with more than 225,000 commercial, military, and general aviation aircraft now sharing American airspace. In 1981 alone, over 285 million passengers flew with scheduled airlines, while general aviation and military pilots accumulated over 47 million flight hours in American airspace. Consequently, safe and efficient operation of the system is essential to the Nation's commerce and defense.

The Air Traffic Control (ATC) automation system, comprised of computers, application software and controller work stations, plays a major role in support of the National Airspace System. Over 200 ATC automation facilities exist today. The ability to serve airspace system users is directly dependent on the capacity and functional capability of these automated facilities. Most of the current automation system was developed in the 1960's. Accordingly, it is based on 20-year-old technology in a field that has experienced sweeping technical advances during this period. Since its installation, the automation system has been periodically improved to provide additional capacity and operating functions in response to growing air traffic demands. The ability to further improve the existing system is reaching design limitations.

Because of its age and design characteristics, the present system is limited in both capacity and capability. Despite the planned enhancement of present equipment, by the late 1980's the projected growth in airway traffic will saturate the present system's capacity to handle traffic demands in some sectors of U.S. airspace. Such saturation means constraints and delays in flight operations with accompanying reductions in operating efficiency. Due to limitations of the current computer system, this problem is one that cannot be solved by merely adding more current-type equipment to the system.

Through continued FAA research and development, technical advances are being made in ATC functions that offer the future possibility of enhanced flight safety, improved aircraft fuel efficiency, increased controller productivity, and reduced flight operation delays. However, the basic system architecture and the structure of the software limit extension of the current automation system to perform these new functions.

Another factor of concern is the continued increase in logistics and maintenance costs of the present system. There are several reasons for this. As the equipment ages, spare parts are more difficult to obtain. With reduced market demand for these obsolete parts, manufacturing costs and purchase price have increased and the manufacturer is beginning to phase out production of some parts. This means that the FAA must stockpile replacement parts now so that the equipment can be kept operating in the future. Consequently, logistics and maintenance costs of the current system are substantially greater than the costs for modern equipment with its miniaturization and solid-state electronics. In addition, the computer software has become extremely expensive to maintain in comparison with modern software systems.

The capacity and capability limitations of the automation systems currently in use, along with their associated operating costs, have created an urgent need for their replacement. A common system is needed that will reduce these costs, improve controller productivity, and provide the needed capability, reliability and capacity to safely and efficiently handle air traffic demands in the 1990's and beyond.

1.3 Goal

FAA's mission, as stated in the Federal Aviation Act of 1958, is "to provide for the regulation and promotion of civil aviation in such a manner as best fosters its development and safety and to provide for the safe and efficient use of airspace by both civil and military aircraft and for other purposes." One aspect of this mission assignment is providing for safe and efficient use of the national airspace. In response to this aspect of its mission assignment, a goal established by the FAA and stated in its National Airspace System Plan is:

- To provide for the safe and efficient use of the Nation's airspace, while minimizing constraints on its use.

Pursuit of this goal implies the achievement of three airspace system capabilities that are dependent on a new automation system. The first of these capabilities is:

- To be able to handle safely, without delays, the growing civil and military air traffic projected through 1990 and beyond.

Forecasts indicate that demand for aviation services will more than double in the next two decades. To accommodate this growth, air traffic system capacity must be expanded to provide more direct routings and to handle the rate, sequence, and speed at which aircraft move through the system. This can be achieved by increasing the capacity and reliability of the ATC computers, and by increasing their capability to perform new functions and accommodate new interfaces.

Continued technical advances in automation systems lead to the second capability implied by the FAA goal:

- To perform new functions which will lead to enhanced system safety, improved fuel efficiency, increased FAA productivity, and decreased air traffic delays.

A number of improved functional capabilities are now being developed by the FAA. Those within the capability of the current automation system will be phased in during the next 5 years. Others, which offer even greater functional improvements in airspace system operation, require new software combined with a growth in computer and controller sector suite capability that are achievable only with modern computers and automation equipment.

The third capability implied by the FAA goal is:

- To improve productivity of the system's air traffic controllers and to reduce maintenance costs.

Modern computer hardware, computer software, and controller console equipment, which are capable of performing enhanced system functions, will enable a controller to safely handle an increased volume of air traffic. Also, due to the nature of its design, this modern hardware and software require less maintenance than the present system. These factors can lead to substantial economies in operation of the air traffic control system.

1.4 Program Objectives

It is planned that these enhanced capabilities of the Air Traffic Control automation system will be achieved in three steps. This approach was selected as the one offering minimum risk while providing a cost effective solution to fulfilling the airway system needs. The three-step approach reduces the risk involved in developing a large complex system and offers lower transition risk than would exist if all system elements were simultaneously replaced. The objective of the first step is:

- o To provide the necessary automation system capacity and reliability during the late 1980's and into the early 1990's by installing new computers in the conterminous en route centers.

Achievement of this objective offers early benefits without placing undue pressure on development of the new hardware and software required to enhance functional capability of the system. The existing 9020 computers in all of the conterminous en route centers will be replaced with modern computers compatible with current system computer software. The existing software will be hosted on the new computers. The added capacity of these host computers is needed to accommodate near term functional enhancements and traffic growth into the 1990's. Functional enhancements made possible by the added computer capacity are: Conflict Resolution Advisories, Conflict Alert for VFR Mode C Intruders, and En Route Metering II systems.

The objective of the second step is:

- o To provide increased controller productivity by installing improved sector suite equipment at the en route centers.

Achievement of this objective provides new sector suites at the earliest possible date with such enhanced capabilities as electronic presentation and manipulation of flight data and improved man-machine mechanisms. Improvements offered by the new sector suites will eliminate such manual functions as Flight Strip Printer operations and controller manipulation of flight strips and will enhance flight data displays. As a result, controller productivity will be improved, thereby enabling a controller to handle an increased number of aircraft.

The objective of the third step is:

- o To provide the increased capability to perform new functions required during the 1990's and beyond by: 1) installing new software and processors with enhanced functional capability at the en route centers, thereby completing their modernization; and 2) subsequently installing modern controller work stations with associated new software and processors in approximately 300 Air Traffic Control Towers.

Achievement of this objective will provide the capability to perform new functions being developed by the FAA to improve flight safety and efficiency with reduced operating costs. For example, the Automated En Route Air Traffic Control system functions provided by AERA I will be implemented as part of this third step. These new functions to be provided by AERA I include conflict probe, workload probe for supervisors, and restricted airspace probe. The capability of the ATC System to provide these functions is due to the underlying design of the 4D trajectory estimation feature. The new automation system will also permit subsequent implementation of other AERA functions currently being developed.

1.5. System Consolidation

The National Airspace System Plan calls for an evolution of en route and terminal air traffic control systems from the present until the year 2000 and beyond in two related areas: 1) new and improved automation support, reflected by the program objectives stated above, and 2) consolidation of existing facilities. During this evolution the existing Air Route Traffic Control Centers (ARTCC) and Terminal Radar Approach Control (TRACON/ TRACAB) facilities will be consolidated to form Area Control Facilities (ACF).

This Program Master Plan is based on the assumption that all en route and approach/departure control will be provided by 23 ACF's. It is planned that these will be comprised of the 20 conterminous U.S. ARTCC's, the New York TRACON facility, and the offshore facilities at Anchorage and Honolulu. Consolidation of en route and terminal control functions into these 23 facilities is assumed to follow installation of the full AAS. In addition, it is planned that Tower Control Computer Complexes (TCCC) will be installed in approximately 300 Air Traffic Control Towers (ATCT). The Area Control Computer Complex at the ACF's will be tied, via a telecommunication network, to these TCCCs. The Advanced Automation Program is designed to support this Air Traffic Control System consolidation and transition, which is described further in Section 2.5.

1.6 Supporting Documents

The hierarchy of the management plans to be utilized by the Advanced Automation Program Office (AAPO) to support the top level FAA documents identified in Section 1.1 and to guide the development, implementation, and control of the program is depicted in Figure 1-1. In addition, these management plans will be responsive to program guidance and direction provided by the Congress, the Administrator, the FAA, and the Department of Transportation Major System Acquisition review and approval process.

As illustrated in the figure, the top-level management plan supporting the Program Master Plan is the Program Management Plan (PMP). The PMP is supported by six sets of plans which are represented on the figure by the Program Requirements/ Specificiation/Design Document, System Development Plan,

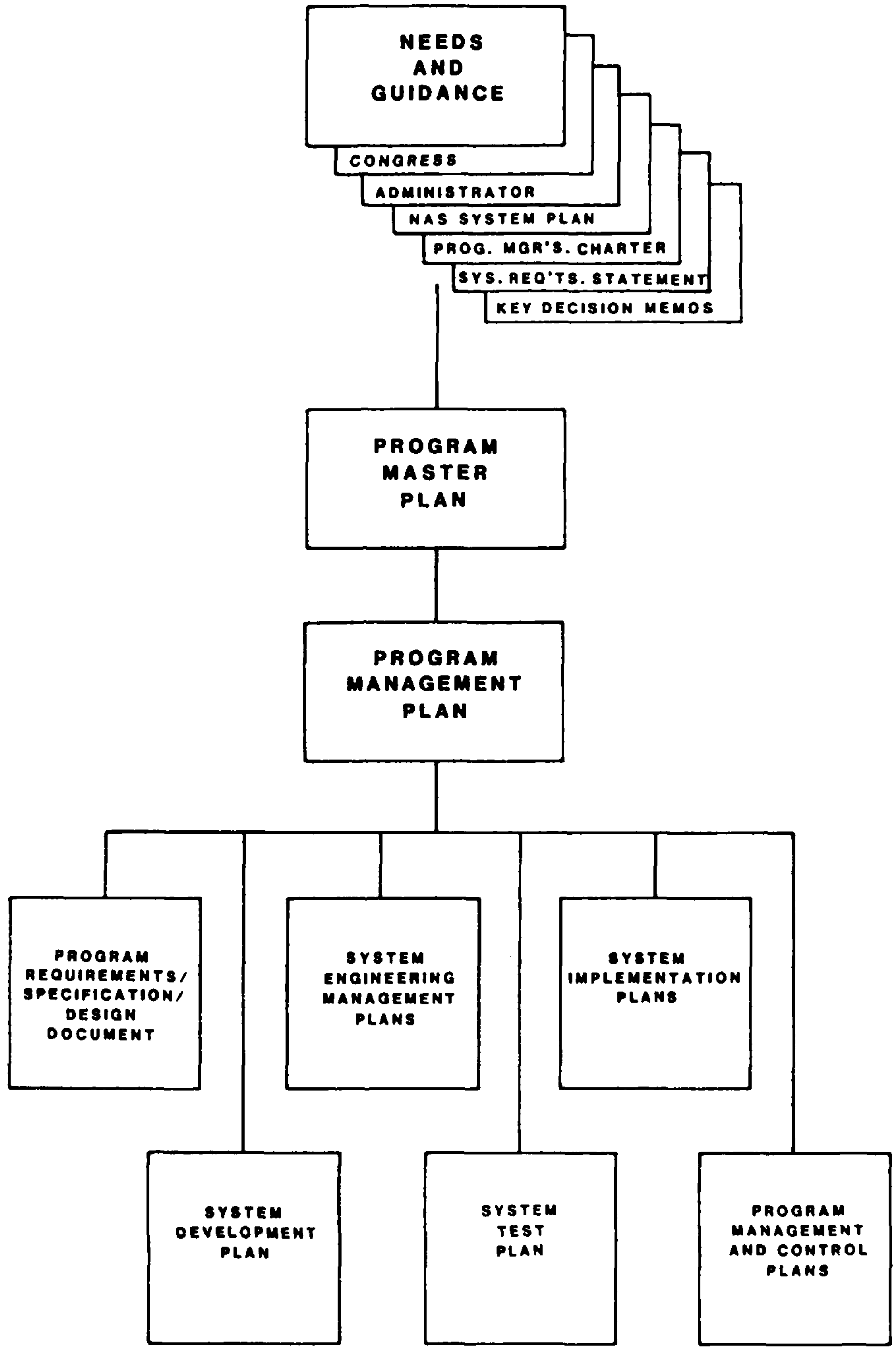


FIGURE 1-1 HIERARCHY OF MANAGEMENT PLANS FOR ADVANCED AUTOMATION PROGRAM

System Engineering Management Plan, System Test Plan, System Implementation Plans, and Program Management and Control Plans. The Program Management Plan and the six sets of supporting plans are described in the discussion that follows.

