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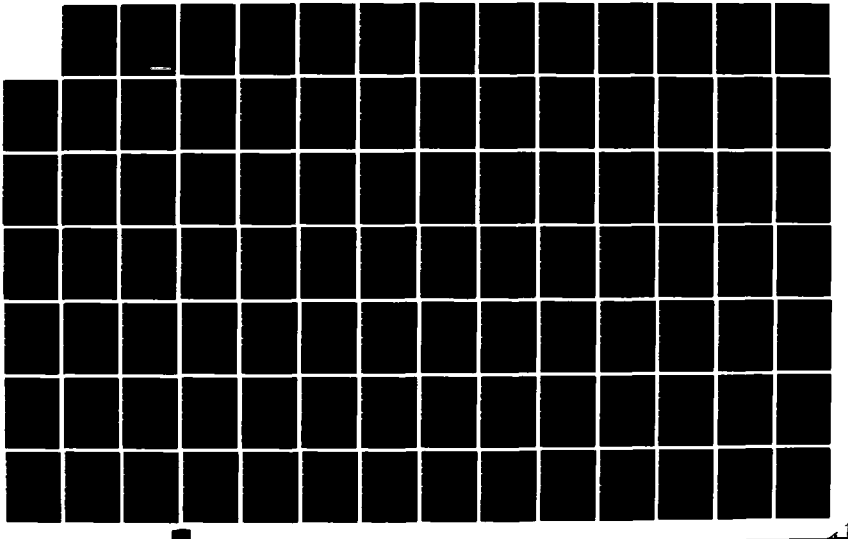

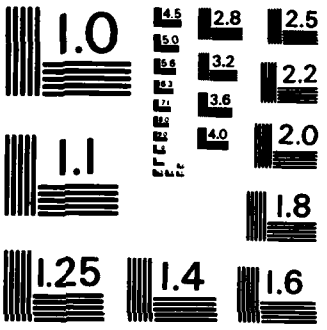

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NAS Plan
Audit Report August 1984

Volume 2

Section 5.0 NAS Plan
Project Findings

System Engineering and Integration Contract for Implementation of the National Airspace System Plan

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Air Traffic Control Division

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Volume 2

NAS Plan
Audit Report

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Section 5.0 NAS Plan
Project Findings

SYSTEM ENGINEERING AND INTEGRATION CONTRACT FOR IMPLEMENTATION OF THE NATIONAL AIRSPACE SYSTEM PLAN

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FOREWORD

Martin Marietta Aerospace, Air Traffic Control Division, submits this document to the Department of Transportation, Federal Aviation Administration, in response to Statement of Work, Section 6.2, and Article II, Period of Performance and Delivery, on contract DTFA01-84-C-00017.

Sections 1.0 through 4.0 and section 6.0 are presented in Volume 1. Volume 2 contains section 5.0, the NAS Plan project findings.

CONTENTS

5.0 NAS PLAN PROJECT FINDINGS

This section provides the detailed audit findings for each of the NAS Plan F&E projects. The individual sections are arranged to follow the sequence and order of the technical program chapters in the NAS Plan. The text on each project is formatted to describe:

1) Project role in the National Airspace System.

2) The products that will be produced by the project.

3) The status of the project.

4) The major audit findings broken into technical, schedule, and cost if appropriate.

5) Recommendations to help achieve a successful project on schedule.

5.1 ATC SYSTEMS

5.1.1 En Route Systems

This section contains the audit results for the en route section of NAS Plan (F&E) and the fifteen individual en route projects. The projects are summarized in Table 5.1.1-1.

Assessment of Approach

Our assessment of the en route systems modernization approach, as described in the NAS Plan Chapter III, is that it is both technically and programmatically sound. This conclusion is based on how well the approach appears to meet NAS Plan goals/objectives established in the first two NAS Plan chapters. At the individual project level, however, planning reflects some compromises from classic procurement approaches in order to strike the balance among projects

Table 5.1.1-1 En Route Systems

Project	Category	Next CDP	1st ORD	SEI Role
En Route Automation Hardware Improvements and Enhancements		In Progress		--
FDIO		Critical Desisn Review 7-84	N/A	Technical Support
DARC		1st Site Test 7-84	N/A	
EARTS Enhancements		Contract Award 7-84	N/A	
ODAPS		Contract Award 7-84	N/A	Technical Support
TMS		Start Ph 2 Od 7-84	N/A	Monitor 10-84
Host Computer	DMSA	KDM 4 6-85	10-86	Technical Support
ERM II		Des Verif Test 11-84	7-87	Monitor 9-84
Conflict Resolution		System Test 7-84	7-87	Monitor 9-84
Conflict Alert IFR/VFR		Design Evaluation 8-84	7-87	
VSCS	DMSA	KPD 3 8-84	10-91	Monitor
AAS	DMSA	DCP Award 8-84	11-90	Technical Support
AERA		Test Bed at Technical Center 7-84	N/A	Monitor
Integration of Nonradar Approach Control		Underway	N/A	
ACF	MSA	Implementation Plan 8-84	5-93	

needed to meet system-level goals/constraints. This is to be expected in a system modernization effort where the implementation approach must ensure that the current system remains viable as transition is made to the new system.

Near-Term Evaluation (to 1985)

At the end of the near-term period, the en route projects fall into three major life cycle categories:

1) Partial or Complete Implementation (start of site 1 installation to last ORD)

Project 1	En Route Automation Hardware Improvements and Enhancements (partial)
Project 2	Flight Data Entry and Printout Devices (partial)
Project 14	Integration of Nonradar Approach Control into Radar Facilities (partial)
Project 3	Direct Access Radar Channel (DARC) System (partial)
Project 6	Traffic Management System (Phase I - complete)

2) System acquisition (acquisition phase award to start of site 1 installation)

Project 5	Oceanic Display and Planning System (ODAPS)
Project 4	EARTS Enhancements
Project 6	Traffic Management System (Phase II)

3) System definition/development (before acquisition phase award)

Project 7	Modern ATC Host Computer
Project 8	En Route Metering II (ERM II)
Project 9	Conflict Resolution Advisory Function
Project 10	Conflict Alert IFR/VFR Mode-C Intruder
Project 11	Voice Switching and Control System (VSCS)
Project 12	Advanced Automation System
Project 13	Automated En Route Air Traffic Control (AERA)
Project 15	Area Control Facilities (ACF)

Our audit results identified no significant technical, cost, or schedule risks for categories 1 and 2. Minor concerns were identified on several projects, as discussed in the project-level subparagraphs below. There were, however, several integration issues identified for category 3 projects. These integration issues are not considered to pose an adverse impact to achievement of NAS goals or benefits.

One issue is the simultaneous development of VSCS and AAS in the areas of operations concept and selection of man-machine interface language. Both programs have structured programs for Air Traffic Service (ATS) controller involvement in man-machine interface definition/development. This, we agree, is crucial to ensure operational acceptance of the sector suite and ultimate obtainment of productivity benefits. Since the VSCS control panel will become an integral part of the sector suite, we recommend that close coordination between these two man-machine interface development efforts be accomplished by a single operational team derived from the existing AAS Sector Suite Requirements Validation Team (SSRVT) and VSCS Operational Requirements Team (ORT).

A second issue concerns parallel AERA requirements definition and AAS development especially relating to sizing and software architecture definition. AERA definition will involve functional and operational analyses over a long period of time. A process and schedule should be defined for insertion of AERA requirements into the AAS development cycle as they are solidified. Likewise, as AAS definition is solidified, the AERA test bed facilities should be refined to reflect the current AAS environment, and plans should be established for the ultimate transition into the Research and Development Computer Complex (RDCC) at the FAATC. This close coordination of AERA and AAS is required to capture the significant long-term NAS benefits dependent on AERA implementation in AAS or post-AAS software.

A third issue involves the parallel TMS phase III requirements definition and AAS development. Like AERA, the TMS definition will evolve over time and must be integrated into AAS sizing and software definition. This interface is essential to meet NAS goals related to traffic management and safety.

We consider these issues to be significant but not unresolvable if management and technical processes required to control potential technical risk are implemented in a timely manner. Recommendations (refer to para 4.2, 5.1.1.6, 5.1.1.12, and 5.1.1.13) involve establishment of working groups, project consolidations, and disciplined review processes between NAS design efforts and individual project management activities. Many of these techniques are now in existence or being established, such as interface working groups and NAS system design reviews, which include membership from all required parties.

Intermediate Evolution (1985 to 1990)

At the end of the intermediate period, the following categorization of en route projects exists:

1) Partial or complete implementation (start of site 1 installation to last ORD)

Project 1	En Route Automation Hardware Improvements and Enhancements (complete)
Project 2	Flight Data Entry and Printout Devices (complete)
Project 14	Integration of Nonradar Approach Control Radar Facilities (complete)
Project 3	DARC (complete)
Project 4	EARTS Enhancements (complete)
Project 6	Traffic Management System (phase II complete)
Project 5	ODAPS (complete)
Project 7	Modern ATC Host Computer (complete)
Project 8	ERM II (complete)
Project 9	Conflict Resolution Advisory Functions (complete)
Project 10	Conflict Alert IFR/VFR Mode C Intruder (complete)
Project 11	VSCS (partial)
Project 12	Advanced Automation System (partial-ISSS)

2) System acquisition (acquisition phase award to start of site 1 installation)

Project 12	Advanced Automation System (partial-full AAS)
Project 6	Traffic Management System (Phase III)

3) System definition/development (before acquisition phase award)

Project 13 AERA

Project 15 ACF (no acquisition phase involved)

The issues in this phase are the same (requirements integration among projects) as discussed in the previous near-term period. However, the risks involved with uncoordinated requirements is greater now since most of the involved projects are in their acquisition phases or, in the case of AERA, in a late development phase.

Long-Term Evolution (1990 to 2000)

This period involves the completion of all NAS Plan en route system modernization projects including AERA, ACF, and TMS Phase III. The most significant cost benefits are realized during this period when en route and terminal facilities are combined as a result of ACF consolidation.

The major issues in this period involve the transition of TRACONs into ACFs and transition of towers to AAS control computer complex.

TRACON consolidation involves many subissues such as parallel operation of existing TRACONs and "new" ACF positions, staffing both locations with trained/certified AT personnel, and other operational aspects.

The tower modernization issue involves space constraints for hardware installations and methods to provide parallel tower operations if mobile/temporary towers are required during the transition phase. Availability of adequate trained/certified AT personnel is also involved in this issue.

Both of these issues are currently long-range planning activities recognized by the AAP and part of both the AAS, DCP, and AP SOWs.

5.1.1.1 En Route Automation Hardware Improvements and Enhancements

Role in NAS

The IBM 9020 computers must continue to operate at the current level of reliability until they are replaced by the Host computer system beginning in 1986. The system repairs and improvements associated with this project will allow the continued operation and provision of vital services required to support the ATC en route function. Without this project, there will probably be unacceptable failures of online systems resulting in operational disruptions and aircraft movement delays.

Products

Medium speed printers have already been replaced with more reliable units. Aging disk read/write heads must be replaced, and deteriorating cables and marginal or intermittent circuit boards must be identified and replaced.

Status

Disk read/write heads have been replaced and the number of spare components increased. Work is underway to identify those printed circuit boards and cables that should be replaced. Spares for these will also be procured and stored to enable rapid replacement following such identification.

Audit Findings

Technical - Identification of printed circuit boards to be replaced is an ongoing problem.

Schedule - No problems identified.

Recommendations

None.

5.1.1.2 Flight Data Entry and Printout Devices

Status

A contract with California Minicomputer Systems was signed in December 1983. The contract calls for delivery of an FDIO center system, an FDIO remote/ODAPS system, and IBM 9020 software modifications to the FAATC no later than December 1984. IBM 9020 software modifications for FDIO will be based on the 2.13 version of software, which must be updated to the appropriate version (2.14 or 2.15) by the FAATC.

Audit Findings

Technical

The NAS Plan calls for simultaneous servicing of both the old and new systems during transition. This requirement may cause physical crowding of equipment installed in control rooms during the transition period. One solution might be to store acceptance tested hardware and limit simultaneous operations to that minimum time essential to establishing the operational credibility of the new system.

Schedule

The current installation schedule calls for 318 remote groups and 22 center groups to be installed in the first year. This raises a question as to the risk in this program of ontime delivery of the total system. A conference with FAA program management personnel on this subject indicates that contingency planning is underway (additional installation teams can make up schedule slippages).

Recommendations

Plans for limiting the impact of simultaneous operations during transition should be prepared.

Close monitoring for schedule compliance during both the production and installation phases must be maintained because of obvious risk implications.

5.1.1.3 Enhanced Direct Access Radar Channel (E-DARC) System

Role in NAS

DARC is a backup system that provides radar data to the plan view displays (PVD) in the Centers in the event of primary system (9020 or Host) failure. Enhanced DARC (E-DARC) will better emulate the display of data emanating from the IBM 9020s, and later, the Host computer system. E-DARC is critical to the transition to the new Host computer and required for ISSS.

E-DARC will improve the controller's operational capability by providing a backup system (similar in appearance and function to the primary) with the flip of a switch without impacting other controller positions not experiencing problems. Currently when a controller experiences problems on a PVD, as many as five other locations in the Center must use DARC, which involves physically moving each PVD to a horizontal position and instituting manual target identification and correlation.

Products

The E-DARC project will procure hardware and software to be installed at the FAATC, the FAA Academy, and the 20 domestic ARTCCs. Hardware consists of plug compatible metal-oxide semiconductor or memory and microcomputer boards, modified display generator input/output boards, cable harnesses, and switches for each PVD console. Software will provide tracking, mosaicking, real-time quality control, and the capability to allow each controller to independently select either primary or backup mode of operation.

Status

Installations have already begun on this project and should be completed by June 1985. Inclusion of several added software requirements for E-DARC, identified after testing begun, resulted in a 2-month slip in system delivery. The newly identified 2-month slip in E-DARC software delivery will not affect the downstream Host initial software delivery; however, since the rehosted software must include E-DARC interfaces, the time required to incorporate these additional requirements in Host should be scheduled as soon as practical.

Audit Findings

Technical - No problems identified.

Schedule - The 2-month slip in E-DARC software delivery will not adversely affect the Host computer project. The schedule for incorporating the final E-DARC software functions remains to be established.

Recommendations

The schedule adjustment relating to the new E-DARC software functions as they impact the Host computer project should be ascertained.

5.1.1.4 En Route Automated Radar Tracking System (EARTS) Enhancements

Role in NAS

EARTS provides the capability to selectively display data from up to 5 long-range radars. Enhancements will provide radar data mosaicking of up to 15 radars, conflict alert, and minimum safe altitude warning (MSAW). Ultimately, AAS will replace EARTS at the Honolulu and Anchorage centers.

Radar mosaicking permits more efficient operational use of radar returns from multiple radar sources. This allows more complete use of radar minimums, reduces delays, and lowers user costs. In addition, the EARTS will increase the controller's efficiency. Conflict alert and MSAW capabilities will be provided to alert ATC personnel to potential hazardous inflight conditions where less than standard separation exists between aircraft, aircraft and the ground, or aircraft and ground obstructions. Anchorage requires the capability for a mosaic display of 15 radars; the EARTS software will be written to accommodate Anchorage's requirements and will be provided to all EARTS locations.

Products

The EARTS enhancement project will procure hardware and software modifications for Anchorage, San Juan, Honolulu, Nellis Air Force Base, FAA Technical Center, and Aeronautical Center beginning April 1985 with completion by May 1987. Hardware will consist of consoles, reformatters, and processors.

Status

The mosaicking hardware and software contract was awarded December 1983 and mosaicking capability will be implemented by March 1986. The Conflict Alert and MSAW contract will be awarded sometime between August 1984 and December 1984 with implementation to be completed by early 1987.

Audit Findings

Technical - No identified problems.

Schedule - Project completion has slipped at least 9 months.

Recommendations

None.

5.1.1.5 Oceanic Display and Planning System (ODAPS)

Role in NAS

ODAPS will provide air traffic controllers with automation assistance for oceanic ATC within airspace delegated to the U.S. in the Atlantic and Pacific Ocean. FDIO will provide oceanic controller input/output capabilities including the strip printing function. In the future, AAS will have designed into it the capability to perform the same functions as ODAPS.

The current method of controlling oceanic traffic is antiquated and the system is ideally suited for automation. Fuel efficiency and safety will be increased when controllers are provided automated conflict probing and a visual display of spatial relationships between aircraft. This will allow the controllers to assign aircraft more fuel efficient altitudes or routes while still maintaining safe separation.

Products

The ODAPS project will procure hardware and software for 2 operational sites (Oakland and an East Coast center), and the FAA Technical Center. The hardware for each location will consist of duplex IBM 4381 central processing units, a computer display subsystem, the communications subsystem, and all of

the associated interface hardware. Software will be needed for external interfacing, applications programs, display generation, conflict probe, and conflict prediction.

Status

The contract award originally scheduled for April 1984 has been delayed until September 1984 due to over-budget cost proposals submitted by the selected source vendor and legal questions associated with the acquisition process. Price and SBA audits are underway.

Audit Findings

Technical - The original budget for ODAPS was based on the use of IBM 4341 CPUs. An analysis by the bidding contractors implies that the higher capability 4381 configuration may be required to meet the operational requirement. A decision to use the IBM 4381 in lieu of the 4341 will result in distinct advantages of increased capabilities, ease of implementation, and reduced maintenance costs.

Retention of ODAPS as a standalone system versus replacement of ODAPS by AAS as baselined should be thoroughly studied.

Schedule - Since the ODAPS system will provide a new function in the admittedly archaic oceanic ATC environment, any delay in implementation will also delay the associated increase in controller productivity and monetary savings to the users of oceanic airspace.

Recommendations

1) Expedite the decision relating to the IBM 4341 versus the IBM 4381 as the main processor, and providing funding increases as necessary.

2) Perform a technical/operational analysis to verify the planned incorporation of ODAPS into the future AAS.

5.1.1.6 Traffic Management System (TMS)

Role in NAS

TMS will upgrade the present flow control system to include the Central Flow Control Facility (CFCF), Central Altitude Reservation Function (CARF), Airport Reservation Function (ARF), central flow weather service unit, and the traffic management units (TMU) in each ARTCC and designated terminals. TMS interfaces with FSS, AERA, NADIN, and CWP and will be integrated with AAS in the mid 1990s.

Upgrading TMS will improve air traffic system efficiency, minimize delays, expand services, and be more responsive to user requirements. The effect of these improvements will reduce fuel waste and system delays.

Products

Phase I of TMS is nearing completion and includes: (1) replacement of the 9020A Jacksonville computer system with the IBM 4341 computer located at the FAA Technical Center; (2) relocation of CARF and the automation staff to FAA headquarters; (3) implementation of a data communications system to interface users and 9020 computers at each ARTCC in a two-way data mode; (4) installation of upgraded data terminals in CFCF; (5) improvement of departure release time software; and (6) implementation of a static en route sector load software at flight level 240 and above.

Phase II, to be completed by 1986, focuses on:

1) TMU enhancements--upgraded terminals.

2) En route sector sequencing, loading, and metering.

3) Estimated departure clearance (time) (EDCT) program enhancements.

4) Establishment of enhanced ATC system graphic capability.

5) Interface with CARF automation.

6) Implementation of computer runway configuration management system.

7) Implementation of random route graphics.

Phase III will fully integrate TMS with the AAS to provide all planned flow management functions. This phase will be implemented in the mid-1990s.

Status

Most Phase I tasks will be completed by the end of July 1984. The power conditioning system will be installed December 1984. Phase II will begin July 1984 as currently scheduled.

Audit Findings

Technical - A disconnect exists between Phase II and Phase III requirements. Since Phase III of TMS will be managed by a new FAA organizational element, close coordination procedures must be maintained.

Schedule - Phase I and Phase II are behind schedule.

Recommendations

1) Ensure close coordination and requirements continuity between the Phase II and Phase III project offices.

2) Combine TMS Phase III with AERA-2/3 into a single project. The single project would become a block upgrade to AAS.

5.1.1.7 Modern ATC Host Computer

Role in NAS

The role of this new system is to permit the ATC system to reliably handle the increased demand forecasted in Chapter II of the NAS Plan. It will do this by providing the capacity necessary to process more aircraft and to accommodate functional growth. Completion of the Host program is a prerequisite to implementation of the En Route Metering II, Conflict Resolution Advisory, and

Conflict Alert IFR/VFR Mode-C Intruder software functions that cannot be performed by the existing system due to capacity limitations. A portion of the growth capacity offered by the new Host will be used for these three planned automated functions.