1.6.1 Program Management Plan

The Program Management Plan (PMP) will delineate the Program Manager's policies, objectives, major functions to be accomplished, managerial responsibilities, general procedures, and the basic technical approach to be employed in the overall operation, management, and control of the program's activities. In providing this guidance and direction, the PMP will set forth the detailed definition of the program's description, structure, and organization; the technical development approach, including test and evaluation, interfaces, system implementation and support functions; and the management approach including acquisition strategy, program control, master schedule including major subnets and the responsibility matrix. Accordingly, the PMP establishes the plan and policies for management of the program and provides uniform guidance to all program participants for effective program implementation. Program policies, objectives, and management responsibilities contained in the Program Management Plan reflect and expand upon the direction and guidance specified in the top level FAA documents and that provided by the Program Master Plan. As such, System Engineering, System Development, System Implementation, and Program Control functions will be described and the roles of the individual AAP contributing organizations with respect to the program's overall objectives and mission will be addressed.

1.6.2 Program Requirements/Specification/Design Document

This document will identify overall system requirements and provide broad technical guidance to the FAA elements, prime system contractors and all other interested parties relative to acquisition of the Host Computer and Advanced Automation Systems. This top level document will contain the AAP definition of the total requirements of the system to be built. As such, it will be the top "node" of requirements and specifications documentation tree and, in so doing, will provide the "top rung" of the traceability ladder for all elements in the specification tree. Initially, the highest level documents will be the functional or system level specifications and, as the system is developed, the lower tier "as built" or "C" level specifications will be prepared. After the system has been developed, this specification tree will represent the formal documentation of the Host Computer and Advanced Automation Systems.

1.6.3 System Development Plan

The System Development Plan describes in detail the processes and procedures to be used in developing the Host Computer and Advanced Automation Systems and defines the responsibilities for implementing them. The plan will describe in detail how the new systems will be developed, and will describe the FAA procedures for monitoring and directing all of the prime system contractors' activities. Specific categories of management processes and procedures that the plan will address include: schedule management, technical data requirements, cost and technical performance, subcontracting, production, transition and turnover criteria, program reporting requirements, standards and languages. Pertinent FAA regulations and facility/GFE policies will also be defined in the plan.

1.6.4 System Engineering Management Plan

The System Engineering Management Plan (SEMP) will establish the guidelines and requirements for the management of the fully integrated engineering effort to be used in the design, development, acquisition, and implementation of the Host Computer and Advanced Automation Systems. Emphasis will be placed on the integrated nature of the system engineering process and engineering management approach to be used in developing and implementing the systems. The plan will define how product assessment will be accomplished; define objectives and scheduled milestones for each assessment; identify critical performance parameters to be measured and tracked; and provide guidance in the forecasting of parameter values to be attained, technical data to be required for assessments, and technical data required from analysis, test, and/or simulation. The major parts of the SEMP are:

- Technical Program Planning and Control
- System Engineering Procedures
- Engineering Specialty Integration

Under these major categories, a variety of lower tier plans will describe how the engineering specialties, such as reliability, maintainability, logistics engineering, human factors, safety, standardization, etc., will be implemented to ensure their influence on system design. Specific examples of these plans include the Integrated Logistics Plan, Training Plan, Quality Assurance Plan, Reliability/Maintainability/Availability Plans, Risk Assessment Plan, and Security Plan. The SEMP will also address the AAP configuration management system and procedures to be used and will describe the processes and procedures for controlling, evaluating, and coordinating interface issues both within the AAPO's purview and with other elements of the NAS.

1.6.5 System Test Plan

The System Test Plan (STP) will provide a summary overview of all AAP test and evaluation activities to be performed. This plan will be an executive level document that:

- o Establishes overall test and evaluation policies.
- o Presents test and evaluation goals and objectives.
- o Describes each type of test to be performed.
- o Presents details on the schedule and location of the testing and evaluation.
- o Delineates roles and responsibilities for the tests and evaluations.

Additionally, this plan will establish the overall AAP test and evaluation policy, framework, and guidance required for development of the more detailed, lower tier supporting test plans, i.e. Test and Evaluation Management Plan (TEMP), Test Requirements Document, etc.

1.6.6 System Implementation Plans

System Implementation Plans will define the activities involved and procedures to be used for implementing the Host Computer and Advanced Automation Systems at the field sites, for training operations and maintenance personnel, and for providing logisitic support for the systems once they become operational. The System Implementation Plans will contain a detailed description of the steps to be taken in the design and construction of facilities to accommodate the new systems, deployment of hardware and software to each site, the mechanical and electrical installation and checkout of the system, the integrated testing of the new systems, the operational shakedown of the systems following validation of initial operating capability, and the handover for full operation as part of the NAS. The implementation planning will also include Test Plans, which describe the required training and how it will be provided, and will include Integrated Logistic Support Plans, which describe the logistic support required during the life cycle of the systems and the means for providing this support.

1.6.7 Program Management and Control Plans

Program Management and Control Plans will delineate the broad spectrum of activities that will provide the management control of the program. Included in these plans will be the control and tracking of program costs and schedules, management reporting and reviews, configuration management, cost management, risk management, and data management. Lower tier plans and other supporting documents will describe in detail the processes and procedures to be used in performing each management and control function. The purpose of this planning is to define the management processes and procedures to be used to support the following management system:

- o Allocation of budgets for work scheduled.
- o Accumulation of costs related to progress of planned work.
- o Comparison of planned and actual resources (dollars and manhours) applied to specific work assignments.
- o Integrated cost and schedule performance measurement.
- o Distribution, tracking, storage, and retrieval of program data.
- o Preparation of estimates of costs to complete remaining work.
- o Identification and control of program risks.
- o Analysis and evaluation of available information to identify problems in sufficient time to take remedial action.

1.6.8 Preparation of Supporting Documents

Preparation of these supporting plans and documents is presently underway. The Program Management Plan is scheduled to be completed by the end of the calendar year 1983. All other supporting plans and documents, except the Advanced Automation System (AAS) Implementation Plans, are scheduled for completion during the following year. Plans for implementing the Initial Sector Suite System portion of the AAS are scheduled for completion in 1985 and plans for implementing the full AAS are scheduled to follow one year later.

2.0 TECHNICAL PLAN

2.1 Program Description

The purpose of the Advanced Automation Program is to provide modern computers, software, and controller sector suites for the FAA's Air Traffic Control system. This modernization program is comprised of two major elements, the Host Computer System and the Advanced Automation System. The program includes requirements analysis, design, development, acquisition, testing, installation, training, and the final hand-over of an operational system for each of these major program elements. Included as part of the program will be such facility modification and construction as needed to accommodate installation and operation of the new automation equipment. Maintenance for Host Computer and Advanced Automation Systems will be in accordance with the FAA Structured Maintenance approach to be approved by the Administrator during the summer of 1983.

The overall architecture of the new automation system will have an expected lifetime of 20 years. The new system architecture will be designed in such a way that new hardware and software can be added within the basic architecture. This feature provides the vehicle to add new functions. When completed, the system will be capable of handling the volume of air traffic projected beyond the turn of the century, and it will have the capability to perform new functions currently being planned and developed by FAA, separately from this program, to enhance safety and service to users.

2.2 Current Automation System

An overview of the elements that currently comprise the ATC automation system at each en route center is illustrated in Figure 2-1. Key elements of the en route automation system are 9020 computers, which are modified IBM 360 units. Redundancy is built into the system to handle the event of an equipment failure. When a hardware or software element fails, a backup element is switched into the system with minimal interruption in service to the air traffic controller.

In addition to the 9020 computers, the en route center systems include the 9020 computer software, the peripheral adapter module (PAM), the Direct Access Radar Channel (DARC), the display channel, and up to 60 controller work stations per center. Each work station includes a console with Plan View Display (PVD), computer entry and readout devices, a Flight Strip Printer (FSP) which provides data printouts on aircraft scheduled to enter the controller's flight advisory area, and a voice communications subsystem. The DARC is used as the backup system to support flight controller operations in the event of primary system failure.

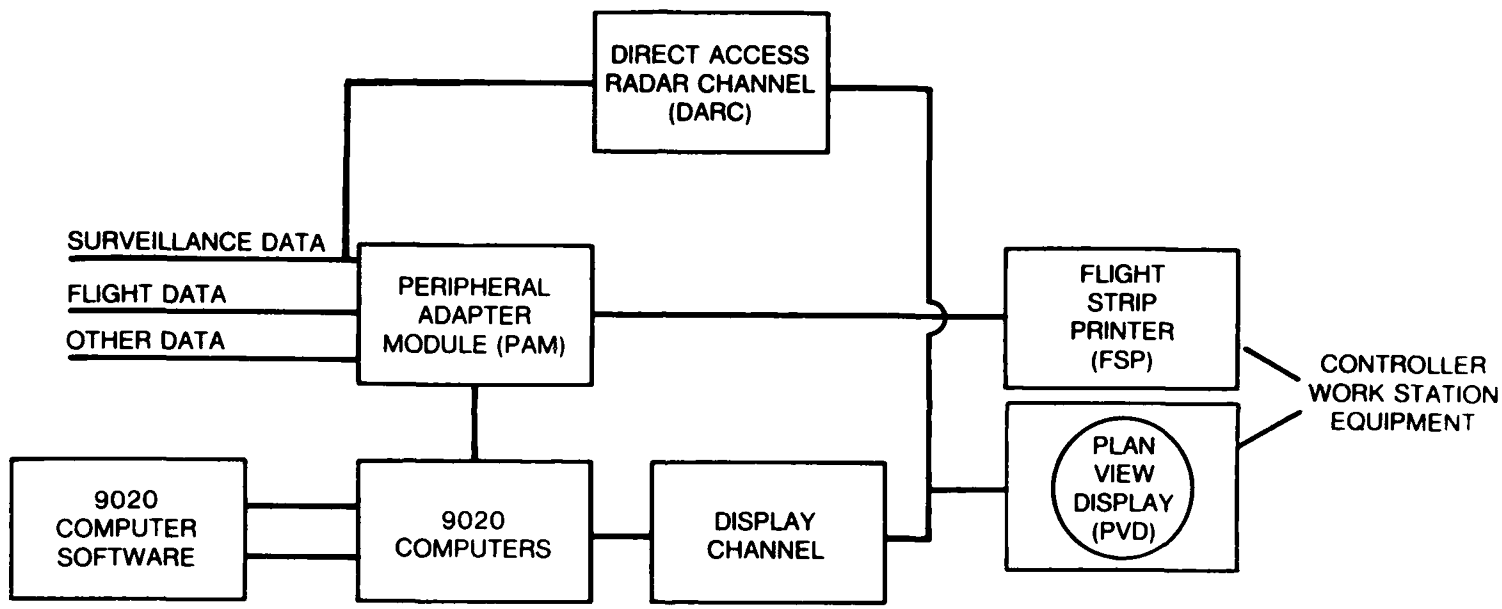


FIGURE 2-1: CURRENT EN ROUTE CENTER AIR TRAFFIC CONTROL AUTOMATION SYSTEM

The TRACON facilities and tower cabs also contain controller work stations. The Automated Radar Terminal System (ARTS-III), a computer system manufactured by Univac, serves controller work stations at large TRACON's and airport towers. The Automated Radar Terminal System (ARTS-II), a computer system manufactured by Burroughs, serves controller work stations at smaller TRACON and tower facilities.