Concurrent with the Host project are the FDIO and E-DARC projects, which provide the new additional functions to improve system processing/capacity. These two projects and the Host project complement each other by providing increased system capacity pending possible system redesign arising out of AAS. The FDIO project will make room available for additional interfaces to the 9020 and Host computers. E-DARC will ensure the availability of needed backup radar data processing functions, especially during implementation of new systems interfaces to the NAS stage A software in the Host computer.

The benefits of the Host project are threefold: (1) it will remove constraints on the control data processing capability of the system, thereby eliminating delays caused by this current weakness and reducing the probability of system degradation due to high traffic loads; (2) it will reduce maintenance costs; and (3) it will provide capacity to implement enhancements to the existing software before implementation of the AAS.

An analysis based on an FAA report to Congress in January 1982 and a March 1983 survey of 9020 system capacity indicate that at least three 9020 systems may incur serious capacity problems by 1986/7, a number of years before implementation of the first AAS. These and other studies also demonstrate that over time, the reliability, maintainability, and availability (RMA) of the current 9020 system will erode, thus becoming a major cost concern and eventually being totally prohibitive. The Host will provide sufficient capacity increase to minimize operational delays otherwise resulting without the 9020 replacement taking place.

The Host project will reduce maintenance costs because a large portion of the obsolete hardware in the ARTCCs will be replaced with more modern equipment, which will also offer more availability and reliability after an initial burn-in period. Software maintainability will increase to some degree due to the additional computer capacity available in the back-up machine. This

capacity improvement allows for the inclusion of more modern software tools (editors, debuggers, etc), and full-screen editing display terminals. The additional capacity will also reduce the amount of time spent optimizing code to achieve the required throughput rates.

Finally, this project will provide the added capacity to implement pre-AAS automation functions such as En Route Metering II, Conflict Resolution Advisory, and Conflict Alert IFR/VFR Mode-C Intruder. Early operational assessment of these functions will contribute to definition of AERA requirements for future systems.

Products

The modern Host computer project will replace the aging 9020 computers with new instruction-compatible machines and modify the existing NAS Stage A software to run on the new machines.

Testing of the new Host system will span approximately 3-1/2 years (first quarter 1984 through fourth quarter 1987) and includes various test phases. Each of the test phases contain numerous subphases to assure adequate testing is conducted before the use of the Host at each of the 20 sites. All observed test deficiencies during the DCP are being corrected and retested during the Acquisition Phase (AP) and incorporated into the AP RFP as test requirements to assure adequate testing. The driving test philosophy has been to run tests using the existing 9020 system (at the FAATC), repeat the same tests using the new Host, and then compare results. This is augmented with special tests on the modified/new software and those associated with the new computer equipment/interfaces.

Status

Currently, the Host program is in the design competition phase (DCP). Both DCP contractors are delivering systems to the FAA Technical Center for testing. The acquisition phase contract award is scheduled for June 1985.

Audit Findings

Technical

A major technical challenge of this program is the transfer of the existing NAS Stage A software to the new Host computer. The NAS Stage A software is quite complex because it is an unstructured design, and resides in a customized 20-year old computer with the memory and throughput limitations inherent in that technology. Storage and throughput capacities need to be increased to process more aircraft and also provide sufficient growth capacity to allow for additional automated functions. Other technical challenges are assuring that the needed capacity improvements are preserved during the rehosting process, and that the system is adequately tested. This testing must assure the ability of the new system to perform the same ATC automated functions the current 9020 system does with the increased traffic loads. Test analysis and modeling must assure the additional capacity needed to accept the new automated functions of En Route Metering II, Conflict Advisory, and Conflict Alert IFR/VFR Mode-C Intruder Software.

Schedule

The FAA is on schedule in determining the best contractor to conduct the acquisition phase. The DCP testing program at the FAATC is underway, and the AP RFP is being prepared.

Recommendations

1) Since the Host computer system is an essential first step in meeting the NAS Plan goals (capacity and maintainability), it is necessary to assure that the Host computer system is installed and made operational at the 20 sites on schedule. Detailed planning and coordination is necessary and should include contingency and backup/recovery plans to avoid unnecessary delays. Key aspects are: (1) starting the Acquisition Phase on schedule, (2) assuring the 20 sites are ready to accept the new Host, and (3) the site installation schedules are met.

2) Reconsider the Host software test philosophy. The current plan indicates that FAATC Host software testing will terminate at the beginning of Site 1 installation. A tradeoff analysis should be performed to determine the benefits and cost/schedule impact of expanding the FAATC test activities to include site-specific testing prior to the site-specific software delivery concurrent with the site-specific hardware installation (Fig. 5.1.1-2). This will allow for additional testing at the FAATC without impacting the site installation schedule and would minimize the number of problems encountered in the field.

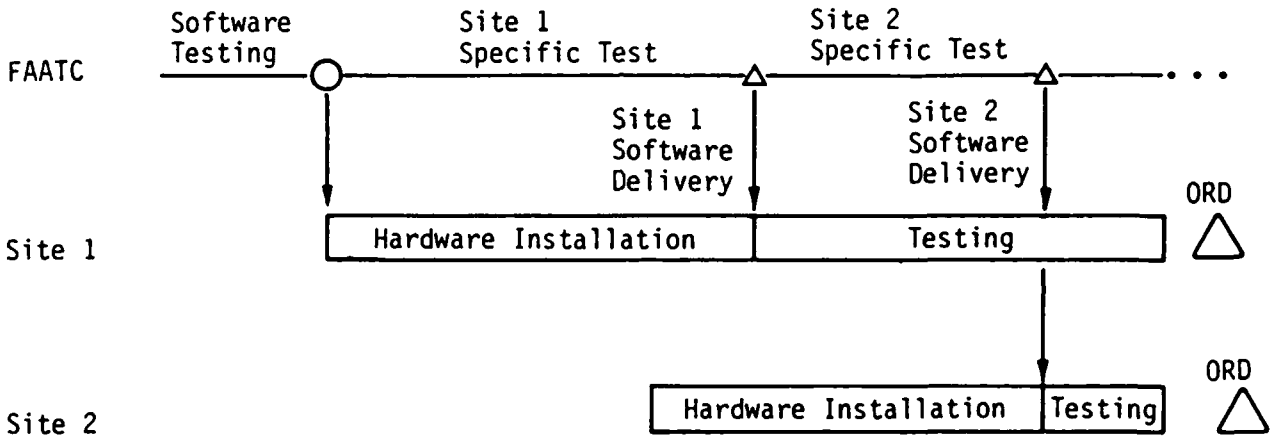

Figure 5.1.1-2 FAATC Test Activities

3) Particular emphasis should be placed on the system capacity margins actually being gained vs the predicted capacity margins. Budgets should be assigned to measurement parameters associated with system storage, throughput, and timing. The current performance monitor software should continue to be analyzed to assure its integrity and viability to provide system capacity measures. If deficiencies are found, studies should be performed to determine the cost effectiveness of implementing additional software monitor routines to assure the measurement data integrity. As a minimum, monthly technical reviews of the system capacity margins should be planned. The FAA's Modeling and Simulation Program Element (MSPE) addresses the Host computer in these capacity areas. We recommend that the MSPE activity be expanded to include all components of the Host system. This extension should identify system margin and response times actually delivered and should predict system margin and response times with various enhancements added.

4) Capacity requirements for En Route Metering II, Conflict Resolution Advisory, and Conflict Alert IFR/VFR Mode-C Intruder software should be baselined and tracked in relation to the Host software development effort.

5) Project schedule for the Host and Host compatibilities among the Host, FDIO, and E-DARC should be tracked quarterly to define any changes and to determine appropriate corrective action.

5.1.1.8 En Route Metering II (ERM-II)

Role in NAS

Flow control of aircraft is performed on a national level at the Central Flow Control facility and on a center-to-center level by either the sector controllers or local flow controller. Center personnel will be aided by ERM-II. National flow control relies on information from the local flow controllers to perform its functions.

This improved function will increase the efficiency of the NAS by reducing fuel consuming delays through a better planning tool and by providing data allowing the controllers to handle delays in the most efficient manner (e.g. high altitude holding, etc).

Implementation of this program is dependent on the modern ATC Host computer project to supply the needed computer capacity.

Products

This project will provide modification to the NAS Stage A software to provide automation aids to the controller for metering traffic to terminal areas at rates consistent with the airport acceptance rate. Outputs from this function will include metering and advisory lists. These will help the controllers in centers adjacent to the destination center absorb delays in an efficient manner.

Status

ERM-II is currently being created by modification to the NAS Stage A3d2.12 computer program by Computer Science Corporation (CSC). Design evaluation is scheduled for December 1984. The ERM-II modifications will be integrated with the Conflict Resolution Advisory, Conflict Alert IFR/VFR Mode-C Intruder, and Conflict Alert Enhancements modifications in January of 1986 for eventual implementation in version A3d2.16 in November 1986.

Audit Findings

Technical - No technical concerns about ERM-II have been identified. It should be noted that the Host project must supply the necessary processing capacity. Operationally, ERM-II may not be implemented as currently designed. While waiting for ERM-II, the Air Traffic Service has modified the existing ERM-I package. As a result, ERM-II functions seem to overlap some functions already implemented by the ERM-Ia modifications. The requirements for this program need to be reviewed to ensure that all the functions currently performed by ERM-Ia will be performed by ERM II. In other words, will ERM-II provide a functional enhancement to the system? If not, ERM-II must be modified to meet the real requirement.

Schedule - The schedule for this program has considerable slack because it depends on the Host program. Any slip in the Host project will impact the implementation date of this project.

Recommendations

The requirements of ERM-II should be reviewed in the context of functional capabilities of ERM-Ia.

5.1.1.9 Conflict Resolution Advisory Function

Role in NAS

This software function is a precursor to advanced automation functions that will be added by the AAS and AERA projects. Implementing this program in the post-Host timeframe will allow early operational evaluation of a more advanced ATC automation function, providing feedback to the designers of AERA. This function will help reduce the number of operational errors by decreasing the amount of time the controller must spend analyzing a Conflict Alert situation to determine the optimum resolution. Like ERM-II, this project is dependent on the Host project to supply the necessary computer capacity.

Products

This project will provide modifications to the NAS Stage A software to provide the controller with a display of alternative actions for the resolution of an impending conflict. The resolutions provided are initiated by the Conflict Alert parameters and are selected so as to not cause additional conflicts.

Status

Conflict resolution advisory (CRA) is currently being coded by CSC. The preliminary design is being evaluated by MITRE. Operational evaluation by the ATS of IFR/IFR conflict resolution will start in November. This function will be integrated with Conflict Alert IFR/VFR Mode-C Intruder and ERM-II into version A3d2.16 for final operational evaluation in September 1986.

Audit Findings

Technical

There is a technical/operational risk when the CRA function is combined with the Conflict Alert IFR/VFR Mode-C Intruder function, which expands the Conflict Alert function to provide alerts when an uncontrolled (VFR) aircraft is going to conflict with a controlled aircraft. This risk concerns the technical challenge of providing resolution advisories in conflict situations where the future planned actions of the uncontrolled (VFR) aircraft are not known. This scenario will not be operationally evaluated until September 1986.

Schedule

The schedule currently calls for operational evaluation in December 1984 of the CRA function for conflict between two controlled aircraft.

Recommendations

FAA should formulate policy for the use of CRA in IFR/VFR conflicts before the CRA operational evaluation. Existing CRA requirements should then be reviewed for compatibility to facilitate operational evaluation.

5.1.1.10 Conflict Alert IFR/VFR Mode-C Intruder

Role in NAS

This function will be integrated with the CRA and ERM-II functions for implementation in NAS Stage A3d2.16 in September 1986. Implementation is dependent on the Host program to provide the necessary computer capacity. This function will increase safety by reducing the risk of collision between uncontrolled and controlled aircraft.

Products

This project will provide modifications to the NAS Stage A software that will enhance the existing Conflict Alert (CA) function. Currently CA provides alert information to the controller on the radar display when two controlled IFR aircraft (Mode-C equipped) are going to violate separation minimal in 2 minutes if their paths do not change. Conflict Alert IFR/VFR Mode-C Intruder will provide alerts when an uncontrolled Mode-C equipped target (VFR) and a controlled track are going to conflict.

Status

The software has been developed by CSC and the design is being evaluated by MITRE. It will be integrated with the other functions in January 1986 with implementation in September 1986.

Audit Findings

This is a viable program that will increase system safety. No technical, operational, schedule, or cost issues were found. An operational issue exists for integration of CRA and this function (see section 5.1.1.9), and the development of appropriate algorithms to preclude false alarms triggered by relatively small altitude deviations.

Recommendations

Close attention must be given to the algorithm/parameter aspect to assure an operationally acceptable level of false alarms.

5.1.1.11 Voice Switching and Control System (VSCS)

Role in NAS

The VSCS provides the man-machine interface and the switching control system for voice communications in the AAS/ACF environment. The VSCS provides an integrated system for the operation and management of voice communications resources for ATC. Connectivity and control are provided for ground-ground intercom and interphone as well as air-ground radio control and advisory communications. The VSCS is the prime system that supports the stringent availability requirements of operational communications services. It provides the means for dynamic reconfiguration of voice communications resources and is a critical item for achieving increased controller productivity along with reduction of leased services cost.

There are two VSCS program drivers. First, an urgent operational need to replace the current ARTCC voice communications switch. The Western Electric 300 system is well beyond its economic useful life and vendor support may not be available until the VSCS is operational unless extraordinary FAA action is taken. Second, is a technical dependency on VSCS to support the AAS/ACF communications requirements and Sector Suite program.

Products

There are 26 VSCS systems to be procured. Prototype/first article items are for operational evaluation to be followed by integration testing with the Initial Sector Suite at the FAA Technical Center in 1988. Field installation of production systems is scheduled to begin in 1989 and be completed in 1992.

Status

The program office is currently preparing documentation to support TSARC-3 in August.

Audit Findings

Technical

The VSCS program is an essential element of the NAS Plan that can meet the functional requirements of the ACF/Sector Suite. The procurement approach selected for VSCS uses a dual design and development competition with down selection to a single contractor after testing is completed at the FAATC. However, we feel that by down selecting earlier (after CDR) provides several advantages not available otherwise; i.e., reduced development and long-lead time procurement costs, additional opportunity for coordination of final design refinements, and reduced testing and design coordination requirements for the interfacing system. The technical risk of this program is a function of the stability of user and functional requirements. There is no system requirement dependent on new technologies. There is some risk associated with relying on the WECO 300 system for ARTCC until the VSCS is operational.

Schedule

The procurement strategy adopted by the FAA (as referenced in KDM-3) represents an acceptable level of schedule risk through operational test and evaluation at FAATC. However, further refinement of field installation and commissioning of the VSCS systems in the ARTCC environment is required.

Recommendations

1) The VSCS Operational Requirements Team effort should be combined with the Sector Suite Requirements Validation Team and the Transition Requirements Validation Team so that a common assessment is made of both the Sector Suite console and VSCS panel.

2) Select a procurement strategy and contractual vehicle supported by a Prime Item System Development (B-1) specification of requirements.

3) Modify the VSCS procurement strategy to a dual competition phase through CDR, and select a single contractor for production phase.

5.1.1.12 Advanced Automation System (AAS)

The AAS provides the primary upgrade to ATC automation capability in the NAS Plan. It provides the foundation for AERA and is the key system through which the benefits for NEXRAD, Mode-S, and CWP are realized. The AAS contributes to NAS operational, cost, and expandability goals. Operationally, the AAS will improve ATC efficiency, improve safety, and provide for increased use of the NAS (improve capacity). The AAS will contribute to decreasing NAS maintenance costs by providing highly reliable hardware and software and reducing the maintenance staff needed. The AAS will provide the computer capacity needed to support facility consolidation, a major cost benefit in the NAS Plan. Finally, the AAS is structured to be expandable to meet future growth requirements. This expandability is targeted both to software (AERA) and hardware (a system that can be "block" upgraded).

Products

The AAS project will produce two system designs and two prototype Sector Suite consoles in its design competition phase (DCP). These products from competing contractors will be evaluated against system requirements to select a design for implementation in the acquisition phase (AP).

AP products include Initial Sector Suite Systems (ISSS) for near-term operational productivity improvement of en route ATC, Area Control Computer Complexes (ACCC) to support long-term goals of terminal approach/departure productivity enhancement and ATC operations consolidations, Tower Control Computer Complexes (TCCC) to improve tower ATC operational productivity, and two support systems (SSCC, RDCC) at FAATC to provide national system support/configuration management and R&D capabilities. Hardware deliveries associated with these products include 1796 specialized Sector Suites, 300

tower position consoles, an LCN to support the entire ACF, computer processors and peripheral equipment. Software delivered will include ISSS interface software (to current NAS software running on Host) and new NAS software with AAS (ACCC).

Status

The AAS project is a Designated Major System Acquisition (DMSA), which is well managed, carefully conceived, and on schedule. The DCP is on schedule for an August 1984 award date. The AP award is scheduled for September 1987 with ISSS completion in October 1991, and AAS (ACCC, RDCC, SSCC) completion in March 1993. Tower upgrades (TCCC) will continue into the 1998 time period.

Audit Findings

Technical

The procurement approach is well structured to meet both near-term and far-term NAS Plan goals. The FAA is currently implementing the techniques/tools required to manage the dual DCP contracts. Since AAS involves complex interfaces (both technical and programmatic), the FAA has established several working groups to facilitate the required close coordination between AAS and other activities/projects through the DCP. The AAS working group has recently established to resolve NAS design issues related to Host/AAS. We recommend that the character of this group be expanded to provide a single focal point for interfaces to all major interfacing projects (VSCS, ACF, etc), as well as the NAS design efforts through the DCP. The SSRVT and the Transition Requirements Validation Team (TRVT) have also been established to work the critical sector suite and transition areas. We concur with the charters of these groups with a single recommendation being to integrate the SSRVT and VSCS ORT efforts so that a common operational assessment is made of both the Sector Suite console and VSCS panel.

Recent questions have been raised about the impact on the AAS project should TRACONs not be consolidated into the ACF. The AAS specification does not currently reflect mixed (consolidated and nonconsolidated) environment requirements for the ACCC since this is currently not an operations

requirement. The DCP competitors are required to study and report on how their respective ACCC architectures could be adapted to such an environment in the pre-ACF time period. We recommend that these efforts be supplemented by contingency planning performed as part of the ACF project.

Other concerns have been raised that the current AAS effort may impact the capability or flexibility of the design to sufficiently or cost-effectively achieve the levels of services and automation desired with AERA. Our study of the AAS DCP SOW identified adequate trade studies that the contractors will produce to prove the expandability and flexibility of their designs.

Schedule

Our overall assessment of the AAS DCP and AP schedules are that the span times and major milestones appear to be reasonable and achievable. There are, however, several areas of potential risk as discussed below.

The 6-month span from DCP contract award to the SRR may be optimistic based on the major revision of the system specification to be released at contract award. We base this conclusion on the fact that the 6-month span did not assume this specification update and the amount of time required to clarify questions concerning requirements interpretation raised by both contractors. This workload is in addition to development, submittal, and government review/comment to approximately 40 CDRL items within that period. Our estimate is that this workload may incur a 2 to 3 month schedule risk for completion of the SRR. To mitigate this risk, we recommend that the selected DCP contractors be provided a detailed written change summary with RFP change 8, which includes detailed rationale/interpretation of change/new requirements. This should help to decrease the request for action (RFA) workload.

A second area is the ISSS evaluation of FAATC span time adequacy to support dual DCP VSCS interface evaluations instead of the single AP system previously baselined. The current VSCS procurement strategy calls for dual VSCS competition through first unit evaluation at FAATC. The impact of this change should be assessed against current AAS baseline planning.

Recommendations

1) Continue the AAS working group activities beyond the NAS Level I Design baselining. Expand the charter to be the single focal point for AAS external interfaces to other projects as well as NAS design activities (Levels II, III, IV, and standards). This should also include participation of AAS working group members on other parallel working groups such as weather, TMS, etc.

2) Establish a single operational team that supports both the Sector Suite and the VSCS panel design/development activities. This team should consist of some mix of the current SSRVT and VSCS ORT. The team's involvement in both procurements should include, as a minimum, the establishment of specific man-machine interface requirements/guidelines, monitoring of contractor design documentation, attendance at appropriate technical reviews, and involvement in tests/evaluations at mockups and prototype equipment.

3) Provide a change summary package (with change 8) to the DCP contractors that provides more detail on change rationale and interpretation of new/changed requirements. This document should decrease RFA traffic and help reduce the schedule risk associated with completion of SRR.

4) The new VSCS schedule should be analyzed for compatibility to the AAS schedule. In particular, potential impact to the "ISSS evaluation at FAATC" span time should be assessed in view of dual VSCS evaluations.

5) Contingency planning should be performed as a part of the ACF project to supplement the effort by the AAS DCP competitors in looking at the impact of the possible eventuality of TRACONs not being consolidated into the ACF.

5.1.1.13 Automated En Route Air Traffic Control (AERA)

Role in NAS

AERA is a series of enhancements to the functions contained in the AAS program. Initially, AERA will be a set of problem-solving and planning tools used by the controller to assist him in providing ATC services to higher traffic volumes while improving system efficiency and safety. AERA will evolve into an automated conflict resolution and decision-making system capable of reducing the controllers workload. When AERA is fully implemented it will: (1) improve the quality of services to the user by permitting most aircraft to fly fuel efficient routes, (2) increase controllers productivity by increasing the number of aircraft handled and the volume of airspace assigned to each sector, and (3) improve system safety by reducing the potential for operational errors.

Products

Three software packages referred to as AERA 1, AERA 2, and AERA 3 will emanate from this project. AERA 1 will be implemented as part of the AAS program. AERA 2 and 3 represent higher levels of automation and are scheduled to be fielded in the mid-1990s.

Audit Findings

Technical

MITRE is currently under contract to develop the algorithmic specifications for a portion of AERA 1, install an operational test bed to evaluate AERA 1, and will later publish an AERA 1 CPFS in April of 1986. Planning for the procurement, integration, and implementation of AERA 2/3 has not been completed, and little progress has been achieved in establishing the planning necessary to deploy the AERA 2/3 automation concepts in an AAS-compatible environment. Late deployment of AERA-2/3 concepts will severely erode forecasted benefits.

Schedule

Software for operational test bed is currently 10 months behind schedule.

Recommendations

1) AT has recently issued an order for AERA 1 requirements. The FAA is now preparing an AERA 1 specification update to reflect the order. After the update has been coordinated and accepted by the AAS CCB, the AAS contract will be modified. Consequently, all MITRE effort associated with the development and testing of AERA 1 can be terminated.

2) Effort should be initiated immediately to develop a strawman A specification of the AERA 2 functions.

3) A senior management team representing all applicable organizations should be formed with the charter to establish and document the development, procurement, and implementation strategy of AERA-2/3 and TMS Phase III (i.e., produce a program plan).

4) The selected acquisition phase AAS contractor should be required to accommodate an interface with AERA 2/3 functions to help simplify the eventual integration of AERA 2/3 into AAS.

5) Serious consideration should be given to combining TMS Phase III and AERA-2/3 into a standalone project. This single project would then develop a single update to the AAS software.

5.1.1.14 Integration of Nonradar Approach Control into Radar Facilities

Role in NAS

This project provides for reassignment of the responsibility for approach control from nonradar facilities to facilities having radar approach control capability. It is expected to provide economy through eliminating control positions, since a radar controller can handle more aircraft in a given volume of air space than can a nonradar controller. Further, reduced radar separation criteria can be applied, resulting in fewer delays and greater capacity without sacrificing safety.

Products

The project originally encompassed all nonradar facilities; however, the 1981 PATCO strike resulted in considerable restructuring of control responsibilities, and many radar facilities were pushed to maximum capacity. Seven nonradar facilities have been integrated into radar facilities to date, and 28 more are planned over the next 30 months. Approximately $1.6M has been authorized in FY 84 funds for the project. Facility integrations will be accomplished according to schedules and plans developed by the Regions.

Audit Findings

Technical - There are no technical considerations involved in this project, as it provides only for a reassignment of operational responsibility. No operational risks were identified. Some console reconfigurations are involved, but these are not major in nature.

Schedule - Schedule performance is not critical, since the integrations are accomplished by the Regions and no other NAS projects are affected.

Recommendations

None.

5.1.1.15 Area Control Facilities (ACF)

Role in NAS

This project consolidates 188 TRACONs into 23 ACFs located at the 20 CONUS ARTCCs, the Anchorage and Honolulu ARTCCs, and the New York TRACON. The ACFs will perform an integrated en route and terminal ATC function.

Successful implementation of the ACF project will result in improved ATC service to users, increase AT and AF personnel productivity, accommodate future growth through facility consolidation, and minimize the costs of providing identical advanced automation features to en route and terminal controllers at a large number of facilities.

Products

An ACF is functionally divided into an operations center and a computer center. The ACF operations center will directly support the operational services and associated management functions performed in the ACF. The basic equipment in the operations center will include AAS Sector Suites, which will provide ATC workstations with associated data entry and display devices, and voice switching and control system (VSCS) equipment for operational voice communications. In addition to the Sector Suite workstations provided for the operational control positions, the ACF operations center will also contain a traffic management unit (TMU), which will serve as a workstation for traffic management specialists and provide local traffic management coordination with the ATCCC, and a center weather service unit, which will enable a meteorologist to interface with the Central Weather Processor (CWP) in the computer center. The computer center will provide major processing capabilities required for the ACF operations center, the TCF, and the AFSS facilities.

Status

The ACF program consists of two phases: Phase I (pre-ACF activities) and Phase II (ACF establishment activities). Planning and program tracking are of paramount importance to Phase I, which includes such items as ARTCC building expansion, installation of the ISSS in a sterile environment, and en route controller training on new systems. Phase I began in early 1984 and will continue for approximately 7 years. Phase II begins with relocation and operational commissioning of the first approach control functions to be consolidated and will be complete when the last approach control functions are consolidated and operational in the final ACF.

Related projects/activities include ARTCC building expansion/modernization, AAS, radar remoting and digitizing, VSCS, communications networking and remoting, NAVAIDS networking, software development, military liaison, and weather programs.

The SEI A&E subcontractor is providing the design packages for 12 of the standard sites, supporting the contractor activity for all 18 standard sites, and will revisit all 20 CONUS sites for compatibility assessment with the winning Host contractor design. No Host computer system is planned for the New York TRACON, Honolulu, or Anchorage, based on a decision that capability at these sites is adequate at this time and can await the results of the AAS design competition. The ACF program is an umbrella program that is very complex and includes the successful integration of many independent projects. No major acquisitions are to be accomplished within the project itself; all such acquisitions will be made via the individual AAPO and APM programs. An integrated master ACF implementation schedule and its credibility are determined by the schedules of the independent programs.

Audit Findings

Technical

Successful implementation of the ACF project will result in improved ATC service to users, increase AT and AF personnel productivity, accommodate future growth through facility consolidation, and minimize the costs of providing identical advanced automation features to en route and terminal controllers at a large number of facilities.

Schedule

No significant problems were identified through the rehosting phase; however, this project schedule is reflective of the supporting projects.

Recommendations

1) An ACF program team, including a permanent ACF program manager, should be put in place as rapidly as possible.

2) An improved interface between the ACF implementation plan and the NAS design and implementation cycle must be established.

3) A more comprehensive ACF development and implementation master schedule and supporting project schedules suitable for use by the ACF program manager as baselines for managing and achieving the objectives of the ACF implementation program must be established.

4) An independent detailed audit of the ACF project implementation plan should be undertaken along the lines of the NAS Level I design audit, including a reassessment of the Honolulu and Anchorage ARTCCs and the New York TRACON to determine their operational capacities through full ACF implementation.

5.1.2 Terminal Systems

There are 17 projects in the terminal systems portion of the NAS Plan. The majority are interim solutions or system improvements needed to meet the objectives stated above during the years before ACF/AAS implementation.

The objectives of the terminal systems improvement plan are to maintain a very high level of safety, impose minimum constraints consistent with efficient use of the system, and at the same time, minimize FAA operations cost.

The projects provide software modifications, display system improvements, expanded memory and processing capability, total system replacements, voice communications switching, and improvements to facilities. Features added by the projects are:

1) More useful and reliable information presented to controllers,

2) Improved software development and maintenance capability,

3) Better simulation training through additional displays,

4) Capability of controller's tools to perform under an ever-increasing air traffic workload,

5) Efficiency improvements such as automation, consolidations, and hardware replacement (solid state vs tube),

6) Better communications.

The projects are summarized in Figure 5.1.2-1 as to type of effort, areas where benefits are expected, and current assessment of cost and schedule. Table 5.1.2-1 presents additional information on funding, the next critical decision point, and the SEI role.

	Type of Effort (S/W-H/W)					Improvements							Program
	Software	Modification	Expansion	Replacement	New Capability	Safety	System Efficiency	Maintenance	Training	Capacity	Reliability	Cost	Schedule
ARTS-III/IIIA													
2.01 Improved Conflict Alert	o					o	o			o	o	(-)	o
2.02 New Assembler/CPU	o	o	o	o			o	o		o	o	o	o
2.03 ETG			o				o		o			o	o
2.04 Added Memory (32k)			o							o		o	o
2.05 FAATC Support System			o			o	o	o		o		o	o
ARTS-II/IIA													
2.06 IIA Enhancements	o	o	o			o	o		o	o	o	(+)	?
2.07 II Displays				o		o	o	o		o	o	o	o
2.08 II Interfacility I/F							o			o		o	?
2.09 II I/F with Mode-S/ASR-9	o		o		o	o	o			o		o	R

o Yes or OK
(-) Underfunded
R Behind Schedule
? Possible Problem

Figure 5.1.2-1 Terminal System Projects

	Type of Effort (S/W-H/W)					Improvements						Program
	Software	Modification	Expansion	Replacement	New Capability	Safety	System Efficiency	Maintenance	Training	Capacity	Reliability	Cost	Schedule
Communications													
2.10 ATIS Recorders				o	o		o	o			o	(-)	o
2.11 Multichannel Voice Rcdrs			o	o			o			o	o	(-)	?
2.12 Tower Comm System				o	o	o	o	o		o	o	o	
Facility Consolidations													
2.13 ATCT/TRACON Improvements		o	o	o	o	o	o				o	(+)	?
2.14 VFR ATCT Closures							o	o				o	o
2.15 Combine RAPCON/ARTCC		o		o		o	o	o			o	o	?
Other													
2.16 BRITE				o	o		o	o		o	o	(-)	R
2.17 TPX-42 Replacement				o	o	o	o	o	o	o	o	(-)	o

o Yes or UK
(-) Underfunded
(+) Over Funded
R Behind Schedule
? Possible Problem

Figure 5.1.2-1 Terminal System Projects (concl)

Table 5.1.2-1 Terminal Systems

Project	Category	Next CDP	1st ORD	SEI Role
Provide Enh Term. Conf Alert		Start FAATC Impl 5-84	8-85	
ARTS-IIIA Assembler		Contract Award 9-84	3-85	
ETG Displays ARTS-IIIA		Spec (FDAD) Compl 6-84	4-86	Monitor (1-86)
ARTS III-A Memory		1st Delivery 7-85	9-85	
Additional ARTS-IIIA at FAATC		Delivery 8-85	10-85	Monitor (1-86)
ARTS-IIA Enhancements		MSAW CA Accept. Demo 8-84	2-85	
ARTS-II Displays		Project Complete		
ARTS-II Interfacility Int		Project Complete		
ARTS-II Int Mode-S/ASR-9		Contract Award 9-84	N/A	Monitor
Replace ATIS Recorders			1986	
Replace Multichannel Rec		Contract Award 9-84	N/A	Support (8-84)
Tower Comm Switching Sys		Proc Request 12-88	11-93	
ATCT/TRACON		ATC Tower Stds 7-84	N/A	
VFR ATCT Closures				
Comb TRACONs into ARTCC				
Replace BRITE Displays		Contract Award (DOD) S 9-84, P 1-85	5-86	Monitor
Replace TPX-42		Contract Award 10-84	1-86	Monitor (1986)

All of these projects are important elements of the NAS modernization objective. Some are technically independent while others are related to or are dependent on other projects, as follows:

1) ARTS-II interface with Mode-S and ASR-9 is dependent on ICDs from the Mode-S data link and ASR-9, and achieving operational status (project completion) is tied to the implementation schedule of the Mode-S/Data link and ASR-9 projects.

2) The tower communications system requirements are closely related to the VSCS project and need to be very accurately defined to ensure proper interfacing with the latter system.

Our audit results confirmed a need for, and a corresponding improvement associated with each of the projects, with one possible exception--the project to combine Terminal Radar Control and ARTCC facilities. A cost benefit trade study (combining vs retaining and improving) is currently under way to clarify this issue.

The audit indicated that the terminal projects are required and approaches are feasible. Most of the projects are in good shape relative to cost and schedule. One overall concern, however, is whether or not the terminal automation systems in the Level V facilities can sustain the current level of performance until they are replaced by the ACF/AAS in the mid to late 1990s.

The safety assessment matrix for terminal systems is shown in Figure 3.5-1.

The terminal system projects (ATCT/TRACON establishment, replacement, and modernization, and the transfer of some radar approach control functions into ARTCCs) pose difficult transition problems.

5.1.2.1 ARTS-III Enhanced Terminal Conflict Alert

Role in NAS

The benefits achieved by modification are improved information for the controller and improved system (processor and memory) efficiency. By reducing the number of nuisance alerts, the controller will have increased confidence in the performance of this function in areas currently desensitized by employing the inhibit functions.

Products

The output of this project is a software modification to be installed at 63 ARTS-IIIA locations and later at the ARTS-IIA locations, either through program modification or a new program build that will reduce nuisance alerts, eliminate dependence on inhibit functions, and control registration in dual sensor systems. Test and evaluation (T&E) is scheduled for completion in May 1985 with site implementation scheduled for June 1985 to June 1986.

Status

The study and design reports have been completed, AAT has been briefed, and a decision has been made to proceed with software development. APM is preparing a letter to formalize their agreement with AAT.

The project will be implemented in phases, currently consisting of (1) changing the A1.01 program in patch form, (2) changing the A3.01 in patch form, and (3) Conflict Alert will be added to the A3.02 program in patch form.

Installation at the first site is scheduled for June 1985 and the last site is currently scheduled for June 1986.

Audit Findings

Technical - No problems identified.

Schedule - Rescheduling is required.

This project is being funded as a part of the overall ARTS-III enhancement contract. The total funding required for the study and development of the Conflict Alert program packages is not available. A purchase requisition has been prepared for $283k to fund the remaining FY 84 effort. Funding required for FY 85 is estimated at $305k and a request for budget approval is currently under way. Since implementation (deployment in field) is the responsibility of the Air Traffic Service, their efforts are not included in the project totals.

Recommendations

Detailed planning between APM and the Air Traffic Service needs to be completed at the earliest practical time with reference to the installation/deployment portion of this project.

5.1.2.2 ARTS-III Assembler

Role in NAS

The present ARTS-IIIA assembler system (software and hardware) is inefficient and difficult to use. This project will improve software maintenance by making the ARTS-IIIA assembler more interactive and will expedite support by establishing restart points in the assembly process.

Products

The program described in the NAS F&E Plan was to have provided software packages to be installed at qualifying facilities.

Status

Delivery to the field was scheduled for completion in early 1984. Software programs for ARTS-IIIA are currently built and assembled on the IOP and output to the 9300 peripheral system, which has become complex and time consuming. The project has been modified and now includes a dedicated computer system at the FAATC. The new computer and the assembler software will provide an efficient software development and maintenance facility capable of supporting the ARTS-IIIA facilities at the operational sites. Contract award for the modified project is now scheduled for September 1984, with system operational capability slated for March 1985.

Audit Findings

Technical - No problems identified.

Schedule - No problems are identified with the modified schedule.

Recommendations

None.

5.1.2.3 Enhanced Target Generator (ETG) Display (ARTS-III)

Role in NAS

Some ARTS-III facilities do not have dedicated display systems onsite for controller simulation training. Experience has shown that at least two physical displays are required for the labs at each ARTS-III facility (one for the trainee and one for pilot simulation). This project will provide the additional displays required to support the onsite training function. Implementation of the dual displays will enhance training capabilities. The enhanced training will be achieved through a more realistic simulation of the ATC environment in the training scenario.

Products

The products of this project are fifty additional displays to support onsite training.

Status

Installation of full digital ARTS-III displays (FDAD) is planned to be provided through a competitive procurement. Contract award is scheduled for June 1985 with project completion in November 1986. FDADs are currently baselined for this implementation; however, digital-bright radar indicator terminal equipment (D-BRITE) displays are under consideration as a substitute. A decision between the two systems has not been made.

Preparation of the specification for FDAD is in progress.

Audit Findings

Technical - No problems identified.

Schedule - The specification release date may be delayed if a decision is made to use D-BRITE displays in lieu of the full digital ARTS III displays.

Recommendations

1) Since this is a new competition, the procurement process should be monitored for cost and schedule performance, particularly if the decision is made to use D-BRITE displays.

2) The decision to proceed with either the FDAD or D-BRITE systems must be made soon to preclude schedule slippage.

3) Integration of the two programs (2-03 and 2-16) should be considered if the decision is in favor of D-BRITE.

5.1.2.4 Additional ARTS-IIIA Memory

Role in NAS

Operational programs for the present ARTS-IIIA system are approaching capacity limitations. If the system is to remain abreast of the traffic growth and demand until the systems are replaced by the Advanced Automation System, additional memory must be provided.

Products

Additional memory hardware (32k) will be procured for each of the 63 ARTS-IIIA locations plus depot spares.

Status

The contract was awarded in March 1984. First delivery is scheduled to start in July 1985 and to be completed by April 1986.

Audit Findings

Technical - The audit raised a question about the terminal system's capability to function efficiently throughout the time period before ACF, especially at the Level V facilities. Enhancements more significant than added memory may be required to provide the needed controller support tools.

Schedule - No problems identified.

Recommendations

An analysis concerning terminal automation system upgrades should be undertaken.

5.1.2.5 Additional ARTS-IIIA Support System at the FAA Technical Center

Role in NAS

The current Terminal System Support Facility (TSSF) at the FAATC consists of a single ARTS-IIIA system. This system is used to support the NY TRACON, EARTS, and ARTS-IIIA field systems, and is also used to support development program activities. Scheduling conflicts between these activities can be alleviated by providing an additional ARTS-IIIA support system at FAATC. The increasing demands by the NY TRACON for support can be met and still provide the desired support to the other users with this additional system.

Products

This project provides a standalone ARTS-IIIA for the TSSF.

Status

The contract was awarded in March 1984 and the schedule for completion in August 1985 appears to be achievable.

Audit Findings

Technical - No problems identified.

Schedule - No problems identified.

Recommendations

None.

5.1.2.6 ARTS-IIA Enhancements

Role in NAS

The enhancements included in this project will add Beacon Tracking, Minimum Safe Altitude Warning (MSAW), Conflict Alert (CA), and Training Target Generator (TTG) to the ARTS-II systems. MSAW and CA are required to alert controllers to potentially hazardous situations when less than standard separation exists. The target generator will provide the capability to train controllers in selected and varied control situations in a simulated environment. These added features will provide the controllers with additional functions to enhance ATC system safety and efficiency.

Products

Equipment, software, and services will be procured to implement these enhancements. Software will be developed with proven techniques and methods used in the ARTS-II and IIIA systems. The enhancements will be implemented at 89 operational locations plus 6 support systems.

Status

Contract award was in October 1981 and the hardware has been developed. Beacon Tracking has been demonstrated and MSAW is scheduled for demonstration in August 1984. Site implementation will occur between October 1985 and October 1987.

Audit Findings

Technical - The ARTS-II enhancements now include a new processor with additional software. The capacity of this processor may not be adequate to perform these enhancements at all planned sites, and additional processors may be required. The answer to this question will depend on software and hardware development testing. The new processor is currently experiencing certain timing problems and, depending on the final resolution, additional funding may be required with resultant schedule impact.

Schedule - The above problem and required solution is still indeterminate.

Recommendations

The testing program should be closely monitored so that potential processor capacity and cost/schedule impacts are immediately identified and corrective action initiated.

5.1.2.7 ARTS-II Displays

Role in NAS

Initially, eight ARTS II facilities were commissioned using BRITE type displays in the TRACON. This project has replaced the BRITE displays with ARTS-II radar alphanumeric display subsystems. The BRITE displays are unreliable and require extensive maintenance. The ARTS-II radar display type provide superior operational performance.

Status

Procurement and installation are complete and the systems are in operational shakedown testing. The project is essentially completed, on schedule, and within budget.

Recommendations

None.

5.1.2.8 ARTS-II Interfacility Interface

Role in NAS

Initially, 32 of the ARTS-II systems were provided with interfacility interface capability with their associated ARTCCs. Similar interface capability will be provided by this project between 51 terminal (ARTS-II) and 20 ARTCC (9020) systems. Such interfacing will provide for automated handoff and transfer of flight data capability with the ARTCC, thereby improving controller and ATC system efficiency.