2.3 Technical Approach

As discussed in Section 1.0, the capacity and capability limits of the current automation system have led to the need for its replacement with a system that will be able to:

- o Handle the growing civil and military air traffic
- o Perform new functions
- o Improve controller productivity and reduce maintenance costs

Replacement of the current automation system entails the three-step approach introduced earlier. To implement this approach, a Host Computer System and an Advanced Automation System (AAS) will be developed. The manner in which the Host system, the Initial Sector Suite System (ISSS) - an element of the AAS - and the full AAS are sequentially implemented to modernize the en route centers is illustrated in Figure 2-2 and discussed further in Section 2.4. A description of the Host system and the AAS follows.

2.3.1 Host Computer System

The Host Computer System is a current generation replacement for the present FAA Central Computer Complex (CCC) 9020 computers in the 20 conterminous U.S. en route centers. The Host system will be IBM 360/370 instruction compatible, will operate with all of the current 9020 software, and will interface with the present display channel systems, peripheral adapter modules, and input/output devices. The system will require only minimum changes to the existing en route system software and will permit air traffic control operations to continue uninterrupted during the transition process. In addition, the system will be designed to support near-term functional enhancements of the Air Traffic Control System, full-time controller training requirements and data recording for the volume of air traffic projected through 1995.

The increased capability offered by the Host system's modern technology will provide the needed additional computer capacity and will improve the en route system availability and reliability. Installation of the system constitutes the first transition step in modernizing the en route centers.

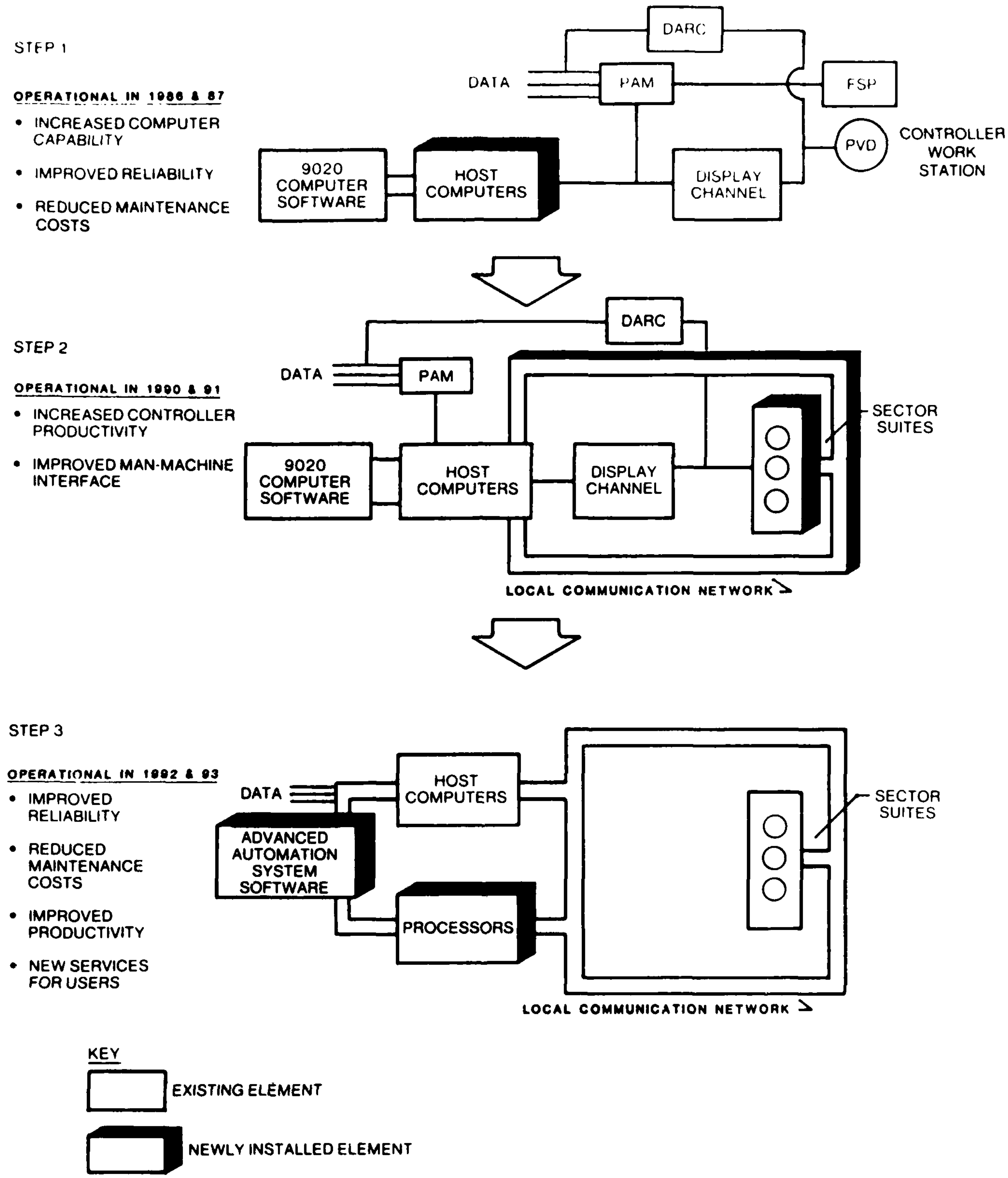


Figure 2-2 Three-Step Process For En Route Center Automation System Modernization

2.3.2 Advanced Automation System

Concurrent with development and demonstration of the Host system, competing contracts will be awarded for design, development, and demonstration of the Advanced Automation System (AAS). The AAS is a total automation system that includes the controller sector suite, new computer software, and new processors to augment the Host computers. The broad functional requirements for the Advanced Automation System include:

- Capacity to handle the projected traffic load through the 1990's and beyond;
- Capability to interface with the other elements of the ATC system;
- Capability to perform all of the new functions to be introduced into the Air Traffic Control system throughout the 1990's;
- Increased productivity through introduction of sector suites;
- A high degree of reliability and availability; and
- Capability for enhancement to perform other functions subsequently introduced into the system.

There will be two parallel and integrated avenues of development activity leading to the full Advanced Automation System. One avenue will be development of an Initial Sector Suite System (ISSS), and the other will be full AAS development. Although designed as part of the AAS, the ISSS will be developed as an integral element. As discussed in the following section, the ISSS will be installed at the en route centers prior to AAS installation and will provide a transition step toward later full AAS implementation. The ISSS will be served by the Host computer and 9020 software until the full AAS is installed.

The Initial Sector Suite System will contain modular controller work stations, referred to as sector suites. These sector suites will be designed so that common elements can be used in en route centers and in airport tower cabs. In addition to the sector suites, the ISSS will contain a subset of the AAS computer hardware and software, the Host computer and 9020 software, and the subset of the AAS Local Communications Network necessary to support communications among these system elements.

The sector suite will consist of one to four identical consoles. Each console will have a Voice Switching and Control System (VSCS) panel (VSCS is a separate program) and will contain one or more embedded microprocessors. The sector suite will introduce new display and input devices, and new methods for the controller and automation system to communicate (i.e., a new man/machine "language"). Because design of the ISSS and AAS will be integrated, the sector suites will not require modification in later transition steps with the possible exception of changes to some interim interfaces that are required to operate with the ARTCC equipment in the Host system configuration.

The Advanced Automation System is a total automation system which includes the new sector suites developed as part of the ISSS, new processors, new computer software, a full local communications network, and those mechanisms needed to interface with other ATC system elements. The new software will include software functions that are presently unique to terminal air traffic control. The AAS will replace all remaining elements of the current en route hardware and software, lead to integration of en route and terminal operations in Area Control Facilities, and provide sector suite consoles for installation in airport tower cabs. The manner in which elements of the AAS will be phased into the ATC system is described in the following section.

2.4 Transition to Future System

The strategy selected for implementation of the AAS is built around a three-step transition of the 20 conterminous U.S. (CONUS) en route centers to Area Control Computer Complexes (ACCC), and installation of the full AAS at the Honolulu, Anchorage, and New York TRACON facilities. These steps will be followed by final Area Control Facility (ACF) airspace allocations and the gradual activation of approach and departure control functions in the Area Control Computer Complex as Tower Control Computer Complexes (TCCCs) become operational at the Air Traffic Control Towers. This approach meets the NAS Plan objectives with minimal operational disruption and with manageable technical, cost, and schedule risk.

During the initial stabilization period following each of the three en route center transition steps, a system failure would lead to operation with DARC, which will remain as the primary backup. In addition, the automation configuration that was replaced in that transition step will be held in a standby condition for a period of time so that it can be used as a temporary backup should a prolonged unrecoverable failure occur in the new system. To provide similar continuity in terminal service, it is likely that both the old terminal (ARTS) radar positions and the new positions in the ACCC control room will be manned for a period of time to provide a fallback to the old system should the new system fail.

2.4.1 Transition to ACCC's

The three-step approach for modernizing the 20 CONUS en route centers is illustrated in Figure 2-2. This approach was selected as the one offering minimum risk while providing needed system capacity and functional capability in a timely and cost effective manner.

The first step will be replacement of the 9020 computers at the en route centers with a new Host Computer System. The Host system is scheduled to become operational in 1986 at the initial site and in 1987 at the final site.

The second step will be installation of the Initial Sector Suite System at the en route centers. This system, which will contain modular controller work stations, will be served by the Host computers using the existing 9020 computer software. A subset of the ACCC Local Communication Network (LCN) will also be required. ISSS operational readiness is scheduled during 1990 and 1991 at the various en route centers.

The third step will introduce new computer software and new processors to augment the Host computers and will complete installation of the Area Control Computer Complex at each site. During the third step of en route center modernization, the full AAS will be introduced at the remaining three ACF's - Anchorage, Honolulu, and the New York TRACON. Operational readiness of the ACCC's is scheduled during 1992 and 1993. A summary program network schedule of major events leading to completion of ATC system modernization is presented in Figure 6-1.

As indicated in Figure 2-2, introduction of the new Host Computer System in Step 1 will increase computer capacity and reliability while reducing hardware maintenance costs. The Initial Sector Suite System installed in Step 2 will increase controller productivity and provide the man-machine interface to be used for air traffic control in the 1990's and beyond. Step 3, which introduces the final system software and new processors, will improve reliability, reduce maintenance costs, improve productivity, and provide new services for aviation users. This system will also provide the basis for future addition of higher levels of ATC automation.

A transition requirement established by the Administrator is that there shall be, at a minimum, a two-year stabilization period between each transition step. Accordingly, a two- to three-year period is scheduled between the Operational Readiness Dates of the Host Computer System, the Initial Sector Suite System and the full Advanced Automation System at each of the 20 en route centers. This period allows for stabilization of facility operations between transition steps, thereby providing for an orderly transition with minimal operational disruption.

2.4.2 Transition to the Full ACF Concept

Once the ACCC is installed at the 20 CONUS en route centers, Honolulu, Anchorage, and the New York TRACON facility, it will have the capacity and functional capability to support a fully integrated en route and terminal ACF airspace configuration. Operational transition to a system in which the ACCC's at 23 ACF's are used for radar control of all airspace, both en route and terminal, will be carried out gradually over a period of five or more years. En route sectors will be realigned and, where necessary, reassigned to a different facility.

Terminal sectors can be introduced gradually into the ACCC - probably one airport at a time. When the radar control for an airport is introduced into an ACCC, a Tower Control Computer Complex (TCCC) will be installed concurrently at the corresponding Air Traffic Control Tower (ATCT). The schedule for TCCC implementation at the Air Traffic Control Towers will be defined by the Air Traffic Service as part of its transition planning. This information will serve as a basis for development of the schedule by AAPO for system delivery, installation, and testing, leading to the operational readiness date (ORD) at each site.

2.5 Future System

When fully installed by the mid-1990's, the Advanced Automation System will contain four major elements:

- An Area Control Computer Complex (ACCC) at each Area Control Facility,
- A Tower Control Computer Complex (TCCC) at each of 300 selected Air Traffic Control Towers,
- A System Support Computer Complex (SSCC) at the FAA Technical Center (FAATC), and
- A Research and Development Computer Complex (RDCC) at the FAATC.