Products

Modems, additional computer memory, and interfacility hardware will be provided to the terminal facilities. Modems and computer adapters will be provided to the ARTCCs.

Audit Findings

Technical - There are no technical problems. Complete implementation of the interface activity depends on AAT-developed software testing and controller training.

Schedule - FDIO implementation should be closely monitored so that any potential schedule impacts to this program can be assessed immediately.

Recommendations

None.

5.1.2.9 ARTS-II Interface with Mode-S/ASR-9

Role in NAS

The ARTS-II interface with the Mode-S/ASR-9 and Mode-S/ASR-7 and 8 sensors requires development of hardware and software. This project will allow the ARTS-IIA systems to accept and process surveillance and Mode-S digital data derived from various terminal radar systems.

Project implementation is dependent on the Mode-S/Data Link project. The new airport surveillance radar (ASR-9) is designed to provide information on aircraft targets within a 60-nmi radius. The surveillance processor also accepts the beacon video from the ATCRBS and converts it to a digital message for transmission to the surveillance and communications interface processor (SCIP), which provides the interface to the ARTS-IIA system. The ICD to accomplish interface of the Mode-S with the ASR-9 is identified as being under the responsibility of the Mode-S program office. Implementing this interface will allow the ARTS-II to accept, process, and display ASR-9 and Mode-S data.

The airport surveillance radars (ASR-7/8) are also designed to provide information on aircraft targets within a 60-nmi radius. Hardware and software modifications are to be developed that will interface the Mode-S with the ARTS-II. This interface has been generically termed as "common digitizer format". The Mode-S program master plan charges preparation of the ICD to the Mode-S contractor. Implementing these interfaces will allow the ARTS-II to accept, process, and display ASR-7/8 and Mode-S data and from Mode-S and ATCRBS-equipped aircraft.

Products

The project will provide one interface modification package for each ARTS-IIA site.

Status

Contract award is scheduled for August 1984 with delivery of one interface modification package for each ARTS-IIA site (85 kits) by October 1986.

Audit Findings

Technical - In the opinion of the audit team, the three-system interface of ASR/ARTS-II/Mode-S is complex, and detailed ICDs are required for each separate interface. The Mode-S program master plan states that the ICD for the ASR-9 interface is the responsibility of the Mode-S program office and the responsibility for all other ICDs are the responsibility of the Mode-S contractor.

Software development and field implementation must ensure that the system performs satisfactorily when it is fielded.

Schedule - The principle schedule dependency for project completion is the Mode-S schedule. Secondary dependencies are the ASR-9 and ASR-7/8 schedules.

Recommendations

1) The FAA-SEI team needs to track the technical adequacy and completeness of each Mode-S/ASR-7/8/9 ICD. This should commence with tracking Mode-S/ASR-9 interface details forthcoming from APM.

2) Software development should be tracked as an area of concern from an initial development, field implementation, and system integration viewpoint.

3) The FAA-SEI team needs to track the Mode-S schedule as a key dependency and also to track ASR-9, ASR-7/8, and ARTS-II schedules.

4) A detailed review of the cost aspect is required.

5) The methodology recommended for accomplishment of these recommendations is the formation of an ICD working group. This project should be scrutinized as part of a general effort to look at "control of NAS project interfaces." An ICD working group could provide a major portion of this scrutiny as well as establishing a vehicle for disciplined configuration control for each interface.

5.1.2.10 Automatic Terminal Information Service (ATIS) Recorders

Role in NAS

At all major airports, air traffic controllers manually record local weather and airport conditions on ATIS recorders. This information is continuously broadcast to pilots in or near the terminal area on a NAVAID or discrete radio frequency.

Products

This project will replace 450 existing recorders, which are electromechanical and exhibit low reliability and high maintenance costs, with highly reliable solid-state models. It will also provide for equipping approximately 150 new locations.

Status

The ATIS recorders are available off-the-shelf, and will be procured and deployed over the 1985-1988 timeframe.

Audit Findings

Technical - This project appears to be operationally and technically feasible, in that it consists of upgrading an existing operational capability with improved, readily available equipment.

Schedule - The project schedule appears realistic and is expected to be met; however, plans are underway to make a combined procurement of ATIS and HIWAS recorders after HIWAS tests are concluded. This development should be monitored to ensure that it does not cause slippage of ATIS procurement, although such slippage would have little or no impact on the overall NAS.

Recommendations

The effect of a combined ATIS/HIWAS procurement should be reviewed for impact on unit costs and schedules.

5.1.2.11 Multichannel Voice Recorders

Role in NAS

Multichannel voice recorders record all conversations taking place on interphone and radio circuits at centers towers and flight service stations. This project replaces existing recorders with new models offering improved reliability and greater channel capacity. Because the scope of the recording function at ARTCCs (and eventually ACFs) is distinctly different from that at ATCTs and FSS, this project is discussed in two separate parts: (1) ATCT/FSS recorders, and (2) ARTCC/ACF recorders. Such recording is used primarily for legal purposes associated with aircraft accidents or system errors.

Products

The existing 5- and 9-channel electromechanical recorders at ATCTs/FSSs are being replaced with solid-state 10- and 20-channel models featuring higher reliability and lower maintenance requirements. Approximately 60 percent of existing recorders have been replaced, with more than 300 remaining to be replaced over the next 5 years. These recorders are off-the-shelf from existing product lines.

The ARTCC/ACF recorders currently have a capacity of 152 channels. Future requirements have not been firmly defined, but a draft requirement statement from AAT indicates that some ACF installations may require in excess of 400-channel capacity. The existing recorders were purchased on a one-time buy from 3M Corporation approximately 15 years ago. Their reliability has greatly degraded with age, and they are difficult to support because they are no longer manufactured and the only source for spare parts is from recorders on hand. It has not been decided whether the ARTCC/ACF need will be met with multiple recorders, modularly expandable units, or with newly designed high-capacity recording devices. The FAA plans to prepare a specification based on AAT requirements, and to conduct tests and evaluations for validation of technical and operational requirements before full production. According to the NAS Plan, the specification was to be complete in late 1983, with contract award in early 1985 and implementation continuing into 1988.

Audit Findings

ATCT/FSS - Technical - No identified problems.

Schedule - No schedule problems are anticipated for the ATCT/FSS recorders since more than half the number required have already been procured and the recorders are available from existing manufacturers' product lines. There is some inconsistency as to the number yet to be procured; the NAS Plan shows 329, the project resume shows 383, and the FAA project manager anticipates as many as 450. This inconsistency will be resolved. Further, a review of budget work sheets showed that a unit cost of $82k was used for FY 84 and $53k for FY 85, while a draft procurement request reflected an average unit cost of approximately $31k. This situation also requires resolution.

ARTCC/ACF - Technical - Since a readily available source for ARTCC/ACF high-channel-capacity recorders has not been identified, it may be desirable to take some preliminary steps before preparing a specification. The FAA should consider asking sources from the supplier industry to participate in preparing the specification. These suppliers are in the best position to suggest ways to meet the recording requirements using current or development products.

Schedule - It is evident that the new ARTCC/ACF recorders will not be available according to currently published schedules. The specification, originally planned for 1983, is now targeted for June 1986. A period of test and evaluation will further delay the award of a production contract and the installation of new recorders.

Recommendations

1) The quantities of ATCT/FSS recorders to be procured and procurement cost estimates should be made consistent.

2) The NAS Plan should be revised to reflect a realistic schedule for ARTCC/ACF recorder procurement on a projected availability date of June 1986 for the specification.

3) The FAA should solicit advice from potential suppliers during specification preparation.

5.1.2.12 Tower Communications System (TCS)

Role in the NAS

The TCS meets a requirement for providing a voice communications switch and control system for the air traffic tower. TCS will have control capabilities and functions similar to the much larger VSCS in the area control facilities. The operational benefit to the NAS will be derived from the enhanced man-machine interface and the improved maintenance aspects of tower communications.

Products

Between 250 and 410 systems depending on the acquisition approach and replacement policy chosen.

Status

Two approaches to meeting the TCS requirement will be evaluated. One approach is based on the replacement of the control/display equipment of the Type-1 ICSS to emulate the functional and ergonomic design of the VSCS. A second approach would be based on procurement of a replacement system, using VSCS-type technology and interfaces, for the existing tower voice control systems.

The procurement approach for TCS anticipates an R&D effort in FY 85 to develop the TCS concept and prepare a production specification by FY 87. A production contract is to be awarded in FY 90 for delivery of units to correspond with implementation of the AAS Tower Control Computer Complex (TCCC) in FY 92.

Audit Findings

Technical - The technical and operational requirements for development of the TCS are in concert with the overall NAS Plan. Specific conclusions will be reached upon further development of the VSCS program. It may be cost effective to replace the ICSS that will reach a service life of over 10 years during implementation of TCS. It may be feasible to procure the TCS as a modular subsystem of VSCS.

Schedule - No problems identified.

Recommendations

The TCS technical requirement and associated schedules and cost aspects should be evaluated in the future in the context of the VSCS program development.

5.1.2.13 ATCT/TRACON Establishment, Replacement, and Modernization

Role in NAS

This project is an ongoing, continuing program that includes establishment of new, relocation, or replacement of existing facilities and modernization of existing facilities. TRACONs will not be included in this project after 1984 due to their planned consolidation into ARTCCs under the ACF program. Relocation or replacement of ATCT/TRACON facilities is required when the facility has become inadequate due to deterioration, restricted visibility, or insufficient space for planned growth. Modernization is required when facilities and equipment must be upgraded, improved, or expanded to meet current and future operational requirements. Establishment of new FAA control tower service at public use airports is desirable when traffic and safety issues dictate based on FAA standard qualification criteria.

Improved operational systems and layouts implemented by this program will reduce operational costs and improve operator functions. Energy efficient designs for modernization will reduce energy costs and consolidation will reduce manpower requirements and improve operations efficiency.

The ATCT/TRACONs interface directly or indirectly with most major systems or subsystems comprising the NAS, including weather, navigational aids, and en route and terminal air traffic control.

Status

A modernization/relocation policy and handbook is being developed to direct the regions in ATCT/TRACON modernizations/relocation. Standard designs previously developed will be upgraded to reflect the removal of TRACON. Procurement for architect/engineering services contracts for design and site adaptation of ATCT/TRACON facilities is currently underway with contract award anticipated in July 1984.

Audit Findings

Technical - The Modernization/Relocation Policy and Handbook, scheduled for completion in March 1984, is delayed awaiting input from the Air Traffic

Service (AAT). The handbook will be published as an order around September 1984. The scope of the program is dependent on projects meeting established criteria.

Several other programs currently underway may modify the ATCT program, including: (1) decommissioning of significant numbers of low activity ATCTs (39 have been closed to date), (2) defederalization or transfer of ATCT facilities to sponsors, and (3) planned consolidation of TRACON facilities into ACFs.

Schedule - The delayed procurement of ICSS is causing a small (3 month) slip in schedule but only effects the commissioning of facilities.

Recommendations

Perform a reassessment of the scope, schedule, and cost aspects of this project in the context of the modernization/relocation policy and handbook.

5.1.2.14 VFR ATCT Closures

Role in NAS and Products

This project provides for improving cost effectiveness and operational productivity of the federally operated ATC system by closing VFR ATCTs that do not meet established criteria for retention in service. Responsibility for operation of towers identified for closure would be offered to local governments as an alternative to full closure.

Based on 32 tower closures proposed for the period FY84 to FY87, it was estimated that over 200 air traffic positions would become available for use at other locations.

Audit Findings

At present, 34 VFR towers are closed as a result of the PATCO strike and other actions in recent years. Of these, 22 do not meet retention criteria; the remainder have not been reopened for other reasons such as lack of resources. Of the 32 towers referenced in the NAS Plan, only the one at Valdez, Alaska, has been closed. New retention criteria have been prepared and are being reviewed by the regions. It is considered unlikely that additional tower closures will take place due to overriding local concerns for safety of flight operations. The most recent funding for this project was $0.5M in FY 83, and no future budget requests have been projected.

It appears that this project is in a state of inactivity, and that closure of any significant number of VFR towers is unlikely in the near future. The project has no impact on other projects and has little or no funding requirement.

Recommendations

1) Consideration should be given to removing this project from the NAS Plan. Any future opportunities for tower closures could be addressed on a case-by-case basis as they meet criteria and are identified by the Regions.

2) The benefits attributed to the freeing-up of some 200 air traffic positions should be reassessed in view of the current direction of this project.

5.1.2.15 Combine Radar Approach Control into ARTCC

Role in NAS

When the Area Control Facility (ACF) and Advanced Automation Programs (AAP) are fully implemented, all terminal and en route radar control functions will be performed at 23 ACFs. In the meantime, a number of the 188 TRACON facilities are in need of substantial modernization or complete replacement. This project is directed at consolidating selected TRACONs needing to be modernized or replaced within 10 years into the nearest ARTCCs. This consolidation is expected to make more cost-effective use of resources and reduce building maintenance and operations costs.

Products

According to the NAS Plan, seven TRACONs are being considered for relocation/consolidation into four ARTCCs and one EARTS facility.

Audit Findings

Notwithstanding the NAS Plan statement regarding the relocation/consolidation of seven TRACONs, there is considerable uncertainty within the FAA as to the future direction of this project. The cost-benefit aspects of relocating the TRACONs, vis-a-vis doing whatever is necessary to maintain operations until the ACFs are established, is currently a matter of study by the Regions affected. Unless a clear advantage can be shown through the cost-benefit studies currently being conducted by the Regions, it appears highly questionable whether any TRACON/ARTCC consolidations will occur before ACF implementation.

Recommendations

This project should be carefully reviewed to determine whether future TRACON/ARTCC consolidations are likely to occur before ACF implementation. If such consolidations are not likely, it is recommended that this project be dropped from future editions of the NAS Plan.

5.1.2.16 Bright Radar Indicator Tower Equipment (BRITE)

Role in NAS

This project will replace BRITE displays (analog) that have been in the field since 1967 and no longer provide reliable service. It will also provide display systems for satellite Airport Traffic Control Towers (ATCT) that currently do not have radar information available. The original systems employ a TV presentation accomplished by taking a TV picture of a plan position indicator (PPI) and transmitting it to the display in the tower cab.

The subject replacement system, Digital-BRITE, employs a digital scan converter inherently much more stable and reliable than the PPI/TV based system. Replacement will result in an estimated 60-70 percent maintenance workload reduction. The project will provide 50 systems for satellite ATCTs and 350 systems to replace the original BRITE I, II, and IV systems.

Products

This is a joint procurement with DOD obtaining 107 units in addition to the FAA's 400. Satellite ATCT (50 systems) establishment requires the acquisition of television microwave links.

Status

The specification was scheduled for completion in April 1984, RFP in June 1984, FAATC implementation in November 1985, and operational system deliveries during the period between March 1986 to November 1988.

Audit Findings

Technical - No significant problems identified.

Schedule - The USAF specification (DOD has responsibility for the procurement) has been received and reviewed by FAA ARTS group. Comments/changes are being incorporated. RFP release was scheduled for May 1984. It appears that the release will slip to July 1984, which will result in an equal schedule slip for award.

Recommendations

1) Monitor program to define and minimize impact of schedule slippage.

2) The implementation (site activation) sequence should be re-examined to provide for first deliveries to those sites not having radar display capability today, to improve ATC system safety and efficiency at these locations.

3) The decision (FDAD or D-BRITE system) in the ARTS-III ETG project should be monitored so that those requirements could be integrated into this project if the decision is to go with the D-BRITE system.

5.1.2.17 TPX-42 System Replacement

Role in NAS

The TPX-42 is a hard-wired, nonprogrammable radar beacon decoder and processing system. Currently, there are 35 TPX-42 systems (23 TRACABs and 12 TRACONs) in commission. Those were installed over 10 years ago and do not provide the productivity and safety features, such as beacon tracking, MSAW, conflict alert, test target generator, and interfacility interfaces for communication and data transfer necessary in today's ATC environment.

The TPX-42s will be replaced with ARTS-IIA systems which, in addition to the capabilities mentioned above, are programmable and provide target identification and altitude.

Products

Thirty-five ARTS-IIA type systems are to be provided at 1 support and 34 operational locations.

Audit Findings

There is a discrepancy in the quantities required and in the associated funding needed. The NAS Plan calls for a total of 35 units; our audit indicates that a total quantity of 41 (6 in FY 86 and 35 in FY 87) is actually required. These additional six are not now in the budget and will add to funding requirements. The ARTS-IIA system will be an operational system at other sites and no new technical issues are expected.

Recommendations

The quantity required must be changed and the requested budget must be obtained.

5.1.3 Flight Service System (FSS)

The objectives of the Flight Service Systems (FSS) modernization program are to improve flight safety by providing more accurate current and concise weather data to pilots inflight or during preflight briefings and to improve data flow and manpower efficiencies to subsequently reduce FAA facilities operational and maintenance costs. The 13 FSS projects are summarized in Table 5.1.3-1.

The feasibility of the FSS approach, as outlined in the NAS Plan, is basically sound. The primary exception is the lack of understanding of Weather Data Processing and Distribution functional interfaces. Each FAA element with responsibilities in Weather programs has their own unique understanding of how the system will eventually fit together.

The FSAS program is the foundation of the required modernization in the FSS area and represents the largest contribution to NAS Plan benefits for this group of projects. Most of the other projects support the FSAS in realizing these ultimate benefits.

The FSAS will provide pilot data services faster and with more current and more precise information than presently possible. The remaining 12 projects support the FSAS or Center Weather Service Unit (CWSU) data bases as follows:

- AWOS, GOES, RRWDS, Wind Shear Efforts - Provide weather data inputs
- WMSC-R, - Collect and distribute weather data
- CWP, WCP - Process weather data
- IVRS, EFAS, HIWAS, CNS - Disseminate data to pilots
- ICSS - Provides AFSS voice communication links

The major audit findings for these projects are listed below:

1) The thoroughness of interface definition is an overall problem found in six of the thirteen projects.

Table 5.1.3-1 Flight Service

Project	Category	Next CDP	1st ORD	SEI Role
FSAS Implementation	DMSA	Model 2 Specification Final 7-84	Early 1985	Tech Support
Central Weather Processor	MSA	Support SRR 9-84	Mod I Mid-1990	Tech Support
Consolidated NOTAM System WMSC-R		System Regulation Fin 11-84	N/A Early 1984	Monitor
Weather Communications Processor			Mid-1987	Monitor
Interim Voice Response System			12-84	
EFAS		Early 1985		
HIWAS		Early 1985		
AWOS	DMSA	Draft Implementation Plan 11-84	1986	Tech Support
Radar Remote Weather Display		Nearly Complete		
Ceostationary FAX Recorders			3-84	
Wind Shear Effects			8-84	
Integrated Communications Switch	TPL	Contract Monitor PLN	8-84 1983	Tech Support

2) The major problem for FSAS is that the prime contractor has consistently failed to meet their schedule dates and is now more than 2 years late in delivery of the Model 1 system. This has eroded the anticipated realization of NAS Plan benefits.

3) An indepth computer sizing and timing study has not been done to assure that FSAS Model 2 can handle the increased traffic demand. It should be completed in the fall of 1984.

4) The present acquisition plan for AWOS hardware will be to procure two unique system designs for deployment and subsequently will require two separate logistic support systems.

5) A viable set of functional design requirements has not yet been generated for the Weather Communications Processor.

Over 20 recommendations have been made to focus program attention to each area of concern and are listed after each individual program.

5.1.3.1 Establish Flight Service Automation System (FSAS)

Role in NAS

The FSAS represents a modernization of Flight Service Station (FSS) capabilities by providing automated, computerized data handling systems for supplying Weather Briefing and Flight Plan data services to general aviation pilots.

The FSAS program is a key element in obtaining the overall NAS Plan cost, productivity, and service improvement benefits. Realization of these benefits results directly from an effective implementation schedule for FSAS Model 1, Model 2, and Model 2 Enhancement capabilities and the associated closing of unnecessary, antiquated, manual Flight Service Stations.

Products

The FSAS provides three types of equipment: automated Flight Service Station operator terminals for specialists to enter pilot requests and the visual display of system data (Automated Flight Service Stations - AFSS); data processing centers (Flight Service Data Processing System - FSDPS), each servicing several AFSSs; and Aviation Weather Processors (AWP) located at the two NAS Data Switching Centers that serve as preprocessors for the FSDPS. The project is divided into three basic chronological phases: Model 1, Model 2, and Model 2 Enhancements. Model 1 will provide 37 AFSS facilities and 13 FSDPS facilities. Installation is scheduled to occur during 1985 and 1986. Model 2 will expand the System to 61 AFSS facilities, 23 FSDPS facilities, and 2 AWP facilities. Model 2 is currently scheduled for installation between 1986 and 1990. Model 2 Enhancements will provide additional pilot service capabilities to already existing facilities in the 1987 to 1991 timeframe.

Flight Service Stations currently are manpower intensive data distribution centers at some 317 national locations that use teletype equipment for communications within the national flight service network. Flight plans and NOTAMS are entered through a teletype operator, and briefing data must be located and read from multiple pages of typed and graphic material. Specialist briefings frequently require long (6-8 minutes) conversations with

pilots and often create telephone backlogs of pilots awaiting FSS services. The Automated Flight Service Station will provide a major improvement by significantly speeding up the display of route-oriented briefing material to the specialist for review with the pilot. The FSAS will provide much faster response times and more current data than the present system. Later FSAS capabilities will allow pilots to obtain weather briefing information directly from the system data base via touch-tone telephone or personal computer access. It is anticipated that 70% of all FSS services will be provided by these two automated capabilities in the year 2000.

NAS Plan benefits will be obtained by the FSAS capability to provide improved services to an increasing number of pilots. Specialist personnel will be distributed to more effectively and productively serve larger geographic areas, thereby reducing the number of Flight Service Stations required. A reduction in the number of facilities, coupled with the reduction in specialist and support personnel, will represent a significant cost benefit to the NAS while improving pilot services.

No other NAS programs, with the possible exception of Mode-S/Data Link, depend directly upon the FSAS program for the realization of their benefits. However, FSAS is highly dependent on NADIN for data communication link requirements and ICSS for voice communication link requirements. WMSC-R, CNS, RRWDS, AWOS, and CWP will all provide data to improve overall system efficiencies and enhanced FSAS capabilities.

Status

Contractor delivery of the Model 1 hardware/software system is anticipated to be about 6 months behind the current NAS Plan schedule (now expected October 1984). Software subcontract difficulties, a slower than anticipated learning curve period, and overly optimistic test schedules have all contributed to this delay. The Model 1 system will provide the basic fast-service capabilities to AFSS customers and will allow the initiation of facilities consolidation. The Interim Voice Response System (IVRS) to provide touch-tone telephone access of weather briefing data, although not a part of FSAS, will supplement the Model 1 system in 24 high-traffic metropolitan areas.

The Model 2 software contract is currently restrained by a Stop Work Order pending the successful demonstration of the Model 1 system.

The Model 2 program will implement the AWP and the initial personal computer data base access (Direct User Access Terminal - DUAT) capabilities. It also provides FSDPS Weather Radar processing and AFSS Graphic Weather data display capabilities.

It is anticipated that the Model 2 contract will be reinitiated in the November 1984 timeframe, or about 32 months later than its original schedule. A reprogramming plan has been prepared for Model 2 that will provide an early delivery of the new hardware and a phased (packaged) implementation of the high priority software functions. Successful implementation of this revised approach will allow the field installation of Model 2 hardware and the first software package in the April 1987 timeframe, or about 1 year later than the current NAS Plan schedule. Subsequent Model 2 system capabilities will be delivered throughout 1988 and 1989 as indicated on the schedule. However, the current NAS Plan provides no insight into the packaged implementation approach for Model 2 software.

Reprogramming planning efforts have begun to consider revising the implementation approach for Model 2 Enhancements. Functions that can be designed independently of the basic Model 2 program, e.g. VRS, may begin development by late 1985. Initial deliveries may be feasible within the late 1987 timeframe, consistent with the NAS Plan schedule, but a specific plan for enhancements implementation has not yet been generated.

Audit Findings

Technical

The initial review of the FSAS application indicates that the currently designed Model 1 processing system, consisting of three Tandem Central Processing Units per FSDPS and the Model 2 design of four CPUs per FSDPS and AWP, may be inadequate for the anticipated FSAS traffic demands based on comparisons with existing Non-Stop and Non-Stop II system performance data. Model 1 system performance testing in August 1984, along with an SEI Traffic/

performance testing in August 1984, along with an SEI Traffic/Transaction Transaction Analysis, will determine if additional processors are required.

A study was initiated to thoroughly review the definition and phasing of all FSAS Model 1 and Model 2 interfaces. The FSAS Interface Control Documents (ICDs) need to be developed for Model 2 when specified interface requirements are identified.

Schedule

The continued schedule slippage of Model 1 raised an issue concerning the visibility and viability of management review data presented by the FSAS contractor. It has consistently been difficult to identify true project status to the extent of accurately projecting task completion dates. Scheduled milestones continue to slip monthly. This is an important lesson to be learned from the Model 1 experience and must be remedied prior to the initiation of Model 2. Improved contract and technical performance monitoring techniques are required for Model 2.

Recommendations

The FSAS program is a significant contributor to overall NAS Plan objectives and projected benefits. Its schedule delays and probable eventual cost overrun will reduce the originally anticipated benefits contribution, but not the overall program significance.

Recommendations for the FSAS program are to:

1) Continue to monitor Model 1 system testing for indications of the contractor's ability to perform prior to rescinding the Model 2 Stop Work Order.

2) Complete the planning for and assure that the scheduled Tandem Computer Timing/Sizing risk analysis for Model 1 and Model 2 is accomplished; also, take into consideration the results of E-Systems Model 1 performance tests.

3) Establish an FAA resident team at E-Systems and implement improved schedule, earned-value, and technical performance monitors into the modified Model 2 contract.

4) Continue planning for the early implementation of Model 2 Enhancements.

5) Assure required ICDs are promptly identified and implemented early in Model 2 design cycle.

5.1.3.2 Central Weather Processor (CWP)

Role in NAS

The NAS Plan includes development of a Central Weather Processor (CWP) capability to improve collection, development, and distribution of timely weather information throughout the NAS to pilots, controllers, flight service station specialists, and meteorologists.

Products

The Central Weather Processor system will be installed at each ARTCC and at the Central Flow Control Facility (CFCF). Plans call for a total of 26 production systems to be implemented by 1992.

System data processing and display equipment will acquire and process weather information from a variety of sources. Among these sources are weather radar, Automated Weather Observation Systems (AWOS), the Geostationary Environmental Satellite System and the NWS AFOS system. The CWP work station will facilitate ARTCC, and later, ACF meteorologist analysis and interpretation of weather data and appropriate clarifying annotation of output products.

CWP output will be forwarded to both en route and terminal air traffic controllers. The CWP radar mosaic will facilitate controller provision of timely and accurate weather advisories to aircraft under control and will facilitate preplanning of traffic flows to avoid the extremely heavy workload situations currently associated with weather perturbed ATC situations. Accurate ACF meteorologist weather situation forecasting will further facilitate air traffic flow planning.

CWP weather products will also be forwarded to the Flight Service Station Data Processing System (FSDPS) for distribution to AFSS. This will facilitate dissemination of accurate and timely weather information to pilots conducting preflight planning and to en route VFR aircraft through flight service station in flight advisory positions. CWP weather products will also be made available via the Mode-S Data Link.

Through the provision of a weather radar mosaic and through the facilitation of ACF meteorologist trend analysis and forecasting, the CWP will make a significant contribution to the maintenance of orderly traffic flows and will allow informed pilot decisions in regard to their conduct of flights. The CWP will thereby contribute to the NAS system goals of increased user efficiency, reduced risk of weather related accidents, and increased controller productivity.

Status

Definition of the CWP has been underway for several years. The current effort involves refining the CWP system level requirements and interfaces with other elements of the NAS. System engineering studies, such as software size estimation, are also in progress. These are aimed toward a program review at Jet Propulsion Lab (JPL) scheduled for the week of July 9, 1984. Additional information on interfaces, especially with AWOS, are being derived from the Level I Design effort.

Audit Findings

Technical

The data processing load for the CWP includes mosaicking of a large number of NEXRAD radar. An extensive effort is anticipated to develop the operational parameters and the software associated with the use of NEXRAD data.

Schedule

CWP requirements and interface definitions must be completed in accordance with current schedules. The AWOS and NEXRAD interfaces, in particular, may have a significant design impact and must be defined as soon as possible. A common understanding of all CWP requirements is necessary prior to key decision point 3, rescheduled September 1984.

Recommendations

Overall, the CWP effort is proceeding as planned. It is important that requirements and NAS Level I Design definition proceed as planned to enable the CWP Design to continue on schedule. Our recommendations are to:

1) Continue the support to the NAS Level I Design Weather Working Group in defining and coordinating the weather program interfaces.

2) Complete three independent software sizing estimates (e.g., MITRE, JPL, and SEI) and reconcile them to support a project planning baseline.

3) Emphasize the development of processes and software to be used in conjunction with weather radar mosaicking.

5.1.3.3 Consolidated NOTAM System (CNS)

Role in NAS

The CNS will collect, store, monitor, and control the data content of and distribute NOTAMs within the NAS.

Products

The Consolidated NOTAM System is a data processing system designed to receive NOTAMs from all FAA and non-US aviation sources, correct and validate FAA NOTAMS as required, maintain data management control, distribute NOTAMs through the Weather Message Switching Center (WMSC) or National Data Interchange Network (NADIN) networks, and delete nonactive NOTAMs. Data management functions are performed within the National Flight Data Center at FAA Headquarters, while the collection and distribution equipment is presently located within the NATCOM Center in Kansas City.

Status

The international portion of the system is currently operational, however, the domestic CNS will not meet scheduled July 1984 date Additionally, the relocation of the CNS processors from the NATCOM facility has yet to be accomplished and is not specifically discussed in the NAS Plan.

Audit Findings

Technical

CNS distribution of NOTAMs is currently handled through the WMSC in Kansas City. Distribution routing will transfer to the NADIN 1A network sometime after mid-1985. The CNS processor will be relocated from Kansas City to dual locations sometime after the NADIN interface is established. Specific locations for these CNS processors have not yet been defined, although the prime candidates are the FAATC, FAA Academy, and the NADIN Switching Centers. There is no specific plan for the implementation of these activities.

The CNS program has been planned and implemented primarily by AAT. The future interface requirements with all APM NAS Plan Projects need to be defined.

Recommendations

1) Develop a plan to complete domestic NOTAM system implementation.

2) Perform a detailed review of all APM/CNS program interfaces.

3) Prepare a formal transition plan for CNS relocation.

4) Add CNS processor relocation to the NAS Plan.

5.1.3.4 Weather Message Switching Center - Replacement (WMSC-R)

Role in NAS

The WMSC will function as the sole gateway to the National Meteorological Center (NMC) and therefore will be the source of National Weather Service products for the NAS.

WMSC-R will provide state-of-the-art equipment and technology to replace the antiquated electronic equipment of the WMSC and allow decommissioning of the NATCOM Center in Kansas City. The NATCOM building will then be refurbished for turnover to GSA.

Products

The WMSC-R is comprised of two identical data processing facilities collocated within the NADIN switching centers at Atlanta and Salt Lake City.

Status

JPL is preparing the Preliminary System Specification with the Systems Requirements Review (SRR) now scheduled for September 1984. The Request for Proposal will be issued in June 1985, and the contract awarded in March 1986. The operational system is then scheduled for cutover in January 1989.

Audit Findings

Collocation of WMSC-R within the NADIN Centers with the AWP will represent an effective use of operational and maintenance personnel and eliminate the need for the Kansas City facility.

Technical/Schedule

The major issue associated with WMSC-R is the absence of well-defined interfaces with FSAS, CWP, NADIN, and AWOS. The schedule is achievable.

Recommendations

WMSC-R interface planning and documentation requirements pertaining to other NAS Plan projects must be resolved prior to SRR.

5.1.3.5 Weather Communications Processor (WCP)

Role in NAS

The Weather Communications Processor is planned to provide the weather data processing capability for the Mode-S/Data Link system and to collect, process, and disseminate data collected from Automatic Weather Observation Stations (AWOS).

Products and Status

No formal requirements definition, approach, program plan, or schedule have yet been defined for WCP, although $35M has been identified for its development.

Audit Findings

Technical

A Mode-S/Data Link Weather Data Processor capability is a valid functional requirement necessary to satisfy the overall objectives of the NAS Plan. However, it is not clear that the WCP should be developed as an individual entity for NAS Plan benefits. Finalization of the WCP requirements is prerequisite to beginning activity on this project. The Level I Design Weather Data Communications and Processing Working Group is currently investigating these issues and will provide recommendations to the FAA in mid-summer 1984.

Recommendations

It is recommended that further planning efforts be delayed, subject to the working group recommendations for WCP functional requirements.

5.1.3.6 Interim Voice Response System (IVRS)

Role in NAS

The IVRS is designed to provide pilot direct access to a national weather data base through standard touch tone telephones, thereby relieving Flight Service Station specialists workload. Data services provided by the IVRS include Surface Observations, Terminal Forecasts, Grid Winds, Convective Sigmets, Alert Weather Watches, and TWEB Route Forecasts. Weather Message Switching Center data are used to define and maintain the IVRS data base and represent the only direct NAS program interface.

Products

The Interim Voice Response System will provide a computer supported, digitally-voiced weather message dissemination service for 24 metropolitan areas. The system will basically consist of 16 PDP 11/24 Remote Speaking Sites and 1 PDP 11/70 Central Service Site in Waltham, Mass.

Status

The contract was awarded to Input-Output Computer Systems (IOCS) in February 1984, and the completion of site installations and testing is scheduled for December 1984. The program is proceeding on schedule as a firm, fixed price contract. All hardware and software from the existing, operational IVRS demonstration system have been provided to IOCS as GFE. They are required to rewrite the software for three of the six product areas, establish the seventeen operational sites, and maintain the operational system through FY 88.

Audit Findings

The IVRS appears to be technically well defined, adequately scheduled, and adequately funded.

One audit question is whether the IVRS operations funding is scheduled long enough to allow the fully developed VRS system of FSAS to be implemented and replace IVRS, thereby providing noninterrupted service. The FSAS program is investigating approaches to their Model 2 Enhancements program that would allow early development of VRS.

Recommendations

IVRS funding and operations schedule should be carefully reviewed to ensure that it is not terminated prematurely.

5.1.3.7 High-Altitude En Route Flight Advisory Service (EFAS) Frequencies

Role in NAS

EFAS currently provides weather advisories to en route aircraft over the designated common VHF frequency of 122.0 MHz. Aircraft above 18,000 feet often block out two or more EFAS outlets, rendering the service unusable to aircraft at lower altitudes. This project will provide for adding new EFAS communications outlets, operating at discrete frequencies stratified according to altitude, to provide improved service to all users. Aircraft above 18,000 feet would access the discrete frequencies, while lower altitude aircraft would continue to use the existing common frequency.

Products

Approximately 60 new communications outlets are scheduled to be implemented in FY 85.

Audit Findings

Technical/Schedule

The addition of communications outlets presents no technical problems in that standardized VHF ground/air communications equipment will be used. The siting of these outlets, however, along with the assignment of discrete VHF frequencies, is awaiting the results of a nationwide frequency allocation study. This study is recognized as the pacing item for project implementation, and as of the date of the audit it had not begun. Schedule performance is dependent on timely completion of the study, and cost figures are dependent on the final number of sites identified.

Recommendations

The nationwide frequency allocation study should be expedited, and the schedules reviewed to reflect the anticipated study completion date. As soon as the results of the study are available, the project costs should be reviewed to ensure that they accommodate the required number of outlets.

5.1.3.8 Hazardous In-Flight Weather Advisory Service (HIWAS)

Role in NAS

At present, weather advisories on hazardous conditions are broadcast by air traffic controllers and flight specialists whenever they can fit them into their busy workload. This detracts from other duties and does not always provide the most timely dissemination of this safety-critical information. The HIWAS project will provide a means for recording the advisories and continuously broadcasting them over selected VORs, thus increasing controller and specialist productivity and improving information timeliness.

Products

Approximately 230 recorders will be purchased over a 2-year period beginning in FY 85. It is anticipated that these recorders will be the same as, or similar to, the ATIS recorders.

Status

The HIWAS concept has been evaluated during operations in the Southern Region. This evaluation established most of the basic requirements for the service and the equipment. Preliminary indications are that the same recorders as those being purchased for ATIS will suit the HIWAS needs, and a combined buy is anticipated. Tests are currently underway in the Atlanta and Houston ARTCC areas to firm up technical and operational requirements for HIWAS.

Audit Findings

Technical

As a product of the testing program, two areas remain to be resolved: (1) final definition of the recording time requirement, and whether it is different from ATIS; and (2) whether remote-recording capability is required to provide for updating HIWAS messages at part-time FSS locations during hours when they are closed.

Schedule

The implementation of HIWAS has been slipped from FY 84 to FY 85, and the latest edition of the NAS Plan reflects this slippage.

Recommendations

Controls should be implemented to ensure that the current testing program is completed in a timely manner to preclude further project slippage and to take advantage of any feasible economy to be gained through a combined equipment buy with the ATIS project.

Review of available funding to ensure that the fiscal year slippage has not affected spending authorizations.

5.1.3.9 Automated Weather Observation System (AWOS)

Role in NAS

The AWOS will obtain and process aviation weather data that is critical to the pilot through the use of automated sensors. It will provide automated surface weather observations at airports and will contribute to a national data base of surface observations. The data that will be sensed and collected includes cloud cover, visibility, wind direction and speed, temperature, dew point, altimeter setting, and precipitation.

AWOS data will be disseminated to airborne pilots, local airport ground users, flight service specialists, and air traffic control personnel. Pilots will receive data via computer synthesized voice broadcast over VHF discrete frequencies (with new, low-power transmitters) or VHF Omnidirectional Range (VOR) channels. Airport users and flight service specialists dissemination will be via discrete VHF frequencies, VOR voice channel, or by direct dial-up telephone access. Local tower display will be provided through the Flight Data Input Output system (FDIO).

AWOS data will also be transmitted on the FAA Communication System for ATC applications and to the National Weather Service (NWS) and Commercial Weather interests. When Area Control Facilities (ACF) are operational, AWOS data will be sent to the ACF's Central Weather Processor (CWP) and Flight Service Data Processor. It will then be disseminated to the AFSS, Mode-S/Data Link through the Weather Communications Processor (WCP), Sector Suites, and to Center Weather Service Unit (CWSU) specialists.

AWOS will contribute to safe and efficient use of airspace by providing automated weather observations at non-towered airports. At towered airports, it will reduce controller workload and free these personnel for their primary duties by providing automated instead of manual observations. The addition of new observation sites and increased frequency of observation will significantly increase and improve the meteorological observation data base. AWOS will satisfy most of the weather observations required by FAR Parts 91, 121, and 135.

Products

The AWOS system includes meteorological sensors, data communications, processing software and hardware, displays and printers, an operator terminal keyboard display and voice input, a voice output, and remote maintenance monitoring. Support for AWOS includes a sensor test and calibration unit, a software development system, and system documentation. A total of 745 AWOSs will be procured (F&E funded) with expansion possibility for additional sensors. The current proposed schedule provides for design contract in late 1984, testing in 1985, and full production from 1986 through 1991.

The NAS Plan currently lists the following interfaces with other NAS elements (Underlined words are recommended additions to more accurately reflect the interface):

1) VOR network and consolidated communication facility implementation--AWOS data will be broadcast through VOR or discrete VHF depending on cost-effectiveness and other operational issues.

2) ATIS--AWOS-generated data will be furnished to ATCTs on a display for the controllers use in the preparation of ATIS broadcasts. AWOS data will be blended with the ATIS where they are collocated.

3) FSAS--AWOS data will be supplied to flight service station specialists through the flight service automation system and communications networks.

4) FAA telecommunications network--AWOS data will be nationally transmitted through the FAA telecommunications network.

5) Weather Communications Processor--AWOS data for national distribution and Mode S application will be collected/routed by this processor.

6) Central Weather Processor and Advanced Automation Systems--AWOS data will be part of the data base used by CWSU meteorologists and supplied to air traffic controllers in ARTCCs and later in area control facilities.

7) Mode-S/Data Link--AWOS information will be part of the services being transmitted to pilots who use Mode-S/Data Link.

8) Rotorcraft program--AWOS development will support the surface observation needs of FAA's rotorcraft program.

9) NAS spectrum engineering.

Additional features of interfacing include:

1) HIWAS - If VORs are used to transmit AWOS data, coordination for non-interference of HIWAS broadcasts over VORs will be required.

2) RMMS - The Maintenance Processor Subsystem (MPS) of the Remote Maintenance Monitoring Systems will collect AWOS maintenance data to allow remote maintenance personnel to monitor and analyze AWOS operational and failure data.

3) FDIO - AWOS data will be displayed at towered airports through the FDIO system.