The Area Control Computer Complex will consist of a newly designed distributed computer hardware and software system, which may include the Host computer; a local communication network (LCN) to handle the non-voice communication within the ACCC, between the ACCC and other systems at an ACF (Flight Service Data Processing System, Center Weather Processor, and Maintenance Processing System), and the intrafacility communications between these other ACF systems; a newly designed sector suite that incorporates new input and output devices, including a display for electronic presentation of flight data information to replace the existing printed flight strips; and a Training Support System. The Tower Control Computer Complex will contain new TCCC position consoles; computer hardware and software required by the AAS design; and interfaces to airport sensor systems, including terminal radar system(s).

System support at the FAATC will be provided by a System Support Computer Complex (SSCC), which will provide the capability for evaluating and testing approved AAS changes, and will support the continued operation and improvement of the ACCC's and TCCC's at field sites. The SSCC will contain the hardware and software for replicating any fielded system in an ACCC and TCCC; replicating two ACCC's simultaneously; reconfiguring the equipment into the above systems; and hardware and software to support all system maintenance activities. The FAATC will also have a Research and Development Computer Complex (RDCC) which contains all elements of an ACCC (including sector suites) and a TCCC. The RDCC will support the continued development and design of enhanced air traffic control automation and provide the capability for experimentation and development of new concepts.

2.6 Other Major Activities

Three of the most significant activities that support the Advanced Automation Program are:

- o The Test and Evaluation program
- o Facility modification and construction
- o Training of the controllers and maintenance personnel

Each activity is described briefly in the following discussion.

2.6.1 Test and Evaluation

An extensive Test and Evaluation (T&E) program will support all aspects of the Host system and AAS development and implementation. Plans for the T&E program are presently being developed. The purpose of T&E activity is to:

- o Continually and systematically monitor and evaluate the efforts and products of the Host and AAS contractors, and
- o Assess whether the Host system and AAS satisfy their established requirements defined in their respective statements of work and requirements specifications.

This program will provide for coordination of all T&E activities within the scope of Host and AAS development and implementation as well as those T&E activities that span the interfaces between the two systems.

Test and Evaluation is a continuing effort that will begin during the design competition phase of the Host system and AAS, and will continue to the last site Operational Readiness Date. To prepare for this work, T&E planning is currently underway. The T&E activities and milestones being planned will parallel the Host System and AAS milestones. The major program milestones are indicated on the Summary Schedule Network (Figure 6-1). The continuing test and evaluation of the systems and their elements will serve to keep management aware of status as work progresses. In addition, the T&E effort will provide further progress and status information to support the decision process at each milestone.

A description of all AAP test and evaluation activities will be provided in the AAP System Test Plan (STP). This plan will describe the test and evaluation program, present the program goals and objectives, and delineate the roles and responsibilities of the various organizations involved in test and evaluation.

The AAPO will work closely with the Operational Test and Evaluation (OT&E) Staff in the Office of the Deputy Administrator during the course of test and evaluation planning. As the STP and supporting test plans are prepared, they will be coordinated with the OT&E Staff.

2.6.2 Facility Modification and Construction

The facility modification and construction required for installation of the Host system and AAS have been planned to support system transition in a manner least disruptive to ATC operations. The first step is expansion of the two-story control wing required at the en route centers to provide a sterile sector suite environment for the ISSS. This building expansion will be provided early in the program to allow location of the Host Computer System in the lower level during the first transition step. The upper level will remain unfinished until sector suite requirements are identified by the AAS contractor.

It is currently planned that prior to ISSS delivery to a site, the controller training lab (DYSIM) will be moved to the vacated 9020 area, and the system maintenance and monitoring console (SMMC) and the E-desk complex will be relocated from their present position to another part of the control room. The teletype equipment will already have been replaced by the National Airspace Data Interchange Network (NADIN). The reclaimed portion of the existing control room will be combined with the new control room area to provide the needed space for sector suite installation. This area will then be finished to meet sector suite environmental requirements. During preparation of the new control room for the ISSS, a portion of the equipment room on the lower level of the existing control wing will be refurbished to computer room environment to accommodate the local communication network and any new computers. This computer room refurbishment will be adequate to accommodate the full AAS when it is installed.

Following stabilization of the ISSS, the old control room will be deactivated and completely refurbished to accept the new sector suites required for terminal operations of the ACF's. To minimize disruption of operations, all modifications at a given site will be completed, and all additional sector suites will be installed before any of these sector suites will go into operational use.

In addition, a number of site unique modifications will be required. The New York and Houston en route centers are configured differently than the standard-type centers discussed above. Facility considerations for them will be treated separately. The three additional ACF's to be activated at Honolulu, Anchorage, and the New York TRACON facilities are also configured differently than the standard-type centers and will require site unique modifications. It is planned that each of these three sites will be modified, and the full AAS installed before the facility becomes an operational ACF. Because Air Traffic Control Towers are dissimilar in configuration, design of the modification required to install the Tower Control Computer Complex must be tailored to the characteristics of each tower.

The first step in implementing facility construction and modification will be preparation of an architect-engineer design for expansion of the two-story control/equipment wing at the initial site to receive the Host Computer System. This effort will be followed by preparation of site-adapted designs for the remaining en route centers. The Program and Engineering Maintenance Service (APM-500) will be responsible for preparation of these designs in accordance with AAP requirements. Subsequent award and management of site construction and modification contracts will be performed by the cognizant Regional Office with FAA headquarters overview provided by APM-500.

To facilitate modification of the many dissimilar Air Traffic Control Towers, the cognizant Regional Office will be responsible for both the design and implementation of tower modifications. It is anticipated that the appropriate Regional Office will also be responsible for both the design and implementation of required facility construction and modification at Honolulu, Anchorage, and the New York TRACON.

2.6.3 Training

Varying levels and types of training will be required for air traffic controllers and system operation and maintenance personnel at each transition step. The operational impact of Host transition on the air traffic controller will be minimal, since the control position equipment is not affected and the applications software modifications should be transparent to the controller. However, some instruction will be required to familiarize the controller with the Host system and the failure mechanism for the initial Host stabilization period. Introduction of the Host system will have an impact on computer operators, hardware maintenance technicians, and software specialists. Current planning provides for initial training of operator, maintenance, and software personnel at the FAA Academy and for recurrent and on-the-job training at the en route centers and at the FAA Technical Center.

The introduction of the Initial Sector Suite Systems will impact the functions and operations of both controllers and hardware/software maintenance personnel. This phase of the three-step transition is the one that will have a major impact on the controller due to the introduction of electronic flight data presentation. Thus, extensive controller training will be required in the use of the new sector suite. This training will include initial classroom and/or computer-based instruction followed by extensive work with the ISSS equipment in simulation mode. Nearly one year has been scheduled for each facility's training program prior to ORD. Technical training will be required for the ISSS maintenance work force on all aspects of the new system hardware and on new software that is part of the ISSS. The AAS prime contractor will be responsible for developing the necessary hardware, software, and controller training programs.

The major impact of the transition to ACCC's will be on hardware and software operations and maintenance personnel. Training of these personnel in ACCC system operations, new hardware maintenance, and software maintenance will be required. Controller training requirements will be limited to familiarization with the initial transition fall-back mechanism, ACCC failure recovery characteristics, and new functional capabilities. The AAS prime contractor will be responsible for developing required training programs.

Consolidation of terminal sectors into the ACCC will require controller and system operations and maintenance training. As en route sectors are realigned and facility boundaries changed, the en route controllers will have to become familiar with the new sector geographics, new sector-to-sector interfaces, and new facility-to-facility interfaces. Just as the en route controllers had to begin using a totally new man/machine interface when the ISSS was introduced, the approach and departure controllers will now have to use the sector suite instead of the existing ARTS systems. Tower cab controllers who will begin to use the new TCCC position consoles will also be affected. Operation and maintenance training will be required primarily for tower cab personnel, since additional equipment installed at the ACF's will be identical to equipment already in these facilities. The AAS prime contractor will be responsible for developing the controller and maintenance personnel training program.

2.7 Other Related Programs

The Advanced Automation Program will interface with a number of other FAA programs that are part of the NAS Plan. The primary nature of this interface is that the AAS hardware and software design must be such that the AAS will be compatible with and can accept the new features of other systems with their increased levels of automation. In addition, the AAS design must be such that hardware and software incorporating other new functions can be added as a natural extension of the AAS during its projected 20-year or longer lifetime.

Some of the major programs that interface with the AAP are as follows:

- o The Voice Switching and Control System (VSCS) will provide a voice communications system which performs the intercom, interphone, and air-ground voice connectivity and control functions needed for air traffic control operations. This system will also provide the voice communications reconfiguration and service availability needs of the ACF's which will reduce the lease services costs, increase modularity and growth capability, and increase controller productivity.

- o The National Aviation Data Interchange Network (NADIN) is a national, ground-to-ground digital message switching network for aeronautical users that will initially replace a number of inefficient, independent, low speed networks.

- o The Traffic Management System will minimize response times, and automate the collection, communication, and processing of data needed to manage the use of the Nation's airspace. The Traffic Management System will integrate into a single operational facility the Air Traffic Control Command Center (ATCCC), Central Flow Control Function (CFCF), Central Altitude Reservation Function (CARF), Airport Reservation Function (ARF), Consolidated NOTAM System (CNS), Aeronautical Information System (AIS), and Central Flow Weather Service Unit (CFWSU).

- The Automated Flight Service Station (AFSS) will provide automated flight services to airspace users and will be capable of meeting projected increases in demand without proportional increases in staff. The automation will be accomplished in three steps. The first step, Model 1, will provide alphanumeric weather data to FSS specialists via CRT displays, incorporate flight plan filing and supply graphics (maps) by closed circuit TV. The second step, Model 2, will expand the Model 1 capability with enhanced graphics and will add limited direct user access terminals on a test basis. The third step will provide enhancements to the Model 2, such as voice response and improved direct user access.

- The Central Weather Processor (CWP) will provide real-time weather information dissemination to air traffic control and flight service station facilities. This system will also support the meteorologist in analyzing weather data.

- The Maintenance Processor Subsystem (MPS), which will be established in a network of ARTCC's and general NAS sectors, will provide monitoring and control for remote FAA facilities. This system will permit equipment performance monitoring, control, and certification from centralized work centers and will offer substantial savings in operations cost and manpower.

In addition to the AAS compatibility interface with each system, a unique dependency exists between the AAS and the VSCS and NADIN. The VSCS will be the communications system used for ISSS system checkout, transition from the existing system, and support of AAS reconfiguration requirements. It will also support rapid switchover during transition between the existing NAS en route system and the ISSS/VSCS configuration. Therefore, the VSCS must be delivered prior to or concurrent with installation of the first operational ISSS. The VSCS is the only element of the NAS plan on which the AAS transition is dependent.

NADIN is the one new system on which the AAS will impose operating requirements. NADIN must accommodate certain AAS design features in performing its communication function among ACF's and between ACF's and TCF's, such as standardized network interface protocol for exchanging information and meeting operational response time requirements.

A Memorandum of Understanding (MOU) between the AAPO and the Program Engineering and Maintenance Service identifies the nature of the interfaces between the VSCS and AAS, and specifies the responsibilities of the VSCS Program Manager and the AAPO System Engineering Division Manager for coordinating these interfaces. Similar formal interface definition and coordination procedures are yet to be developed for the other major programs that interface with the Advanced Automation Program.

3.0 MANAGEMENT APPROACH

3.1 Program Management

The Advanced Automation Program Office (AAPO) is responsible for management and direction of all FAA activities necessary to accomplish the Advanced Automation Program, which includes two major systems - the Host Computer System and the Advanced Automation System. These activities include design, development, test and evaluation, production, installation, monitoring initial performance, and initial training and logistic support for both systems. Also included is facility modification and construction required to operate and maintain the new systems.

The Director of this office is the Program Manager who is delegated the responsiblity to direct FAA activities associated with system design, development, test and evaluation, full-scale production, and installation. Further, the Program Manager is responsible for directing the program within the total annual funding allocation, key decision milestones, and schedule and performance objectives approved by the Administrator. FAA Order 1810.1C, Major Systems Acquisition, states that a program manager, regardless of his reporting relationship within the FAA, is "personally accountable to the Administrator" for his program. Nevertheless, in implementing delegated management responsibilities, the Program Manager will report to the Administrator through the Associate Administrator for Development and Logistics.