In addition, AWOS will be capable of interfacing with new or additional sensors for low level wind shear and RVR (current NAS Plan pojects), as well as future sensors such as present weather detection and lightning (thunderstorm) detection.

Status

This DMSA project is currently in the precontract award phase with demonstration tests in progress. As a result of unreliable technical performance of demonstration sensors, unresolved algorithm issues, and changed procurement strategy, the project has slipped approximately 9 months from that shown in the NAS Plan. Acquisition strategy is being finalized. It is tentatively planned to let two production contracts each for 50% of the 745 units. One contract award will be under the 8a pilot program for small businesses the first two phases of which are on a cost-plus basis. The

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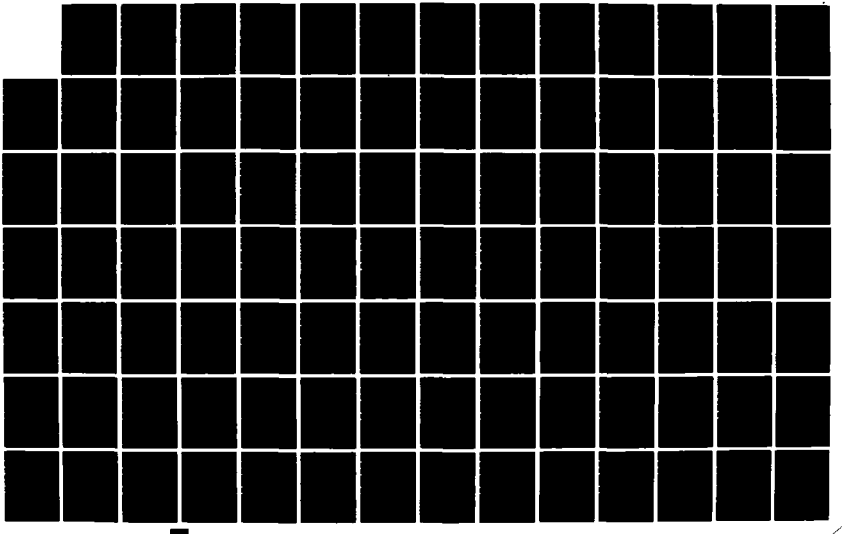

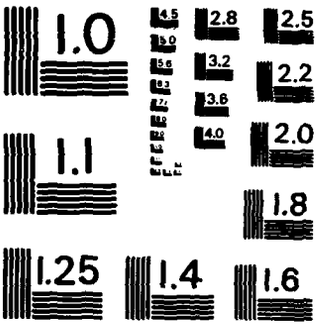

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS - 1963 - A

production phase of the 8a contract will be firm-fixed price. The other will be a competitive fixed-price contract. Each contract will be for full turnkey operations for the respective systems. Prior to production contracts, to satisfy system development requirements, it is now planned to award a design contract to the 8a contractor. Upon successful design and approval, and KDM 4 approval, the 8a contractor will be awarded a follow-on contract to build and test five engineering models. The two production contracts will follow with the competitive contractor also required to design his AWOS systems and conduct first article tests.

Audit Findings

Technical

Two of the AWOS sensors require additional development and evaluation. The demonstration test of 14 off-the-shelf AWOS systems has generally been satisfactory. Reports indicate that the precipitation and cloud height sensors failed to consistently report accurate information on precipitation and cloud height.

The current algorithms require some modifications. Reports from the Demonstration Test indicate that algorithm methodology for sky obscuration sometimes causes AWOS to falsely declare an obscured sky condition when it does not exist, and smoothing of sensor data during dynamic weather periods is excessive. This methodology contributes to the poor cloud height sensor performance, but the algorithms, when modified, should correct this problem.

The planned acquisition strategy for two system designs will result in two different AWOS systems and related logistics support. Accordingly, each design will require a separate logistic support system to include spares, test equipment, documentation, maintenance and operational procedures and training. This duplication will increase the complexity and cost of acquiring and operating and maintaining the AWOS system.

The number of AWOS units to be deployed, as listed in the NAS Plan, is not consistent with current planning. The NAS Plan lists 700 units to be deployed using F&E funding. Current plans are to procure and install 745 F&E funded AWOS units that include installation at 403 non-towered airports, 303 towered airports, and 39 flight service stations which are to be closed. The NAS Plan also states that 400 non-towered airports (Airport Improvement Funds) and 600 local airports will eventually have AWOS units. The identity and location of these 1000 airports are not now known, and their role in the NAS Plan is not clear.

The NAS Plan describes various methods of disseminating AWOS information to users. The method for providing AWOS information to pilots was closely scrutinized with the following findings:

1) Our examination of 15-year life cycle costs showed that the VHF discrete transmitter has a cost advantage over that of the VOR. This was based on equipment, maintenance, and leased line costs for both methods of transmission.

2) Voice signals on the VORs continue to have reception problems. Evidence of this was clearly shown by the pilot questionnaire responses on the AWOS demonstration program. Also the FAA has acknowledged that there are problems with voice over the VORs and is planning an in-depth study at the FAA technical center.

3) 720 channel VHF spacing has been approved for use and will allow expanded frequency spectrum for VHF discrete AWOS frequencies.

4) From preliminary examination in the State of Ohio for AWOS application, it was determined that the VOR facility, serving the non-towered airports in must cases, may not be the best method to transmit AWOS information to the pilot. This finding is based on: (1) the lobing of VOR signals, thus producing blank reception areas; (2) the relative geographic location of AWOS and the VOR transmitter; and (3) the poor voice quality of the AWOS information transmitted over the VOR being the most frequent complaint.

5) Multiple AWOS messages over a single radio facility is best done where there is a high density of airports. This reasoning is based on the common use of radios and radio navigation aids in congested areas.

The ground-to-ground distribution of AWOS is dependent on the integrated communications system which is not clearly defined. As a result, it is not yet possible to define in detail the interconnectivity for distribution of AWOS data.

Schedule

Acquisition strategy has changed, and the schedule has slipped approximately 1 year from that shown in the NAS Plan. Except for the disadvantages of operating and maintaining two systems, the proposed strategy is reasonable and the proposed schedule appears realistic.

Cost

The FAA Office of Aviation Policy and Plans completed an in-depth study entitled "Establishment and Discontinuance Criteria for Automated Weather Observing System (AWOS)," which contained an excellent cost-benefits analysis for non-towered airports and was the cost-benefits basis for establishing AWOS at these locations. The study also included a less rigorous cost-effectiveness analysis for towered airports. Nearly one-half of the 745 production units are to be located at towered airports, but a rigorous analysis for towered airports similar to that for untowered airports has not been accomplished.

Recommendations

The NAS Plan should be updated to accommodate/clarify the selected acquisition strategy and schedule, the number of systems to be deployed, and the related projects/activities.

The planned acquisition of two different AWOS designs and the required duplicate logistics support should be reconsidered. The FAA could procure

the AWOS design and engineering data and require both production contractors to produce and install equipment to identical design and engineering data.

The FAA should accomplish a cost-benefits analysis for towered airports to serve as the basis for selecting towered airports to receive AWOS and provide the same level of justification as developed for untowered airports.

The strategy for locating and selecting the appropriate radio transmitter for distribution of AWOS information to pilots should first include a site specific survey. Some guidelines for selecting the strategy are as follows:

1) Primary distribution through VHF discrete transmitter.

2) Secondary distribution through the VOR serving the airport as the primary approach aid. The TVOR is preferred, because it is collocated at the airport. VORs greater than approximately 10 nmi from the AWOS airport should be eliminated from selection because of decreasing signal strength.

3) Clustering of AWOS data from more than one airport should primarily be transmitted over a centrally located VHF discrete transmitter and secondarily over a VOR. For safety and time constraints, a maximum of two AWOS stations over one facility is recommended.

4) AWOS voice over the NDB should not be considered because of FCC restrictions on low-frequency voice bandwidth and on voice transmissions on NDBs.

5.1.3.10 Radar Remote Weather Display System (RRWDS)

Role in NAS

The RRWDS provides real-time radar weather data on high resolution weather displays for: (1) aircraft flow control planning, (2) weather advisories to controllers by the CWSU meteorologist, (3) the FSS-EFAS operator for advisories to pilots, and (4) non-EFAS AFSS specialists.

Products

The RRWDS provides real-time weather displays at ARTCS, 44 FSS-EFAS, and 2 non-EFAS FSSs. A total of 134 (57 FAA and 77 NWS) long-range radar transmitter sites and 78 indicator sites will have been provided RRWDS equipments during the fourth quarter of 1984. The first delivery commenced in Fall 1983 with the last delivery scheduled for late Summer 1984.

Status

All RRWDS systems will be delivered and completed during the fourth quarter of 1984.

Audit Findings

The RRWDS fulfills the requirements of the FAA in remoting real-time radar information. The program has been in development for many years, and the technology used in the RRWDS is not state of the art. The system needs increased flexibility to be more responsive and effective at the work station.

Recommendations

The FAA should investigate the potential to upgrade the flexibility of the RRWDS to be more useful at the work station.

5.1.3.11 Geostationary Operational Environmental Satellite (GOES) Recorders

Role in NAS

The GOES system supplements weather observations from surface, radiosonde, and pilot-reporting sources by providing satellite weather information (every 30 minutes, 24 hours per day) to FSS specialists.

Products

Sixty-four Unifax II picture receivers (recorders) are being procured for delivery to Flight Service Stations, and eight are being purchased as spares. Delivery of the total 72 will be completed in August 1984. The installation of the data phone lines from the ARTCC's "GOES Tap" to the FSS is being accomplished by each affected region. The GOES recorders will provide timely satellite weather information for more complete pilot briefings and en route advisories than is currently available from existing weather information sources.

Audit Findings

Technical

Installation and checkout has indicated no problems.

Schedule

The project is on schedule, with the last delivery earlier than the end of 1984.

Communication line costs could be saved and data quality substantially improved if GOES antennas/receivers were provided at each GOES recorder site. This approach requires a trade study to compare recurring communication costs and data quality of each alternative approach.

Recommendations

The FAA should perform a trade study to compare costs and data quality of alternative approaches to improve antennas/receivers at each GOES recorder site.

5.1.3.12 Wind Shear Efforts

Role in NAS

LLWAS enhances safety of flight by providing airport surface hazardous wind condition warnings to air traffic controllers for relay to pilots.

The LLWAS does not interface directly with any NAS Plan project. It is related to NEXRAD and AWOS only to the extent that they each are weather sensors.

Products/Status

The project uses state-of-the-art sensors and data processing to detect the presence of wind shears created by meteorological phenomena. This capability has been demonstrated on numerous occasions; and, therefore, it is concluded that LLWAS meets intended objectives. However, since the introduction of LLWAS, microbursts have been identified as a potential source of wind shear. The LLWAS may not detect wind shears created by microbursts. To provide information on such microburst activity, a new sensor such as a terminal Doppler radar may be required. The first and last installations of FY 83 buy (51 units) are scheduled for August 1984 and March 1986, respectively.

The LLWAS is on schedule. Available funds appear to be less than current program needs and may require some reprogramming of funds in the future. This is especially true since the project is sensitive to change as a result of new weather sensor technologies and new processing algorithms, either of which may require changes to the existing system. For instance, the number of sensors at New Orleans was doubled to determine if microbursts can be detected by increasing sensor density. The Joint Airport Weather Studies (JAWS) program is conducting research to quantify wind shear phenomenon.

Audit Findings

Technical/Schedule

No technical or schedule concerns were identified as a result of the audit.

Recommendations

None.

5.1.3.13 Integrated Communications Switching System (ICSS)

Role in NAS

The system provides intercom, interphone, and air-ground communications switching and control for towers, TRACONs, and flight service stations.

Products

The ICSS is provided under a lease, with option to buy, indefinite quantity contract to two separate vendors. Type I ICSS, for ATC towers that have operational requirements prior to 1987, is provided by Denro Laboratories. Type II and Type III systems are provided by Litton AMECOM. There are 61 Type III systems required for AFSS with delivery beginning in the third quarter of 1984.

The ICSS will be implemented and utilized at towers and TRACONs prior to the implementation of the ACF program. At those locations receiving TCCCs, the ICSS will be either upgraded to or replaced by TCS. Type III systems support AFSS implementation.

Status

Approximately 20 Type I and 4 Type II systems have been installed. Integration and cutover schedules have been impacted by the effects of divestiture on the common carriers and by lack of coordination between the vendors and the various FAA organizations. The Type III system development schedule is in jeopardy.

Audit Findings

Technical

There are several areas of technical concern in the performance, support, and reliability of these systems. There are no provisions for FAA quality control and configuration management prior to delivery of systems to the field site within the scope of the leased services contract.

System reliability, maintenance, and availability have been flagged by the FAA field organization as problem areas.

Schedule

Delivery of Type III systems is in jeopardy and could have impact on the AFSS program if not contained within CY 84.

Recommendations

The contracting arrangement, through DECCO, for this leased service--within the context of a Program Plan that places the bulk of site integration, TELCO coordination, and cutover responsibility on the Regions--is a major contributing factor in the problems cited above. It is recommended that the FAA Headquarters assume an expanded role in the ICSS project by providing more centralized coordination for project implementation and configuration management.

5.2 GROUND-TO-AIR (G/A) SYSTEMS

The G/A systems element of the NAS Plan consists of 16 F&E projects related to communications, navigation, landing systems, and surveillance functions within the Air Traffic Control System. These 16 projects were audited using the approach explained in section 2.0. Specific findings for each project are given in the project summaries that follow; however, an overall assessment of the G/A systems element has been made. The projects are summarized in Table 5.2-1.

The approach to achieving the G/A system goals, as stated in the NAS Plan appears to be feasible. From our audit, it is evident that individual project planning for system evolution (i.e., quantities and location) is a dynamic and ongoing effort which, in some instances, has been driven by schedule urgencies related to ongoing project contract commitments made before NAS system-level requirements become fully mature. These situations can occur when, because of hardware lead time, design, development, and production commitments must be made before or concurrent with NAS system design to meet the system implementation schedules committed to in the NAS Plan.

With regard to return on investment, we believe the return on investment as stated in the NAS Plan to be a reasonable expectation. Because of the dynamic nature of system evolution and changing requirements dictated by operational realities, a dollar measure of the final net return on investment cannot be predicted with a high degree of accuracy. It is credible, however, to expect a positive and substantial return when the system is implemented and operating.

Because the NAS Plan is updated only on an annual basis, it is natural that the document may not accurately reflect current equipment quantities and their usage. Several such inconsistencies were discovered during the course of our audit, and these are reported by project in the findings that follow.

Recommendations

Our audit of the 16 projects comprising the G/A systems element revealed no show-stoppers to successful implementation of their role in the NAS Plan. The audit reinforced the recognized need for close and effective coordination and

Table 5.2-1 Ground-to-Air Systems

Project	Category	Next CDP	1st ORD	SEI Role
Air/Ground Communications Equipment		--	Nearing Compl	Monitor
Communicating Facility Consolidation	TPL	-- In Progress	10-87	Monitor (1-85) Monitor
VORTAC Programs		Contract Award 8-84		Monitor
Nondirectional Beacons				
Supp Nav Sys Monitors			1988	
ILS				
MLS	DMSA	Final Master Plan 9-84	Mid-1986	Monitor
RVR Establish/Upgrade			9-86	Monitor
Visual/NAVAIDs		In Progress		Monitor
ALSIP		In Progress		Monitor
Direction Finder	TPL	Award Plan Mid 9-84	1986	Monitor
Mode-S/Data Link	DMSA	Impl Plan Review 8-84	1-87	Tech Support
Terminal Radar (ASR) Program	DMSA	Support CDR 9-84	Mid-1986	Tech Support
Establish/Replace ASR	DMSA	Support CDR 9-84	Mid-1986	Tech Support
ASDE-3	TPL	PR-Contracts 9-84	Mid-1988	Tech Support
Long-Range Radar Program		Conf Sys Req Review 9-84	Mid-1985	Tech Support
NEXRAD			2-88	Monitor

cooperation between all internal elements of the FAA, between the FAA and their system contractors, between the FAA and other federal agencies involved, and between the FAA and various airspace user groups.

Careful analysis of network plans, particularly for collocated facilities, will alleviate potential frequency interference problems and ensure effective operation of the systems in the future NAS environment.

A uniform and structured interface control document (ICD) approach to define system interfaces will enhance integration of the individual systems into the overall NAS.

An accelerated agency-wide effort to coordinate, complete, and approve the National Surveillance Network Plan now being developed will enhance integration of the multiple surveillance programs contained in the NAS Plan. This effort will also mitigate cost uncertainties caused by inadequate definition of the quantity of different systems required to satisfy NAS objectives.

5.2.1 Air/Ground (A/G) Communications Equipment Modernization

Role in NAS

The A/G radio communications system currently provides the only link between the controller and the pilot that permits exercise of air traffic control.

Products

The replacement of tube-type A/G radio transmitters and receivers was initiated as a joint FAA/USAF/Army/Navy project in the mid-1960's. These radios are being procured under an Air Force contract. The radios exhibit a high mean-time-between-failure (MTBF) and are operating satisfactorily. A total of 18,200 transmitters and receivers will be replaced. Multiyear funding of these solid-state radios will be completed in FY 85 and installation by FAA personnel is expected to be completed in FY 87.

Status

Delivery and installation are proceeding satisfactorily.

Audit Findings

Technical

No problems identified.

Schedule

No problems were identified.

Recommendations

None

5.2.2 Communications Facilities Consolidation

Role in NAS

Consolidation (i.e., location of up to 24 A/G frequencies at one site) and collocation (i.e., location of A/G and navigation, radar, or other remote equipment at one location) will result in reduced lease, utility, and maintenance travel costs.

Products

The FAA currently operates A/G communications at more than 2900 locations and more than 950 very high frequency omnidirectional ranges (VOR) stations. The communications facilities consolidation program will consolidate as many of these 2900 locations as possible while maintaining A/G coverage down to 2000 feet above ground level in almost all areas. Where possible, these A/G facilities will be collocated with VOR, radar, or other remote facilities.

Status

Regional network studies have been completed to determine the sites and number of facilities to be collocated and consolidated. The 14-month communications networking study completed by the regions proposes consolidation of A/G facilities into approximately 2165 specific locations. Further effort is underway to finalize the consolidation achievable.

Audit Findings

Technical

The solid-state radios required for the A/G facilities consolidation will be available when required.

It will be possible to achieve about a 25% reduction in the number of facilities through consolidation. It will, however, not be possible to achieve the level of consolidation envisioned in the NAS Plan.

There are technical aspects of collocating up to 24 transmitters and receivers on one site, especially when collocated with a VOR or radar. The NAS Plan recognizes that collocation and consolidation both require the use of

multicouplers, combiners, filters, and other isolation devices. It appears that this program should include dielectric antenna structures for VOR and radar collocation. These devices will be required to achieve the 25% reduction in facilities noted above.

Recommendations

The number of locations required for 2000-foot coverage developed by the networking study has more validity than the 1118 planning figure used in the NAS Plan. This number (2165) should be used to recompute the costs and benefits to be achieved through consolidation of facilities.

The specific isolation devices and installation techniques required to achieve satisfactory channel quality have not been identified. These devices should be identified and demonstrated at the FAA Technical Center (FAATC) to provide installation standards for consolidated facilities. This project should include evaluation of dielectric antenna structures.

5.2.3 VORTAC

Role in NAS

VORs are used to provide electronic guidance for en route navigation and nonprecision approaches. Distance measuring capability is added to the basic azimuth capability with DME or TACAN. VORTAC includes the VOR, DME, and TACAN capability, and is compatible with all airborne equipment. VOTs are used at specific locations to provide a capability for pilots to ensure their VOR equipment is functioning within specified limits as required to ensure safe navigational guidance.

Products

This project provides for the replacement of tube-type VORTAC, VOR, VOR/DME, and VOT equipment with solid-state equipment, the installation of remote monitor and control systems, the relocation of NAVAID facilities, and establishments. The solid-state equipment improves reliability and reduces maintenance and operating cost for the NAS VHF navigation system. In addition, the VOT establishments expand the capability for users to check their airborne navigation receivers. The project calls for the procurement of VHF navigation facilities equipment for 942 sites and 8 support functions, 55 RMM conversion kits for DVOR, 112 VOT, and 75 Doppler VOR conversion kits.

Status

The VORTAC, VOR, and VOR/DME replacement program is approaching satisfactory completion. The VOT and Doppler VOR procurements are being planned, and no significant technical or cost factors are evidenced. A variable to Doppler VOR procurement quantity planning is encroachment at existing sites through building or other developments that degrade facility operation. This could alter the quantities of Doppler VORs required through the NAS planning period. Current planned funding provides for 15 additional Doppler VORs to satisfy this contingency.

Approximately 508 of the 942 sites have been completed with the remainder scheduled for completion by May 1985. The VOT and conversion to Doppler VOR schedules are under development. The present contract is planned for

modification to include selected conversion to Doppler VOR for problem sites. This contract modification could change the completion date to the first quarter FY 87 depending on the conversion kits.

Audit Findings

Technical

A VORTAC/RMM capability was never established as a part of the VORTAC project and is not compatible with current RMM planning.

Recommendations

RMM development should be monitored to ensure that an appropriate interface with VORTAC is established.

5.2.4 Nondirectional Beacon (NDB)

Role in NAS

The NDB transmits omnidirectional, low-frequency signals that enable the pilot to determine aircraft bearing to or from the facility for navigation purposes. The NDB project provides for the upgrade of NDB facilities to solid-state equipment through replacements, relocations, and establishments.

The replacement of tube-type equipment with solid-state equipment improves the reliability and reduces the maintenance and operating costs for the NAS navigational system.

Products

NDBs composed of antennas, automatic antenna tuning units, transmitters, and monitor alarm receivers will be procured for 669 sites for establishments, retrofits, and replacements. Of the 669 sites, 400 are planned for collocation. According to the NAS Plan, the program for establishment, replacements, and relocations will extend from the last quarter of CY 84 to the first quarter of CY 91.

Status

Contract award is planned for August 1984. The base contract will provide for 37 50W transmitters/antennas tuning units, plus an option for 108; 35 antennas, plus an option for 35; and 135 monitor alarm receivers, plus an option for 25. The delivery period is January 1986 through October 1988.

Audit Findings

Technical

The audit revealed the necessity for accommodating additional NDB frequencies. This is accomplished by reducing the bandwidth of the transmitter. Network plan analysis should validate the bandwidth change so that evolutionary changes to the airborne equipment, as reflected in RTCA Document DO-179, can be planned for by manufacturers and users. In addition, the NAS Plan quantity of affected NDB sites is 669, which does not agree with the currently available NDB site listing of approximately 370 affected facilities. Resolution of this variance will determine quantities of

equipment for acquisition. Also, implementation of the collocation plan depends on the conclusions of frequency and spectrum management studies. Interfaces with RMM are yet to be determined.

Recommendations

Frequency interference studies should be performed to validate need for additional NDB frequencies and subsequent bandwidth changes.

The quantity disagreement between the NAS Plan and current NDB site listing should be resolved.

RMM development should be continued to be monitored closely so that appropriate interface equipment can be provided to retrofit the existing NDB sites. (All new NDBs have RMM capabilities incorporated.)

5.2.5 Supplemental Navigation System Monitors

Role in NAS

The satellite-based Global Positioning System (GPS) is planned to become operational by the end of 1988 and may serve as a supplemental navigation system for civil aviation in addition to use by the military. GPS may be used for en route navigation and nonprecision approaches. Monitors are required to provide GPS signal integrity to the pilot via the ATC system. Monitor data will be compared to the position of the monitor, and deviations will be reported to ATC for forwarding to the pilot.

Products

This project provides for the deployment of six monitors in the 1988-1990 timeframe so the FAA can monitor GPS satellite signals to determine the status of the system and forward status data to pilots.

Status

Project planned for FY 86.

Audit Findings

Technical

The GPS monitor system provides GPS status data to pilots using GPS via ATC. When used for nonprecision approach, near real-time data is required to assure proper GPS navigation guidance. Output of the monitors will be transmitted to ATC for relay to pilots. The communication media has not yet been specified, and a time delay analysis has not been made. These could result in a need for more monitors or a modified means of assuring GPS integrity.

The increasing use of other supplemental navigation systems, notably LORAN-C and OMEGA VLF, may result in a similar need to monitor these systems.

Schedule

Establishment of the six monitors, consisting of off-the-shelf receivers and appropriate equipment to compare positions and transmit the results, is

feasible within the 1988-1990 timeframe; however, this may not provide an adequate monitoring capability.

Recommendations

An analysis should be performed to determine the operational requirements for GPS monitoring and verify/modify the currently planned monitoring system design, as needed, to meet the operational requirements.

A similar analysis/design for LORAN-C and OMEGA VLF should be performed.

RMM requirements in the monitors should be defined for each type of system.

5.2.6 Instrument Landing System (ILS)

Role in NAS

The ILS project improves the reliability and expands the precision approach capabilities of the NAS. The replacement of tube-type systems with solid-state equipment will result in lower maintenance and operating costs. It is estimated that the program will break even in 1989, about 6 years after implementation. The establishment of full and partial ILSs will benefit the users by expanding available instrument landing capability.

Products

The project entails replacement of vacuum tube-type equipment with solid-state equipment in 188 full and partial ILSs, and the establishment of 41 full and partial ILSs. The last delivery of the 41 establishments occurred in March 1983, and the last delivery of the system replacements is scheduled for December 1984.

Status

The planned ILS project of equipment replacements and system establishments is approximately 95% complete.

Audit Findings

Technical

The following discrepancies in quantities indicated in the NAS Plan and actual establishments and replacements are noted—41 planned establishments versus 205 actual, and 188 planned replacements versus 141 actual. Other than the need to document a consistency of quantities, this is of mute consequence since the program schedule closely approximated 50% completion in pre FY 83 years.

The project may be required to provide additional establishments due to user reaction to the ILS/MLS networking plans. The degree of modification to the project will depend on FAA reaction to user community demands for additional ILSs at airports prior to the planned installation of MLS.

Recommendatons

The NAS Plan should be updated to reflect quantities actually provided to date and presently planned for.

ILS/MLS networking plans should be finalized to determine additional ILSs required.

5.2.7 Microwave Landing System (MLS)

Role in NAS

MLS provides precision landing guidance to support the operational needs of civil and military aircraft of all types for all landing categories without the inherent limitations of ILS. The MLS research and development activity was initiated in 1971, and the FAA has demonstrated that the MLS system is a technically feasible approach for meeting the evolving needs of expanding aircraft operations in the ATC system. Transition from the development phase to the implementation phase will require close coordination between FAA organizational elements and contractor organizations to achieve the planning, scheduling, controlling, and resource allocation activities needed to bring the MLS systems on-line. The use of full operational capabilities of MLS is an evolutionary process. Throughout this process, FAA and user coordination is essential. Key elements in this coordination include the development of MLS operational procedures by the FAA, users recognizing the benefits to be derived as the procedures are developed, and users equipping their aircraft with MLS systems.

Products

This project provides for the procurement and installation of 1250 MLS systems (azimuth, elevation, DME/P, and monitoring equipment) throughout the NAS planning period.

Status

The procurement strategy provides for the equipment contractor to be responsible for installation at each site (turnkey). A contract for the first buy of 208 MLS systems (including options) was awarded in January 1984. The first MLS system installation is scheduled for completion in January 1986 and the last (not including options) in January 1989. Advanced planning for a second buy of more than 500 systems is underway.

Audit Findings

Technical

The audit shows that the MLS siting plan is in revision. It is important that the sensitivity to the requirements of supporting user groups be reflected in

any of these revisions so that user acceptance of the MLS system grows. In addition, the equipment contractor is also responsible for the design and production of supporting structures and enclosures for the MLS equipment. Unique to this task is complying with FAA frangibility requirements for installations located in the proximity of runways. Development work has been accomplished on frangibility design, and independent verification activities are in progress. It will be necessary to closely monitor the progress of this design through continuous analysis and testing. Finally, the site-specific activities of installation and commissioning require FAA regional personnel coordination and participation. It is anticipated this workload will increase as the installation rate increases. Regional resource planning is a significant factor for a successful MLS program.

Schedule

Even though the technology for the MLS program is well known, the schedule risk for the first buy is medium due to the necessity for integrating development, procurement, manufacturing, and installation cycles to meet contract delivery schedules for the first 208 systems (including options).

The schedules for the second buy are still in the planning stage. However, the procurement strategy depends on a complete reprocurement data package provided by Hazeltime. This package will enable the second buy contractor to produce like MLS. The risk associated with the second buy will be related to the amount of time between the availability of the data package and the second procurement cycle.

Recommendations

Progress of frangibility designs should be monitored through analysis and testing to support the extension of the frangibility concept to MLS equipment.

Program controls should be developed to assure schedules and resource allocations.

5.2.8 Runway Visual Range (RVR)

Role in NAS

The RVR project is required to support aircraft operations at qualifying Category I MLS and ILS equipped runways and at all Category III-B runways. This system is required to meet RMMS requirements and provide a precise visual range capability that is less manpower intensive than the systems currently in place.

Products

There are 420 RVR systems currently installed plus 55 runway visibility value (RVV) systems. All of the RVV devices will be replaced by RVR; however, only a portion of the RVR systems currently in place will be replaced. The program currently plans to establish an RVR capability of 275 airports, upgrade 55 airports from RVV to RVR, replace 150 Tasker 400 and solid-state radiation computers (which are obsolete), and to provide category III-B rated equipment at 37 airports. Many of the existing RVR sensors will remain in the system at the completion of this program. The project is also conducting sensor research and development at Otis AFB and Atlanta, GA. First and last system installations are scheduled April 1986 and January 1990, respectively.

Status

The RVR is in the preprocurement phase with the specification complete. The procurement strategy has been changed from two-step RFTP to 8a set aside.

Audit Findings

Technical

There may be an overlap of RVR and AWOS visual range instrumentation requirements and signal processing.

Schedule

Due to the change in procurement strategy, the RVR contracts will not be awarded in accordance with NAS Plan Schedules (December 1984).

Recommendations

The cost/technical advantages of combining AWOS and RVR at airports scheduled to receive both systems should be evaluated, especially for those airports that do not require category III-B systems. The visual range sensor technology being considered for AWOS should be evaluated to determine if it is capable of meeting category III-B requirements.

The RVR milestones will require rescheduling. The comparative cost of retaining old technology RVR systems (which do not have an RMM interface and retain the high maintenance cost sensors) versus replacing all RVRs with a new technology should be evaluated.

5.2.9 Visual NAVAIDS

Role in NAS

This project enhances safety by providing for various types of lighting systems [omnidirectional airport lighting system (ODALS), runway-end identification lights (REIL), visual approach slope indicator (VASI), precision approach path indicator (PAPI), medium intensity approach lighting system with runway alignment indicator light (MALSR)] to assist the pilot in approach and landing operations.

Solid-state equipment will result in increased reliability and lower maintenance and operating costs. Pilot-initiated on-off operation of the lighting systems at unmanned airports through radio remote control will provide energy savings.

Products

The lighting system (ODALS, REIL, VASI, PAPI, MALSR) presents visual guidance to the pilot for establishing and maintaining contact with the runway, alignment with runway centerline, and descent path to the runway.

The mix and location of these various systems are determined yearly based on urgency requirements, validation requirements, and availability of funds. The timely development of installation plans assures proper procurement cycles and FAA resource allocations for installations and flight checks.

Status

ODALS, REIL, VASI, and MALSRs have been procured before, and future procurement will be a continuing process based on need and fiscal budget. PAPI specifications are scheduled for completion in January 1985. The availability of the specification will allow for the ongoing procurements of PAPI based on need and fiscal budget.

Audit Findings

Technical

No problems identified.

Schedule

No problems were identified.

Recommendations

None.

5.2.10 Approach Lighting System Improvement Program (ALSIP)

Role in NAS

ALSIP is an operational project providing for the procurement of hardware to ultimately provide two standard types of approach and lighting systems (ALSF-2 and MALSR) through conversion, retrofits, and establishments.

The ALSIP program will provide safety, energy, and maintenance benefits to the NAS. The safety benefits result from implementation of low impact-resistant frangible light towers. Energy costs will be reduced due to ALSF-2 switching capabilities compatible with weather and visibility conditions. Maintenance cost benefits will accrue from the conversion of ALSF-1 to MALSR. An additional benefit will result from coordinated volume purchases of ALSIP system components.

Products

The ALSIP program provides for the conversion to MALSR of 205 SSALF, SSALR, and ALSF 1 systems; 68 ALSF-2s will be provided with frangible structures and the capability to switch to SSALR; 182 MALSRs will be placed on frangible structures; 384 existing MALSRs will be provided with runway threshold lights.

Status

Contract awards for funds through FY 84 were started in February 1984 and were planned to be completed in May 1984. The remainder of the procurements necessary to complete the program are planned to be done in fiscal groupings.

Audit Findings

Technical

The audit has revealed no significant technical issues since the ALSIP systems are well-known, operationally proven systems. However, the USAF has indicated the MALSR systems are not adequate for the military at joint-use airfields. This may require the retention of ALSF-1 type configuration.

Recommendations

None.

5.2.11 Direction Finder (DF)

Role in NAS

The DF is used by specialists or controllers to provide navigational guidance to lost pilots. It receives radio transmissions from the pilot, from which the aircraft location is determined. The specialist or controller then provides vectoring information to the pilot to an airport or NAVAID.

The implementation of solid-state equipment in DFs will improve the reliability and reduce maintenance and operating costs for the NAS. In addition, the increased coverage from planned establishments will provide improved services to pilots.

Products

The DF project will replace existing tube-type DF systems with solid-state equipment with RMM capability, establish additional sites to increase service coverage, collocate DFs with existing navigation facilities, and improve operational effectiveness by relocating indicators within selected control facilities. Project planning provides for the procurement of 225 solid-state DFs to be installed from December 1985 through August 1987. Fifty of these will be used for establishments, while 175 will be used for replacements.

Status

Planned contract award is September 1984.

Audit Findings

Technical

The planned collocation of DFs in the 1991-2000 timeframe with other navigation and communications facilities is dependent on the validation of the coexistence of DF receivers and antennas with other navigation and communications equipment at the site.

Schedule

The DF project is ready to move into the procurement and implementation phase with the potential for a 3-month slippage. However, the present network plan

indicates 61 DF establishments, which disagrees with the NAS Plan. A final approved number of establishments is needed prior to contract award so the correct number of DFs for establishments are procured.

This program is considered to be of medium risk since the schedule is tight (15 months from contract award to the first delivery) and since the 8a contractor has no prior related experience. This is compensated for by the experience of the 8a team members and a 6-month shakedown testing program for the first site.

Recommendations

A study program should be established to evaluate the technical and operational impact, if any, of the planned collocations with other navigation and communications facilities.

NAS Plan schedule should be revised to reflect impact of 3 month slippage in approval process.

DF network plan should be finalized to determine quantities for the planned procurement.

Cost data should be finalized after quantities are determined.

The DF program is providing an interface for the FSAS. This needs to be coordinated with the FSAS design.

5.2.12 Mode-S/Data Link

Role in NAS

Mode-S will provide the improved surveillance and communications capabilities required to meet the need of automated ATC beyond the 1990's. Specifically, it is intended to overcome limitations of the present ATC radar beacon system (ATCRBS), provide an integral two-way data link, be of reasonable cost to the airborne user, and provide high availability and reliability.

Products

Mode-S is a cooperative surveillance and communication system for ATC. It uses ground-based sensors (interrogators) and airborne transponders. Ground-air-ground data link communications can be accommodated integrally with the surveillance interrogations and replies. Acquisition of 197 systems is planned. The first procurement of 137 systems will provide surveillance and data link coverage from the ground up at most major terminals and above 12,500 feet MSL in the en route airspace. The second procurement (60 systems) will extend the en route coverage downward to 6000 feet MSL or to minimum en route altitude if higher. The first operational unit is scheduled for delivery in February 1988, and the last system scheduled for commissioning in April 1994. Mode-S/Data Link hardware will be interfaced to existing and future search radars (ASR-7/8, ARSR-3, ASR-9, and 3-D) as part of the nationwide surveillance network. An interface through the Advanced Automation System (AAS) will provide automated controller/pilot data and advisory interchange. The ARTS-II interface project will provide modification packages for ARTS single-sensor and dual-sensor ASR-9/Mode-S sites. The Weather Communications Processor (WCP) will interface with the Mode-S/Data Link System to generate reply messages in response to requests for weather data. Automated Weather Observation System (AWOS) information will be part of the services being transmitted to pilots that use Mode-S/Data Link. Traffic Alert and Collision Avoidance System (TCAS) uses Mode-S data format and frequencies. Mode-S/Data Link will be a Remote Maintenance Monitoring (RMM) system. Other interfaces include National Data Interchange Network (NADIN) 2 and Flight Service Automation System. The major interfaces will be defined by interface control documents (ICD).

Status

Mode-S/Data Link is a designated major system acquisition (DMSA). The first 137 Mode-S sensors will be procured with a firm plus option funded fixed-price incentive contract with partial turnkey installation. An option item for a reprocurement data package is included in the planned contract that will permit competitive procurement of the remaining 60 systems. The contract for the first 137 systems is planned for award in mid-1984. Contract award for the second procurement is scheduled for September 1988.

Audit Findings

Technical

No significant technical concerns were identified during the audit; however, interfaces of the Mode-S antenna with various primary radar antennas is not completely defined. As a result, at FAA's request, we are conducting a study that will assist in defining the interfaces.

Although there is an ongoing FAA research, engineering, and development program to develop, test, validate, and standardize the technical characteristics of the Mode-S Data Link messages, a complete set of users of this capability has not been developed. An accelerated effort to fully define users, their requirements, and compatible interfaces will assure timely integration of data link services into the NAS.

Schedule

Schedule is considered high risk due to undefined antenna requirements.

Recommendations

Increased management emphasis is recommended to ensure the timely development of data link users and services so that full benefits of the system will be realized.

A structured ICD process with each interfacing project should be established.

5.2.13 Terminal Radar (ASR) Program

Role in NAS

The Airport Surveillance Radar (ASR) or Terminal Radar is short range radar used extensively for terminal aircraft flight monitoring. The ASR-9 is designed to meet current and future air traffic service terminal radar coverage requirements, as defined in the System Requirements study, dated April 30, 1978.

The ASR leapfrog program to replace obsolete, high-maintenance terminal radars supports the NAS Plan maintenance reduction objectives and will enhance air traffic control operational capability.

Products

The terminal radar program is to be accomplished in two phases. First is the acquisition of 96 new solid-state moving target detector (MTD) radars with a separate weather channel through the ASR-9 project. These new radars replace all of the moving target indicator (MTI) radars (ASR-4,-5, and-6), as well as the more advanced design ASR-7 and-8 devices at selected airports. The first ASR-9 system delivery is scheduled for March 1986, and the last system delivery is scheduled for November 1989.

Secondly, 56 ASR-7 and-8 equipment displaced by the ASR-9 will be leapfrogged into low-density airports currently equipped with ASR-4,-5, and-6. The first and last ASR-7/8 leapfrog installation starts are scheduled for October 1987 and January 1990, respectively.

The ASR-9 project interfaces with the following NAS Plan projects: Remote Maintenance Monitoring, Air Traffic Control Radar Beacon System (ATCRBS-4 and -5); Mode Select Beacon System (Mode-S); and the Terminal Computer Systems (ARTS-IIA or ARTS-IIIA).

Status

A firm-fixed price contract for ASR-9 design, development, and production was awarded during the last quarter of 1983. The PDR occurred as scheduled during March 1984, and the contractor is proceeding towards a CDR in September 1984.

Audit Findings

Technical

The ASR-9 project provides for contractor development of interface documentation. This method of developing interfaces may result in ASR-9 interface requirements being forced on related interfacing elements.

Schedule

No schedule concerns were identified by the audit, assuming quantity and installation locations remain relatively unchanged as system coverage requirements dictated by national network studies become mature. Software rework is required.

Recommendations

The ASR-9 design has anticipated interface requirements with other NAS Plan projects. It is recommended that these external interfaces be reviewed and formal interface control be established. Since ASR-9 CDR is imminent (September 1984), interface issues must be resolved quickly to avoid cost and schedule impact to the ASR-9 program.

Similar interface control should be established for the leapfrog program.

5.2.14 Airport Surface Detection Equipment (ASDE-3) Radar

Role in NAS

The ASDE-3 will provide an improved, all-weather capability for air traffic controllers to safely handle projected increases in airport traffic at high density airports.

The ASDE-3 is a standalone device. However, by providing ground controllers with an accurate and reliable source of surface and near-surface traffic data, the ASDE-3 enhances the potential for increased traffic densities available through the AAS project. The ASDE will support RMM requirements.