Functions, responsibilities, and organization of AAPO are described in FAA Order 1100.2A, Chapter 18. Responsibilities and authority of the Progam Manager are defined in the Program Manager's Charter. The Program Management Plan, which was described in Section 1.6, will contain detail on the functions and responsibilities of those participating in implementation of the program.

3.2 Management Policy and Concepts

Five major factors that conventionally influence program management policies and concepts are: program significance, complexity, size, duration, and cost. These factors and the nature of the AAP mission were instrumental in the formulation of the AAPO management system.

In implementing its assigned mission responsibilities, the AAPO will use a disciplined management approach throughout the development, acquisition, and implementation of the Advanced Automation Program. A crucial part of the Program Manager's perspective involves the concept of total life cycle cost that includes consideration of requirements for both the operation and maintenance of the system.

To provide an adequate basis for responsible decisionmaking by the FAA and prime system contractors, the AAPO has embraced management control techniques, procedures, and methods which are designed to ensure the attainment of stated program objectives. The management control system will provide data which: 1) indicate work progress; 2) properly relate cost, schedule and technical accomplishment; and 3) are valid, timely, and auditable. Therefore, the AAPO specifically requires the application of DOD Cost/Schedule Control System Criteria (C/SCSC) for both the Host and Advanced Automation System acquisitions.

In addition to the C/SCSC reports, program reviews will be held at frequent intervals with prime system contractors, support contractors, and supporting FAA organizations. These reviews will cover all aspects of the program, including technical, schedule, cost and management accomplishments, problems, status, and forecasts.

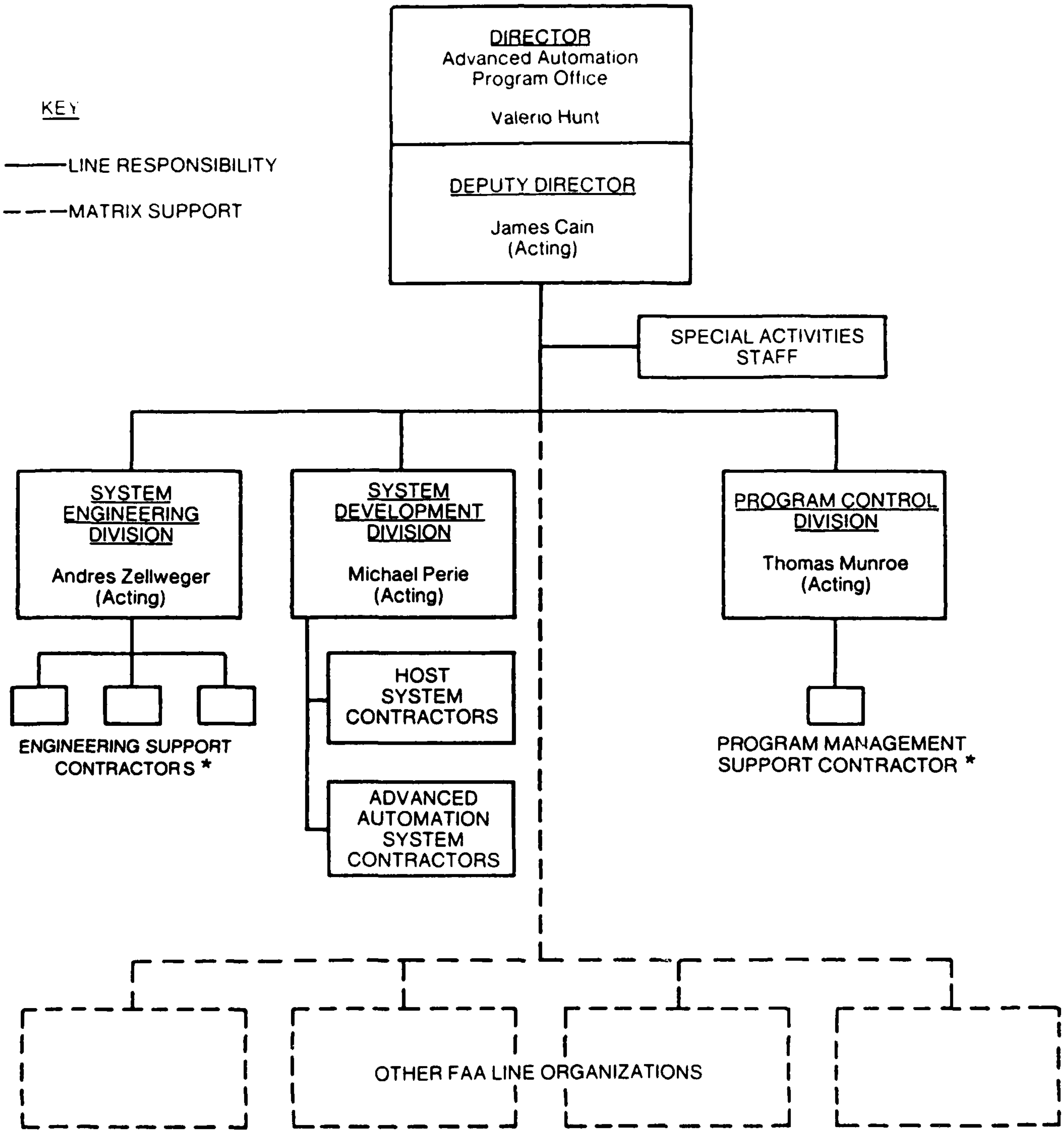
The AAPO will use other techniques and procedures to manage the program including configuration control, risk analysis, alternatives and economic analysis, and cost and schedule tracking systems. Techniques, procedures, and methods to be used by the AAPO in managing the program are described in the Program Management Plan.

3.3 Delegation of Responsibility

The management structure for implementing the Advanced Automation Program is illustrated in Figure 3-1. This figure indicates the flow of program responsibility from the Program Manager to the AAPO division managers, to the system development contractors, and to the program support contractors. Also indicated on the figure is the functional relationship of the Program Manager with other FAA line organizations that provide program support.

Within AAPO, there are three line divisions reporting to the Director. These are the System Engineering Division, System Development Division, and Program Control Division. In addition, there is a Special Activities Staff. Functions and responsibilities of each group are indicated in Figure 3-2 and described briefly in this section.

The manager of the System Engineering Division is responsible for those broad engineering analysis, evaluation, and overview functions essential to successful total system design, development, and implementation. These functions include system engineering analysis, system engineering management, system requirements analysis, maintenance of system functional specifications, design trade-off studies, configuration management, engineering change analysis, interface management, quality assurance planning, system modeling and simulation, independent verification and validation, and program risk management.



*SEE SECTION 5 0 FOR DETAILS ON CONTRACTOR SUPPORT.

FIGURE 3-1 ADVANCED AUTOMATION PROGRAM ORGANIZATION

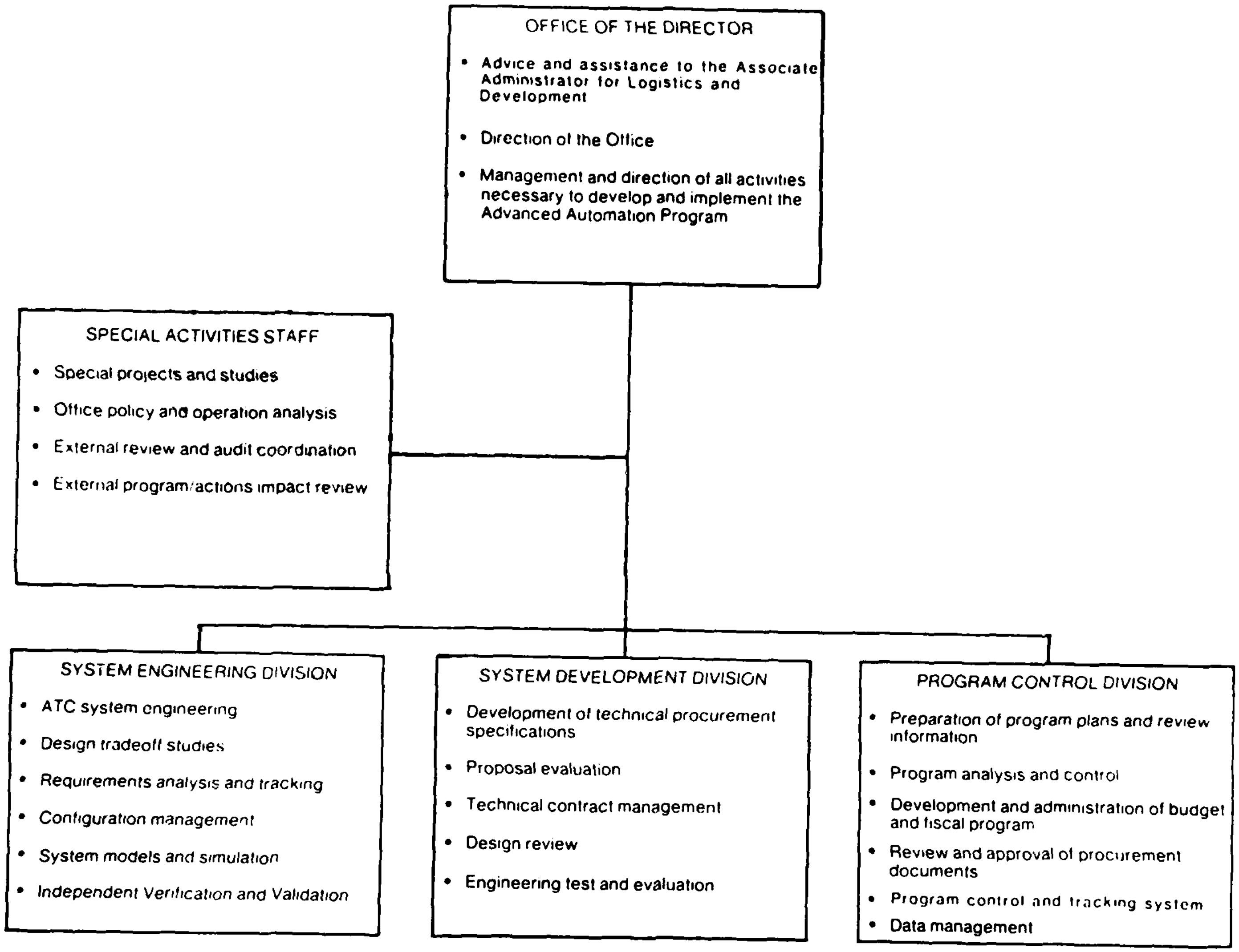


FIGURE 3-2 ADVANCED AUTOMATION PROGRAM OFFICE FUNCTIONS AND RESPONSIBILITIES

The manager of the System Development Division is responsible for the technical management required to design, develop, fabricate, and perform engineering testing of the system. This responsibility includes day-to-day management of the Host Computer System and Advanced Automation System prime development contractors. The System Engineering and Program Control Divisions will provide necessary support to the System Development Division manager.

The manager of the Program Control Division is responsible for those aspects of program planning and control that are essential for the Program Manager to effectively execute the program. Included are overall program planning, acquisition planning, costing, budget administration, fiscal program administration, management documentation administration, and administrative functions to support office operation. An additional major function is development and implementation of a program control and tracking system. This system will establish standardized contractor and internal FAA reporting procedures, data systems, and analysis and evaluation techniques to provide timely tracking of program costs, schedules, and technical performance against approved baselines. The processes and procedures to be used for this and other elements of program management will be described in the Program Management Plan to be prepared by this division.

The Special Activities Staff is the principal element of the program office for special projects and studies. This staff is responsible for activities not functionally assigned to any of the divisions that concern the possible impact of external organizations, programs, and actions on the Advanced Automation Program.

3.4 Matrix Support

AAPO will accomplish the majority of its functions through matrix management, with support from other FAA organizations. These organizations include FAA offices, services, centers, and regional offices, as well as other Government agencies. Key FAA organizations that will provide matrix support to the AAPO are the Program Engineering and Maintenance Service, Systems Engineering Service, Air Traffic Service, Acquisition and Materiel Service, Office of Personnel and Training, FAA Technical Center, and the FAA Regional Offices. These key supporting organizations are highlighted on the FAA organization chart in Figure 3-3. Most of the support provided by the key organizations will be defined in program directives and funded directly by AAPO. Some support, such as training by the Office of Personnel and Training, will be performed as part of another organization's functional responsibilities and will be budgeted separately.

Program directives are official agreements that will be developed, and annually updated, with other FAA organizations to carry out specific planned program effort. The program directives are the official instruments that authorize work to be performed and resources to be expended. They are contracts which are negotiated by the Program Office with the supporting FAA Functional Organizations, and approved by the Program Manager and the

Functional Organizational Director. These program directives will explicitly describe work to be performed, products to be produced, milestones, schedules, and resource requirements. An accepted program directive will commit the supporting organization to satisfactory completion of agreed efforts and products on schedule and within budget. All products produced through program directives are subject to approval by the Program Office.

The principal supporting effort required from each key organization has been defined by the AAPO; and initial support is being provided by these organizations. Other needed support will be defined as the program evolves. Required support currently defined by AAPO, and being negotiated with the key organizations, includes the following:

Program Engineering and Maintenance Service (APM)

- Develop architect and engineering designs for Host and AAS site preparation at ARTCC's.
- Develop and maintain the Host and AAS System Implementation Plans.
- Develop and maintain the Host and AAS Integrated Logistics Systems Plans.
- Support the Office of Personnel and Training in developing and maintaining Host and AAS Training Plans.
- Monitor Host and AAS site preparation and construction at ARTCC's.
- Monitor Host and AAS operational acceptance testing.
- Provide transition management.
- Provide operational implementation management.

Systems Engineering Service (AES)

- Provide assistance as needed for the Advanced Automation Program accomplishment.
- Provide coordination of mutual interest activities such as committees and boards pertaining to configuration control, requirements, interfaces, and standards.

Air Traffic Service (AAT)

- Develop and maintain Operational Shakedown and Changeover Subplans as part of Host and AAS System Implementation Plans.
- Develop operational space requirements within current ARTCC and future ACF facilities.

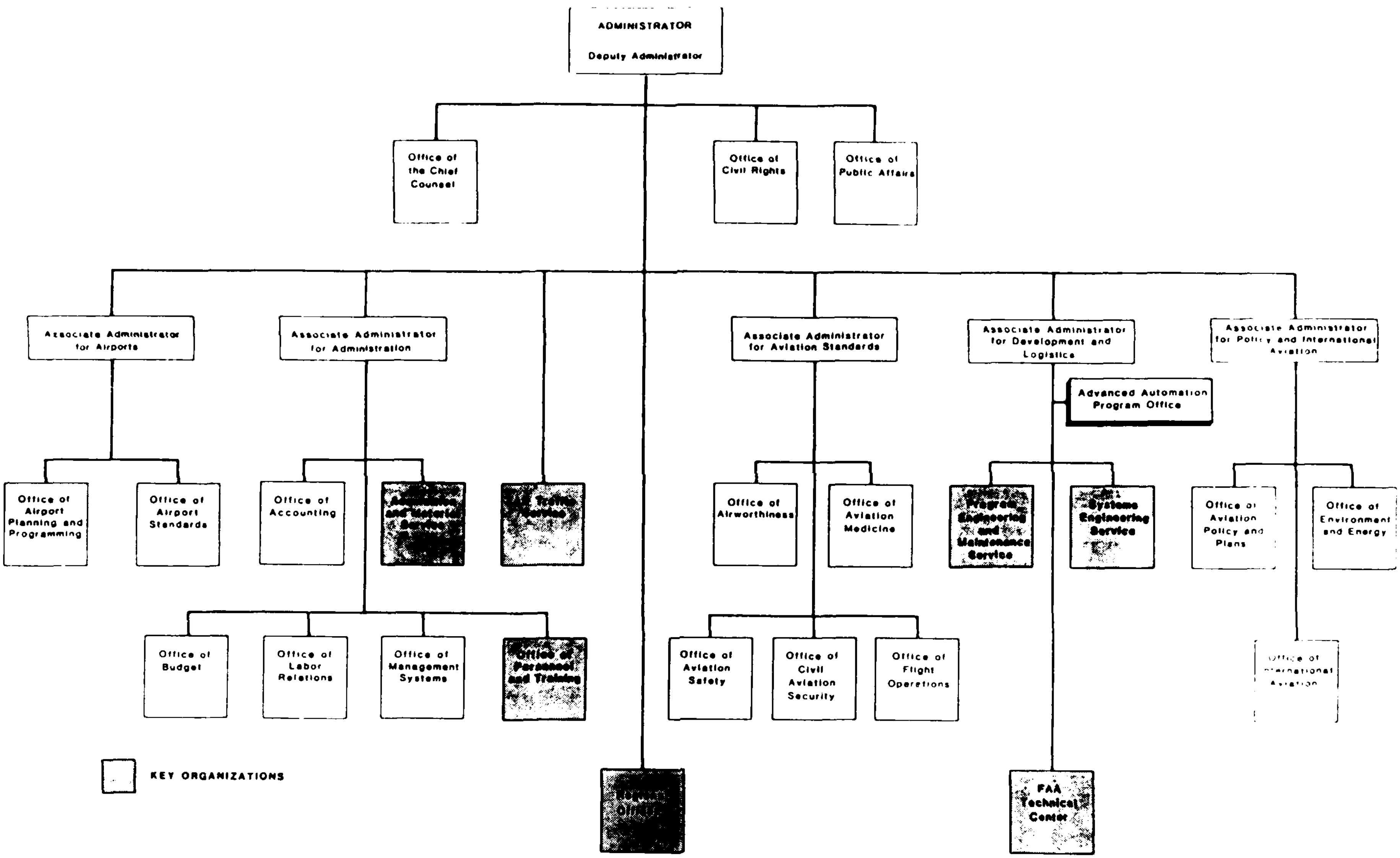


FIGURE 3-3 FAA ORGANIZATION CHART HIGHLIGHTING KEY ORGANIZATIONS SUPPORTING ADVANCED AUTOMATION PROGRAM

- o Develop and maintain ACF and Sector Suite Requirements Plan.
- o Support Host and AAS operational testing at FAATC.

Acquisition and Materiel Service (ALG)

- o Develop required procurement planning and obtain approval of associated documents.
- o Develop and maintain Provisioning Subplans as part of Host and AAS Integrated Logistics Support Plans.
- o Provide all procurement actions necessary to enter into contract(s) for the acquisition of Host and AAS and related items.
- o Contract for supplies and services to support the AAP program.
- o Provide in-plant Quality Review Officer, as appropriate to ensure adequacy of the quality programs and inspection systems.
- o Provide industrial engineering support and production surveillance of program management and contract administration.

Office of Personnel and Training (APT)

- o Develop, coordinate, and maintain Host and AAS Training Plans.
- o Perform Host and AAS training.

FAA Technical Center (ACT)

- o Support Host and AAS prime procurement activities.
- o Support Host and AAS contractor technical monitoring.
- o Provide Host and AAS test and supporting facilities and services.
- o Support Host and AAS test planning and testing at FAATC.

Regional Offices

- o Develop and maintain Site Adapted System Implementation Plans.
- o Perform site preparation and construction to support the Host and AAS.
- o Support AAP study teams as required.

4.0 ACQUISITION STRATEGY

4.1 Approach

As described earlier, there will be two major and parallel acquisitions for this program. One will be for design, development, demonstration, testing, and installation of a new Host Computer System at existing en route centers. The other will be for a corresponding effort to implement the Advanced Automation System, which will consist of new sector suites, new computer software, new processors, and a local communication network.

Three broad management objectives of the Advanced Automation Program are reflected in the strategy for these acquisitions. One objective is to relieve the problem of computer capacity as early as possible. The second is early enhancement of controller productivity. The third objective is to minimize program life cycle cost and risk.

To achieve these objectives, competition and, thereby, maximum participation of qualified contractors, will be maintained throughout the engineering development and system demonstration phases of the two procurements. Competitive design and development contracts will be awarded for both the Host Computer System and the Advanced Automation System.

During the Design Competition Phase of Host acquisition, each prime contractor will develop a Host Computer System, modify existing software, and perform demonstration tests of the system. Following completion of these demonstration tests a single contract will be competitively awarded for acquisition of the Host Computer System and for its installation at each conterminous en route center.

The Design Competition Phase of the Advanced Automation System acquisition will carry complete system design through Critical Design Review, and will include development and testing of prototype sector suite consoles. Upon completion of the Design Competition Phase, receipt of proposals, and proposal evaluation, a single contract will be competitively awarded for the Acquisition Phase.

4.2 Host Computer System Acquisition

The purpose of the Host Computer System acquisition is to procure modern computers, with their associated on-line and support software, that will host the current NAS computer software. A competitive Request for Proposal was released for this procurement in December 1982 and proposals were received in February 1983. Following proposal evaluation, two cost-plus-fixed-fee contracts will be awarded in the third quarter of 1983 for a 21-month Design Competition Phase (DCP). The DCP testing will be performed by the prime system contractors at the FAA Technical Center.

Following testing, each competing prime system contractor will submit a proposal for production, field installation and testing of the proposed computer and rehosted software, and technical support for field implementation. Results of tests performed at the FAA Technical Center and a description of proposed steps to alleviate any deficiencies found during testing will be included in the proposals. These proposals will also include plans for initial training of FAA personnel and initial maintenance support of the system hardware. A single contract award will then be made for acquisition and implementation of the new Host system. The Design Competition Phase contracts will bridge the period between proposal submission and Acquisition Phase contract award to clean up discrepancies found during testing, to complete conversion of software that was not converted prior to the demonstration, and to keep both contractor teams intact until the acquisition award is made, thereby avoiding loss of critical technical skills and knowledge developed during the Design Competition Phase.

Award of the Acquisition Phase contract is scheduled for the second quarter of calendar year 1985, following a review by the TSARC and Key Decision #4 authorization to proceed with acquisition of the Host Computer System. It is planned that this contract will be cost reimbursable, with a fixed price provision covering standard ADPE products (see FPR 1-4.1102-1 for definition of standard ADPE). Contract fee and incentive features are described subsequently in Section 4.4.

The prime system contractor will test and demonstrate the Host Computer System at the FAA Technical Center with the then current version of the 9020 software. After satisfactory completion of these demonstration tests, the prime contractor will provide for site adaptation, install the system hardware and software at each site, and perform site readiness testing. This will include the off-line and on-line shakedown and testing of the integrated hardware and software that is required for subsequent ATC operations at each site. Subsequent to system acceptance, the prime system contractor will provide initial maintenance and supply support of standard ADPE hardware and software. The FAA will continue to maintain the NAS software and remaining NAS hardware.

4.3 Advanced Automation System Acquisition

The purpose of the Advanced Automation System acquisition is to procure newly designed software, controller sector suites, local communication network equipment, and processors. A competitive Request for Proposal was released for this procurement in April 1983. Following proposal evaluation (see Figure 6-1), competitive 35-month cost-plus-fixed-fee contracts will be awarded in the third quarter of 1984 for total system design, the development of a prototype sector suite console, and design of a local communication network and associated software. Each prime system contractor will provide a full set of design specifications for the complete system and perform demonstration tests of prototype sector suite and tower position consoles.

Following completion of prototype console demonstration tests and a Critical Design Review of the final system configuration, each competing prime system contractor will submit a proposal for full system acquisition, including system software development and testing, sector suite and tower position console production, Initial Sector Suite System implementation, full system hardware and software testing, and delivery and installation of the Advanced Automation System throughout the Air Traffic Control System. These proposals will also include provisions for initial training and initial hardware and software maintenance support. A single contract award will then be made for acquisition, implementation, and initial maintenance of the system.

Award of this contract is scheduled for late 1986, following a review by the TSARC and Key Decision #4 authorization to proceed with acquisition of the Advanced Automation System. It is planned that this contract will be cost reimbursable, with a fixed price provision covering all hardware production. Contract fee and incentive features are described in Section 4.4.

The prime system contractor will first test and demonstrate the Initial Sector Suite System (Host/Sector Suite/Local Communication Network system) at the FAA Technical Center. The prime system contractor will then implement the Initial Sector Suite System at the ARTCC's. Meanwhile, the full AAS will have been developed and integrated with full-scale tests performed at the FAA Technical Center. Following these tests, the prime system contractor will provide for site adaptation, deliver and install the AAS at each site, and perform site readiness testing. FAA acceptance of the Advanced Automation System at each site will be followed by the site Operational Readiness Demonstration. Subsequent to system acceptance, the contractor will provide full maintenance and supply support of the AAS for a period sufficient for the FAA to implement its selected approach for continuing system maintenance. Selection of this approach was discussed in Section 2.1.

4.4 Fee and Incentive Features of Acquisition Contracts

The Acquisition Phase contracts to be competitively awarded for both the Host Computer System and the Advanced Automation System will contain special fee and incentive features. The purpose of these features is to encourage responsible assessment and management of risk by the prime system contractor and to reward him for cost reductions and overall excellence in technical and management performance.

The fee structure developed for these contracts will employ a three-step approach consisting of a base fee, a unilateral performance-related award fee, and a final cost incentive fee adjustment at the completion of the contract based on a Government/contractor sharing formula. The base fee will represent a small percentage of the contract target cost, and will be the minimum fee paid to the prime system contractor. In addition, the award fee, consisting of a larger fraction of contract target cost, may be earned by the contractor each quarter based on the Government's unilateral evaluation of the contractor's performance. Performance factors to be assessed are technical performance, schedule performance, project management performance, and risk management performance. At the completion of the contract, the cost incentive will be added to or subtracted from the award fee, depending on whether the contractor underruns or overruns the target cost. This adjustment will be made in accordance with the Government/contractor share ratio agreed to in the contract. The overall purpose of this fee structure is to guarantee a small base fee, and provide the opportunity for the contractor to earn, on an incentive basis, a total maximum fee of up to a negotiated percent of contract target cost.

The unilateral fee awards will be based on contractor performance during each quarterly period. The key evaluation factors to be emphasized each period will be determined by the Government and discussed with the contractor prior to the beginning of the quarter. At the end of the quarter, the Government evaluation board will evaluate the contractor's performance, and the Fee Determining Official will approve the amount of award fee to be paid. Being a unilateral fee award, this fee determination will not be subject to dispute by the contractors.

4.5 Minority Business Enterprise Contracting

Each of the prime system contractors will be required to implement a Government approved plan for subcontracting with minority business enterprise firms in the performance of the Host and AAS design, development, and implementation.

In furtherance of the Government's policy of promoting the development of small business firms owned and controlled by socially and economically disadvantaged individuals, the Host system and AAS contractors will award subcontracts to such enterprises to the maximum practical extent consistent with efficient contract performance.

5.0 CONTRACTOR SUPPORT

5.1 Factors Affecting Program Support Needs

The Advanced Automation Program Office will require a broad spectrum of engineering and management support to implement its program. Although the office will be utilizing matrix support from a number of FAA functional organizations, the breadth and depth of support required far exceeds that available within the FAA. Consequently, contractor support will be required in a number of engineering and management areas to augment the FAA's in-house capabilities. Several factors contribute to the need for this additional support.

For example, the criticality of alleviating current ATC automation system deficiencies as early as possible demands success in meeting planned AAP cost, schedule, and technical targets. This requires a fully dedicated engineering and management staff, experienced in the management disciplines of complex systems acquisition programs such as this to provide the type of program tracking and assessment needed.

In addition, the sheer size and complexity of the Advanced Automation Program contributes to a heavy FAA workload in verifying and validating every aspect of systems development. The effects of this factor on size of staff needed is further compounded by the use of multiple, competitive contractors for the initial phases of the Host and AAS systems efforts, and by the complex interfaces that exist among system elements and with the existing ATC automation components.

Another factor is the need to introduce the new system into the on-line operations of the existing ATC system without adversely affecting flight operations and safety. This essential requirement imposes an unusual amount of planning, training, and testing to assure a quality, reliable product. Much of this training and testing will be performed on-site as the systems are gradually activated during transition at the various Air Traffic Control Centers.

Finally, implementing new, essential management methods and procedures within the FAA and the AAPO will require special expertise not readily available within the organization. The engineering and management support contractors will augment the FAA with the practical experience and capabilities needed in this area. These contractors, working together with the FAA matrix support organizations, will provide an integrated team of sufficient size and expertise to ensure execution of the program as planned.

5.2 Support Requirements

The Advanced Automation Program will require five major types of contractor support: 1) Program Management Support, 2) ATC System Support, 3) System Engineering Support, 4) Testing and Field Implementation Support, and 5) Independent Verification and Validation Support.

Program Management Support includes assistance in developing, implementing and maintaining systems and procedures for program planning, control, performance evaluation, and management. This support will include specifying, developing, maintaining, and operating modern program management tools and data bases; planning and establishing an automated configuration management system; assisting in the preparation of key program management and contract solicitation documentation; providing recommendations for implementation of program management standards; providing recommendations, support, and operation of life cycle cost analysis models; assisting in management proposal evaluations; and performing program cost/schedule/technical performance analyses and evaluations.

ATC System Support refers to the technical studies and services related to ATC systems and operations in support of Advanced Automation Program engineering. This support includes performing automated ATC system simulation and modeling to aid in analyzing system workload factors, assessing technical approaches and tradeoffs and conducting ATC laboratory experiments. Also included is assistance in preparing technical development approaches and plans; preparing RFP specifications and performing technical evaluations of proposals; developing, calibrating, and exercising system reliability/availability models; and performing system safety studies and analyses.

System Engineering Support is required to provide technical assistance in engineering evaluation of the Host and AAS design/development program and its products. This type of support includes providing technical assistance in requirements definition, analysis, and maintenance; analyzing design/development approaches and tradeoff of technical risk alternatives; preparing detailed test plans and procedures; performing computer simulation and modeling; providing support to architect-engineers; evaluating logistics and production engineering; assisting in the preparation of RFP specifications and technical evaluation of proposals; and, conducting performance analysis and evaluation.

Testing and Field Implementation Support covers both laboratory and field site activities. Included are planning and implementing of test beds at the FAATC, preparing and documenting test data bases, and providing support for development testing at the FAATC. Support will also be furnished by the prime system contractors during installation and testing at the field sites.

The Independent Verification and Validation (IV&V) Support is required to assist the FAA in verifying and validating products generated by the Host and AAS development contractors. The major objectives of this support are to assure adequate translation of performance requirements into both hardware and software designs, to evaluate the prime system contractors' implementation of these designs, and to monitor and evaluate test planning, test adequacy, and technical documentation adequacy. As appropriate, the contractor responsible for IV&V will review the prime system contractors' technical documentation, plans, and designs to insure compliance with approved standards/conventions. This review will also assure testable designs, identify problems, assess the impact of the problems and provide recommended solutions.

5.3 Acquisition of Contractor Support

AAPO currently has several contractors who are providing support in the above major areas. ATC System Support is being provided by MITRE Corp., System Engineering Support by RCA, Independent Verification and Validation (IV&V) Support by Systems and Applied Sciences Corp., and Program Management Support by Arthur D. Little, Inc. It is envisioned that AAPO will need to maintain System Engineering and Program Management Support contracts through 1986. Subsequent support in all or most of these areas will be obtained through the planned System Engineering/System Integration contract addressed below. ATC System Support provided by MITRE Corp. will be required for the duration of the program.

The FAA has released the Request for Proposals for a System Engineering and Integration (SEI) support contract to provide assistance across all programs currently in the National Airspace System Plan. It is intended that after award of this contract and following a period of contractor familiarization, the majority of contractor support for AAPO will be derived from the SEI contractor. The SEI contractor will initially provide IV&V support for the program office. Decisions will be made during the next 12 to 36 months on other specific AAPO support to be obtained from the SEI contractor.

A limited amount of specialized technical/engineering support will also be obtained through the award of contracts directly to minority businesses. This support will provide unique expertise and a quick-reaction response capability to perform tasks that augment work of the principal support contractors.

6.0 PROGRAM SCHEDULE

6.1 Summary Schedule

The summary schedule for the Advanced Automation Program is presented in Figure 6-1 in the form of an activity network. This executive summary network illustrates the time phased interrelationships of major program activities and milestones, and reflects current planning estimates for program implementation.

Tower Control Computer Complex (TCCC) and tower position console schedules are not reflected in Figure 6-1 since these schedules are yet to be developed, as discussed in Section 2.5. The specific number of TCCC's and tower position consoles to be installed and the schedule for their delivery will be determined prior to award of the AAS Acquisition Phase contract in 1986. The gradual implementation of the TCCC's will follow stabilization of all CONUS ACCC's.

The AAP summary schedule will be updated as the program evolves. For example, following award of the Host and AAS Design Competition Phase contracts, the network schedule will be updated to reflect contractual commitments for deliveries and work completion. Also, after the facility modification and construction plan is prepared, major milestones for that work will be added.

6.2 Administrator Controls

The following program decisions, indicated in the program schedule, are reserved for the Deputy Secretary of the Department of Transportation:

Decision	Scheduled Date (Calendar Year)
Authorization to proceed with Host Computer System development and demonstration - Key Decision #3	March 11, 1983
Authorization to proceed with Advanced Automation System development and demonstration - Key Decision #3	April 7, 1983
Award of Host Computer System Design Competition Phase contracts	September 22, 1983
Award of Advanced Automation System Design Competition Phase contracts	3rd qtr 1984

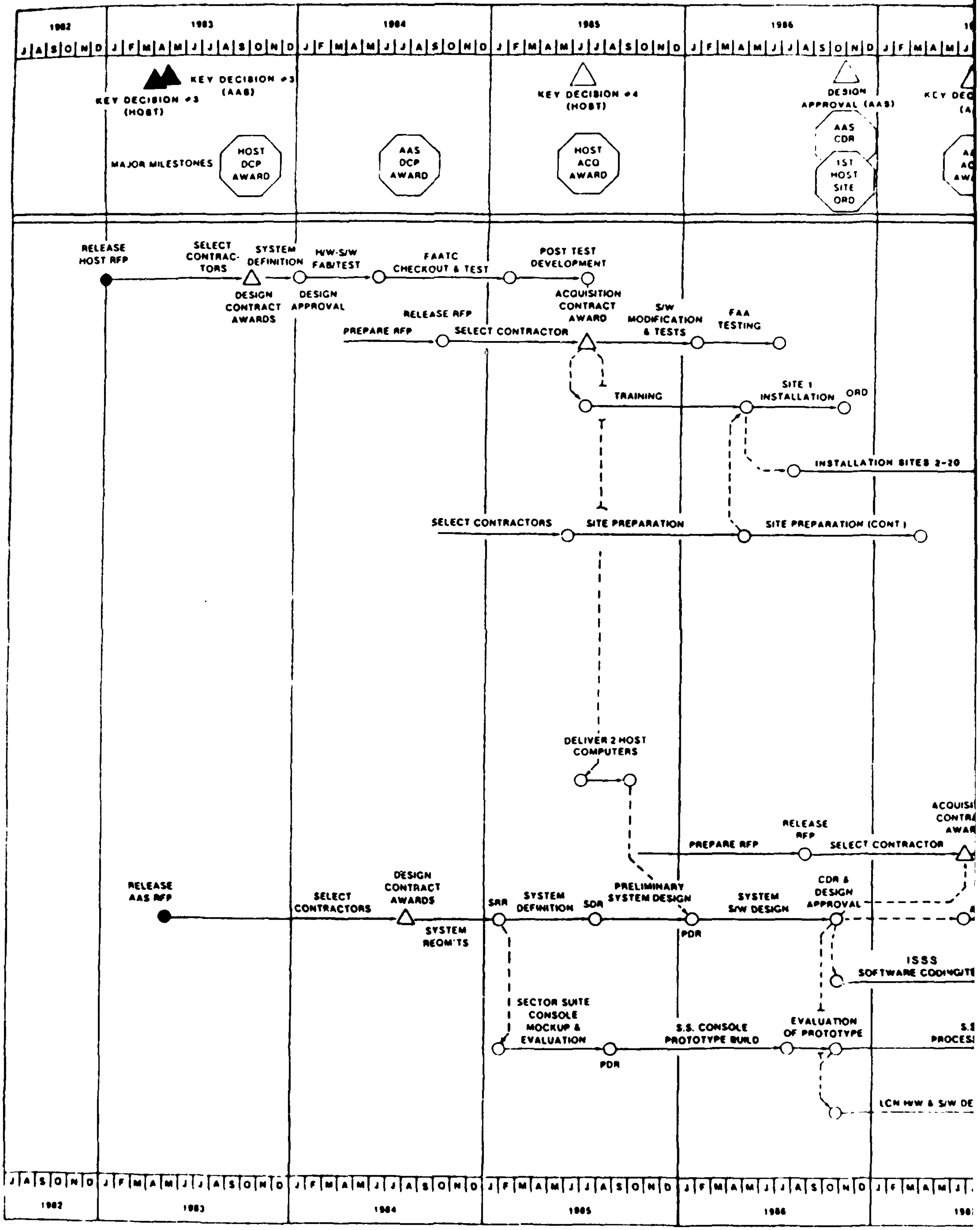
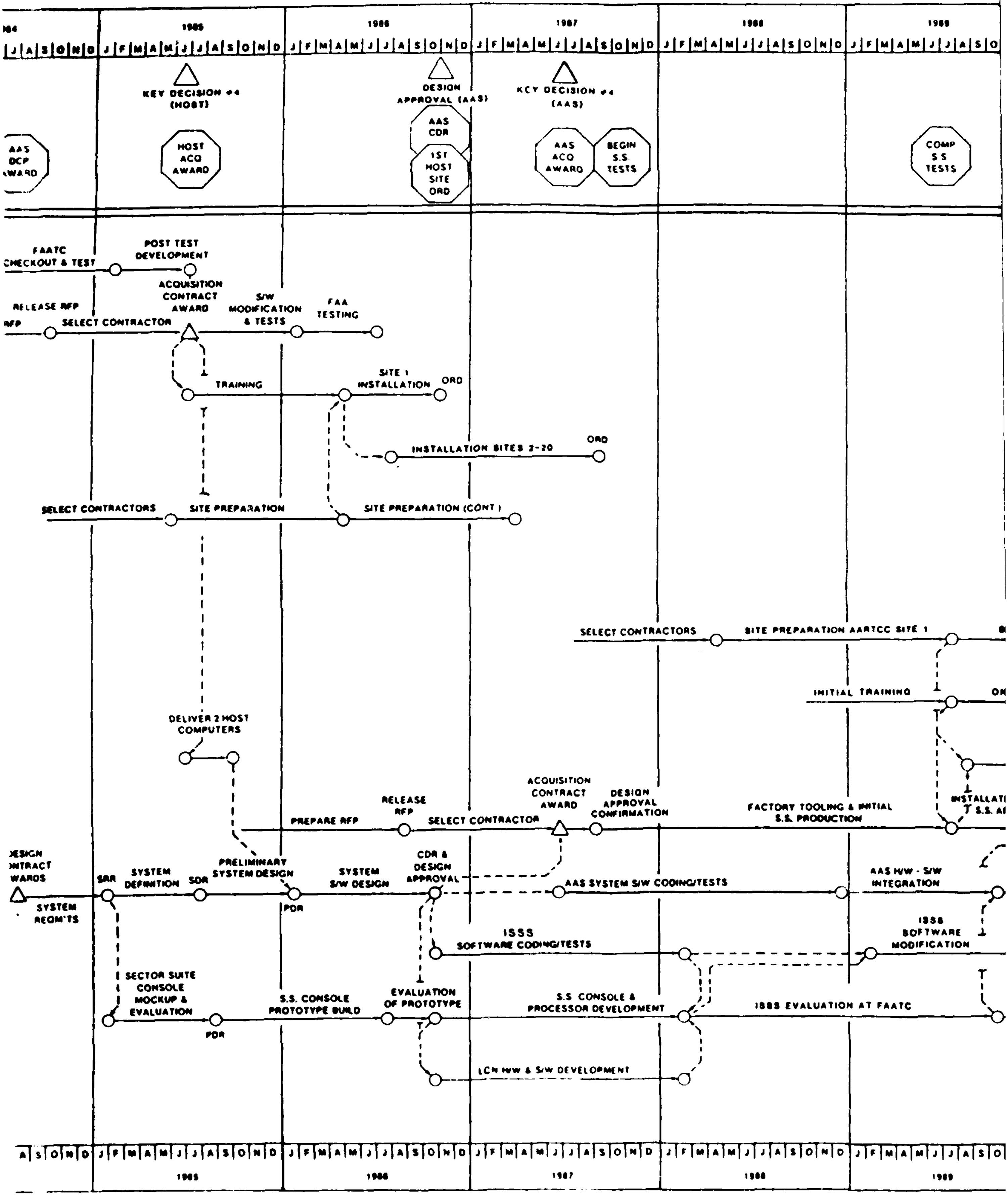
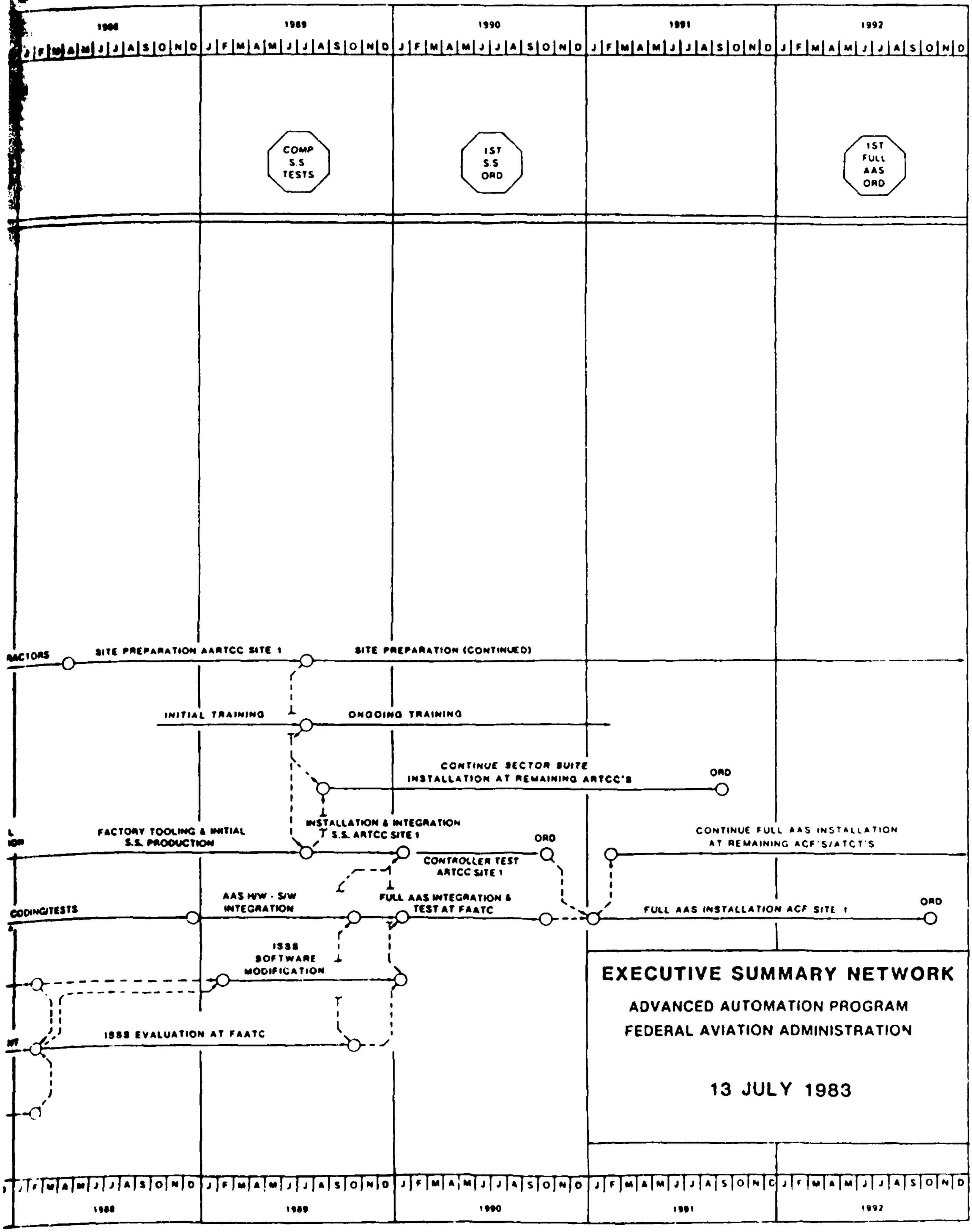


FIGURE 6-1 ADVANCED AUTOMATION PROGRAM SUMMARY SCHEDULE N



OMATION PROGRAM SUMMARY SCHEDULE NETWORK

2



1988
1989
1990
1991
1992
J F M A M J J A S O N D
COMP S.S. TESTS
1ST S.S ORD
1ST FULL AAS ORD
SITE PREPARATION AARTCC SITE 1
SITE PREPARATION (CONTINUED)
INITIAL TRAINING
ONGOING TRAINING
CONTINUE SECTOR SUITE INSTALLATION AT REMAINING ARTCC'S
ORD
FACTORY TOOLING & INITIAL S.S. PRODUCTION
INSTALLATION & INTEGRATION S.S. ARTCC SITE 1
ORD
CONTROLLER TEST ARTCC SITE 1
CONTINUE FULL AAS INSTALLATION AT REMAINING ACF'S/ATCT'S
CODING/TESTS
AAS H/W - S/W INTEGRATION
FULL AAS INTEGRATION & TEST AT FAATC
FULL AAS INSTALLATION ACF SITE 1
ORD
ISSS SOFTWARE MODIFICATION
ISSS EVALUATION AT FAATC
EXECUTIVE SUMMARY NETWORK
ADVANCED AUTOMATION PROGRAM
FEDERAL AVIATION ADMINISTRATION
13 JULY 1983

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<u>Decision</u>	<u>Scheduled Date</u> (Calendar Year)
Authorization to award Host Computer System Acquisition Phase contract - <u>Key Decision #4</u>	2nd qtr 1985
Advanced Automation System Design Approval Confirmation	2nd qtr 1987
Authorization to award Advanced Automation System Acquisition Phase Contract - <u>Key Decision #4</u>	2nd qtr 1987

7.0 PROGRAM FUNDING

7.1 Funding Plan

The next 5-year budget projections for the Advanced Automation Program are presented in Table 7-1 in terms of annual obligation requirements. Included are projections for Research Engineering and Development (RE&D) and Facilities and Equipment (F&E). The total cost to completion of the program is estimated to be $3.1 billion.

The Research Engineering and Development budget projections include the following:

- Host Computer and Advanced Automation Systems design and demonstration.
- FAA in-house support, including development and test facility support.
- Program support contractors.
- Advanced Automation Program Office personnel costs.

The Facilities and Equipment budget projections include the following:

- Host Computer and Advanced Automation Systems production, test and installation.
- Site preparation, including facility modifications.
- Field support.
- One year contractor maintenance for Host Computer System hardware and full Advanced Automation System.
- Training course development.
- Program support contracts.
- FAA in-house support for these activities.

PROGRAM BUDGET PLAN

(Millions of Dollars)

APPROPRIATION	FY1982	FY1983	FY1984	FY1985	FY1986	FY1987	FY1988
Research Engineering and Development	8.7	41.9	156.6	162.8	125.1	21.4	23.6
Facilities and Equipment	—	4.6	8.0	262.0	81.1	296.4	385.5
TOTAL	8.7	46.5	164.6	424.8	206.2	317.8	409.1

TABLE 7-1 PROGRAM BUDGET PLAN

FILM

1-8