Products

This system provides high-resolution, short-range, clutter-free airport surface surveillance information on moving or fixed aircraft and vehicles. The system functions during adverse weather and low visibility conditions. It will detect both stationary and moving aircraft or vehicles at or near the surface of airport movement and holding areas. Information collected by ASDE-3 will be digitally converted from rho-theta to rectilinear coordinates, integrated with locally stored, digitally reproduced, airport surface maps and transmitted via television type communication circuits to dedicated displays located in the airport tower. Thirty ASDE-3 installations are currently planned; some locations will require multiple ASDEs to provide full coverage of the airport moving and holding areas. First and last system deliveries are scheduled for March 1988 and June 1990, respectively.

Status

The ASDE-3 is in the pre-RFP phase. The FAA has demonstrated design feasibility at the Technical Center and is in the process of moving the demonstration unit to Anchorage, Alaska, for operational installation during December 1984.

Audit Findings

Technical

Current planning now reflects the procurement of 30 units versus 29 in the NAS Plan. Some airports will have dual units and may require mosaicking of data.

Recommendations

The NAS Plan project description should be updated to reflect the requirement for some dual ASDE-3 installations and the currently planned number of system installations.

5.2.15 Long-Range Radar (LRR) Program

Role in NAS

This program will reduce maintenance workload and logistics costs, as well as resolve parts problems for obsolete radars. The major value will be the establishment of a national radar surveillance network in the en route airspace structure, providing the surveillance coverage needed for ATC.

Products

This project will provide a national radar surveillance network and upgrade, replace, or decommission systems requiring periodic visits or excessive maintenance. There will be solid-state kits to modernize ARSR 1/2 and FPS-60 vacuum-tube radars. There will be remote control interface units (RCIU) for tube-type radars, and an ARSR-3 relocation and RMM package. Procurement of 48 3-D radars will replace all joint surveillance systems (JSS). Contract award for tube-type upgrade is scheduled for March 1985, with first and last deliveries planned for July 1986 and September 1988 respectively. The ARSR-3 relocation contract will be awarded in July 1987 and the RMM package in March 1987. The contract for the 3-D radar is scheduled to be awarded in January 1986, with first delivery planned for September 1988 and the last in December 1990.

Long-range radar programs will be coordinated with plans for Mode-S implementation to assure compatibility of digital message formats. Mode-S antennas will be installed in a back-to-back configuration on LRR antennas. RMM will be provided for all ARSR-3 and 3-D facilities. The AAS will perform radar mosaicking at Area Control Facilities (ACF) on 3-D sensor data (exclusive of the height channel).

Status

Components of this project will be introduced on a time-phased basis. Separate contracts will be awarded for the tube-type upgrade, 3-D radar acquisition, relocation of the ARSR-3's, and ARSR-3 RMM. The RFP for the tube-type upgrade was released in May 1984. The specification for the 3-D

radar is in preparation, and the site surveys for the 3-D radars are scheduled to start in June 1984. The remote control units for tube-type radars are being delivered, while the ARSR-3 RMM is under development.

Audit Findings

Technical

The procurement of terminal-type radars (such as ASR-9) for use as gap fillers in the national surveillance network is no longer under consideration by the FAA, as other options are being studied.

An air traffic requirement to provide primary and secondary radar coverage from 6000 ft MSL (or MEA) to 20,000 ft MSL, where operationally feasible, may result in the need to procure up to 65 additional long-range radars. The coverage requirement is the goal of a national surveillance network study, currently underway.

The FAA has not established a 3-D radar program office and has not finalized a joint procurement agreement with the Air Force.

Schedule

The Request for Proposal for the 3-D radar is scheduled for release in March 1985, with contract award in January 1986.

Recommendations

The NAS plan should be updated, removing references to the ASR-9 as a gap filler.

Priority should be given to finalizing the national surveillance network study to determine the impact on the long-range radar program. If the results of the study indicate additional LRRs are needed, the coverage

requirements should be analyzed for possible adjustment on an area-by-area basis with the goal of reducing the number of radars necessary, consistent with flight safety.

The FAA should promptly establish the 3-D radar program office and finalize the joint procurement agreement with the Air Force. Following these actions, close coordination between the FAA program office and the Air Force will be required to ensure a timely procurement of 3-D radars.

5.2.16 Weather Radar Program

Role in NAS

Next Generation Weather Radar (NEXRAD) will significantly improve the detection and dissemination of aviation weather data in the en route environment. This improvement will allow pilots and other NAS users to more efficiently use the nation's airspace. There will also be a significant increase in the safety of flight when continuous near real-time weather information is available to pilots and controllers.

Products

NEXRAD is a Doppler radar that will be deployed in a national network to provide accurate aviation weather products for en route applications. According to the NAS Plan, acquisition of 170 systems is planned, broken down as follows: 113 systems for CONUS network, 11 FAA non-CONUS systems, and 44 USAF systems. A contract for limited production of 10 NEXRADs will be awarded in September 1986, following the test and evaluation of two prototype radars. The full production contract is scheduled to be awarded in April 1987, with deliveries running from December 1988 to October 1992.

NEXRAD data will be accepted, contoured, and mosaicked by the Central Weather Processor (CWP) into an image covering Area Control Facility and Flight Service Data Processing System areas. The AAS will enable selected NEXRAD data to be displayed at control positions in the Area Control Facilities.

Status

NEXRAD is being funded jointly by the Department of Commerce (60 percent), the Department of Defense (20 percent), and the FAA (20 percent). An initial procurement of 10 NEXRAD units will be followed by a full production procurement. The program is in the design validation phase. Two contractors are fabricating prototype units for delivery in December 1985.

Audit Findings

Technical

Significant effort remains to complete development of the NEXRAD radar and to define, design, and develop its operational use in the ATC system, i.e., operational concept has not been finalized and weather algorithms not fully defined.

The NAS Plan identifies 11 NEXRADs to be installed at locations outside the continental US. Current requirements are for 13 systems. The timely development and verification of weather product algorithms is essential to the success of the program.

Schedule

The NEXRAD program is on schedule.

Cost

When comparing the NAS Plan funding of $275.5M to our estimated value of $191.0M, the resulting variance is $84.5M.

Recommendations

An adequate working relationship between FAA, DOC, and DOD should be ensured to continue development of NEXRAD.

An operational concept within the ATC system should be defined and developed.

The NAS Plan should be updated to reflect the change from 11 to 13 non-CONUS NEXRADS.

Cost inconsistencies should be resolved.

Weather algorithms should be fully defined.

5.3 INTERFACILITY COMMUNICATIONS SYSTEMS

Approach

Modernization of interfacility communications, as described in the NAS Plan, is an ambitious attempt to upgrade the NAS communications capabilities and reduce costs. The thrust of the overall program schedule is to have the increased and improved communications capability available in time for the other NAS Plan projects to use it effectively and efficiently as they come into being. In fact, the communications system will provide the vehicle for transitioning to the modernized NAS. The approach, as described in the NAS Plan, appears to be both technically and programmatically sound. This conclusion is based on our assessment of the NAS Plan objectives, the selection of current but mature state-of-the-art technology, and the establishment of realistic project schedules. This includes consideration of transition from existing communications capabilities and needs of other NAS Plan projects.

In general, the nine interfacility communication systems projects are an attempt to control FAA communications costs and meet increasing demands. By using state-of-the-art equipment, a by-product of increased communications, system availability and reliability will be achieved. This translates directly to increased air traffic safety. The projects are summarized in Table 5.3-1.

Realization of the potential benefits associated with modernization of the interfacility communication's system is directly dependent on establishment of a NAS integrated communications system (NICS) design. Although the nine interfacility communication system projects appear to be soundly conceived, as described above, they must be properly integrated in an overall design that also encompasses the FAA's voice switching projects and all other NAS Plan projects that are users of the communications system. The need for an integrated approach to NAS communications is discussed in detail in section 3.2.2 of this report.

Table 5.3-1 Interfacility Communications Systems

Project	Category	Next CDP	1st ORD	SEI Role
RML Trunking				Tech Support
Data Multiplexing		Prop Eval Compl 8-84	Late 1984	Tech Support
RML System Replacement	MSA		3-1985	
Television Microwave Link			1987	
Airport Telecommunications			Late 1985	
NADIN 1A	TPL		1-1985	
NADIN 2	TPL	Rev Draft Spec 10-84	1985	Tech Support
Radio Control Equipment	TPL	RFP Rev Compl 8-84	1987	Tech Support
Teletypewriter Replace		In Progress		
Total Interfacility Communications				

Near-Term Evaluation (to 1985)

During the near-term period, all nine of the Interfacility Communications projects will be in the implementation phases.

1) Partial or Complete Implementation (four systems)

- RML Trunking (last funding in 1984, completed in 1985)
- Data Multiplex (partial)
- NADIN 1 (completed)
- Teletypewriter Replacement (partial)

2) Systems Acquisition (three systems)

- RML Replacement and Expansion
- Airport Telecommunications
- NADIN 2

3) System Definition/Development (two systems)

- Television Microwave Link (TML)
- Radio Control Equipment (RCE).

Our audit identified some minor technical, cost, and schedule risks. Minor concerns are identified on several projects and are presented later in this section under audit findings for each project.

There are some programmatic concerns that may affect schedules. The RCE project has been designated for a specified portion of the contract to be set aside for an 8 company. This is unusual for such a large procurement and may translate to technical and schedule problems. The RML Replacement and Expansion project entails adding approximately 250 new sites to the RML system. Environmental impact statement processing for the new sites could affect schedules. These are not considered to impact overall NAS Plan goals or benefits to be derived.

Intermediate Evaluation (1985 to 1990)

During this period, the following categorization of projects will exist:

1) Partial or Complete Implementation (seven projects)

- Data Multiplexing (partial)
- RML Replacement and Expansion (complete)
- Television Microwave Link (complete)
- Airport Telecommunications (partial)
- NADIN 2 (complete)
- Radio Control Equipment (partial)
- Teletypewriter Replacement (complete)

2) Systems Acquisition

- None

3) Systems Definition/Development

- None

The major concerns during this period are the transitions in the RML, NADIN 2, and RCE projects. Careful planning and monitoring will mitigate these concerns.

It is important to note that the major benefits of the Teletypewriter Replacement and Data Multiplex projects will be attained early. The Teletypewriter Replacement project will be completed in 1986, and the majority of the Data Mutiplex project will be completed by 1987.

Long-Term Evaluation (1990 to 2000)

This period will see the completion of all Interfacility Communication projects. Significant cost savings and avoidance benefits plus operational benefits will be realized as the NAS Plan projects use the upgraded facilities provided by the Interfacility Communication projects.

5.3.1 RML Trunking

Role in NAS

The RML trunking project provides telecommunications circuits to meet FAA needs at a lower cost than commercial leases. The use of the circuits is the same as commercial leases.

Products

The RML trunking project provides commercial off-the-shelf multiplex equipment to use unused bandwidth of the current RML system. This use of the unused bandwidth has added common user capability within the RML system.

Status

The regions were tasked by FAA Headquarters to identify targets for the RML trunking project. Since 1984 is the last funding year for the RML trunking project, follow-on efforts will be incorporated in the RML Replacement and Expansion project.

Audit Findings

Technical

The technical goals of the RML trunking project have been met. The project offers FAA-owned transmission media for general user telecommunications circuits having the same capabilities as leased circuits. The RML trunking project has also furnished valuable lessons to the FAA that will be carried forward into the RML Replacement and Expansion project. These include identification of interface parameters and commercial tariff problems.

Schedule

Schedule objectives have not been met and the project dovetails into the follow-on RML Replacement and Expansion project.

Recommendations

None.

5.3.2 Data Multiplexing

Role in NAS

The Data Multiplexing project provides a more cost and operationally-effective method of transferring data information. The interfaces remain the same for user systems as for commercial dedicated leases. The system is transparent to users. When the RML Replacement and Expansion project is deployed, many of the commercial trunk leases for the Data Multiplexer can be cancelled and the circuits routed on the RML system.

Products

The Data Mux project provides commercial off-the-shelf multiport modems and statistical multiplexers to concentrate leased circuits into a smaller number of commercial telecommunication circuit leases. Inherent in the equipment being procured is a new capability for monitoring and analysis of equipment and telecommunications circuit failure and deterioration. The equipment is being installed in phases. The phases are sequenced to provide the optimal cost savings and performance improvements. The first phase will provide modems between radar sites and ARTCCs. The second phase will provide additional units for terminal facilities (i.e., FDIO, ARTS). The third phase will provide modems to support FSDPS. The phases in some cases may become interleaved because one multiport modem can be used to support multiple operational user systems needs. The Data Mux equipment is being obtained on a lease contract administered by the Defense Commercial Communications Ordering Office (DECCO). The contract was awarded as a result of a competitive competition. The contract contains an option to buy. This option will be exercised by the FAA where it is cost effective. The Data Mux project will support operational and communication systems such as RRWDS, ARTS, FDIO, AWOS, TMS, NADIN, IDAT (Interfacility Data), CBI, etc. The Data Mux project is a fast payback project.

The Data Mux project provides three main benefits to the NAS. The first benefit is cost savings and future cost avoidance. This was the main purpose of the program. However, the other two benefits, although by-products, may be more important to the FAA.

The second benefit is the inherent capability of the system to monitor and analyze the Data Mux equipment and its interconnecting telecommunications circuits. This provides near real-time pinpointing of catastrophic system failures, and the ability to predict failures due to degradation. This will enable the FAA technicians in many cases to fix-before-failure rather than the user identifying failures as presently required.

The third benefit is derived from the network topology devised by the FAA for the Data Mux project implementation. This includes, wherever possible, arranging the network in triangles. Thus, when a Data Mux trunk is disrupted for any reason, the circuits using it (such as radar data) can be rerouted using the other two legs of the triangle. This will increase the availability of data to the users, under FAA control, when communications circuits fail. Rerouting of data has been accomplished several times in the lead region (Southwest) for the project. At locations where the Data Mux project has not been installed, the FAA must now depend on high-cost redundant circuit leases. Where redundant leases are not available, the FAA must await repair of the circuit by the commercial telecommunications carrier before data transfer can be restored.

Status

The Data Mux project is on schedule using a lease with option to buy contract. It is spreading nationwide from the Southwest Region, which is the lead region for the project. The Data Mux project is meeting its technical, operational, schedule, and cost objectives. In fact, the benefits to be derived exceed the objectives for the project. There are future schedule concerns as to the availability of the FAA's AF and F&E work force to install the equipment. Workarounds of this impediment are being investigated by the project manager. The workarounds include use of equipment installation personnel from the equipment vendor.

The 14.4-kbps modems in the project require high quality circuits. The equipment specification identifies North American Bell Standard 3002 type circuits with D1 conditioning. Difficulties have been experienced in the field in commissioning (actuating) the high quality circuits. These problems are being overcome by diligent efforts on the part of FAA and commercial communications carrier technicians. The result of the front end efforts should result in less circuit failures in the future.

Audit Findings

Technical

The potential exists for additional circuit lease savings via multiplex engineering by the Martin Marietta, and from results of an AES contract with BDM Corporation for telecommunications modeling and sizing criteria.

Schedule

No schedule problems were identified during the audit.

Recommendations

The Data Mux project should continue as scheduled. The project meets or exceeds its original objectives. As computer tools and models become available to SEI from the BDM Corporation, multiplex systems engineering should be used to attempt to derive even greater cost savings and operational benefits.

5.3.3 RML Replacement and Expansion

Role in NAS

The RML project will provide a national telecommunications network that will meet NAS Plan requirements. It will be transparent to operational users. It will also provide a higher operational availability to the users than the present network, which is a mixture of expensive leased circuits and use of the existing RML system.

Operations costs and maintenance costs will also be reduced since the RML project will provide solid-state electronic equipment with built-in alarm and monitoring functions.

Products

The FAA's RML system was developed as a grouping of star cluster networks, feeding radar information from radar sites into the ARTCCs. Most of the RML equipment in use is obsolete tube-type. It was installed approximately 20 years ago. Although still performing, the equipment is difficult and expensive to maintain.

The RML Replacement and Expansion project will replace the obsolete equipment at approximately 750 facilities. Approximately 250 new sites will be added to the system to connect the tips of the stars together and form a national common user grid communications transmission system. The RML Trunking project has already added some common user capability to the RML system.

The RML Replacement and Expansion project is to be phased over a 5-year period. The first phase will replace marginal links at selected locations throughout the country and provide single-line connectivity between the Albuquerque, Denver, Salt Lake City, San Diego, Oakland, and Seattle ARTCCs. The second phase will provide single-line connectivity between all ARTCCs except Minneapolis. The third phase will tie Minneapolis to the network, complete replacement of existing links, and provide initial dual-route capability between selected ARTCCs. The last phase will complete the network

and provide redundant network communications paths between all ARTCC and many radar sites. The system will also provide drop and insert capability along the routes, where required and cost effective, to allow access to the network for remote sites requiring telecommunications services.

Status

The RML Replacement and Expansion project is in its initial stage. Technical proposals for the RML equipment have been received from industry and are being evaluated by the FAA. BDM Corporation has completed a study that identified the equipment capacity to be in excess of 800 voice-equivalent circuits. Microwave equipment is provided in building block sizes by industry. The next larger size than 800 circuits of 960 circuit capacity was identified by the FAA for the industry to submit proposals.

Although the system sizing has been determined, the multiplex plan remains to be developed to determine the amount of multiplex equipment to be procured for each site. The BDM Corporation, under a support contract from AES, will assist in this determination. The regions will supply information on their specific needs.

We have been tasked to develop the RML implementation plan. The Plan is scheduled to be completed in October 1984.

Audit Findings

Technical

The RML Replacement and Expansion Project will meet the functional and performance goals and objectives of the NAS Plan. Since the equipment used will be mature and proven commercial off-the-shelf equipment, the RML project is a low-risk project.

In the third phase of the program, diverse routing, alternate routing, and restoration routing of circuits will become available as the initial grid networks are activated. At this time, the RML project includes the installation of system control equipment and processors. The system control will be capable of furnishing the required information to the FAA's national maintenance reporting system. This portion of the project entails the only

software required in the project. This software development and procurement will be low risk. Commercial off-the-shelf software for these functions is available from industry. It should be easily tailored to the FAA's RML requirements and will provide a robust and flexible network that can adapt to changing FAA missions and needs. Cost tradeoff studies can be made on a site-by-site or network basis. These studies can determine the economic viability of adding or deleting sites, reconfiguring the network as future changes in mission are identified, or the costs of lease circuits changes. Normal minor engineering difficulties may be expected in the radio frequency spectrum area where new sites are added.

The new solid-state electronic equipment, along with the monitoring and fault reporting system to be used, will reduce maintenance requirements. This may allow concentration of the RML maintenance force in fewer locations. The new RML system will use redundant equipment and in itself will be a redundant system because of the use of frequency diversity techniques and diverse routing.

Schedule

The acquisition plan is feasible and may be accelerated if funding becomes available earlier than scheduled to move forward lease circuit cost savings and future avoidances.

Environmental impact statements must be developed for new sites in the RML system. To mitigate this potential problem, the FAA plans to collocate with already established microwave systems and to use existing government facilities wherever possible.

Transition from the existing RML system to the new RML system will encounter the normal difficulties associated with replacing a microwave system with another where parallel operations must be maintained until the new system is tested and proven prior to commissioning and cutover of circuits. Another transition problem that must be overcome is new antenna placements on existing towers. A great number of the current RML sites use periscope antenna systems that radiate vertically to a flat reflector that reflects the radio signal to the next site in the same manner as a mirror reflect light. Satellite

communication using the same frequency spectrum has necessitated this vertical transmission and reception be terminated during the RML Replacement and Expansion project. Some new horizontally radiating antennas will have to be placed below the reflectors. The selection of an equipment contractor, whose engineers and installation technicians are experienced in dealing with this problem, will mitigate this problem.

Recommendations

None.

5.3.4 Television Microwave Link (TML)

Role in NAS

The role of the TML in the NAS is to transmit BRITE signals to satellite airport towers.

Products

The TML project will provide microwave equipment to transmit the analog television signals from the BRITE display in the towers to the towers at satellite airport. The project will be installed at 46 selected locations in conjunction with BRITE system installations. Funds for the TML equipment are included in the BRITE project.

Status

The TML project is not active. Installations are planned to be completed in 1987 in conjunction with the BRITE project.

Audit Findings

Technical

The TML will be commercial off-the-shelf equipment. Interface to the BRITE system is covered in the BRITE system specification. There are no national buys, and no standards exist that would ensure compatibility with an eventual integrated communications system.

The TML system will perform its stated operational mission. The role of the TML in the NAS Interfacility Communications System (NICS) is unclear. The NAS Plan (April 1984) states: These TML links may be used to extend the Interfacility Transmission System established by the RML Replacement and Expansion project. There are no national buys, and no standards exist that would ensure compatibility with an eventual integrated communications system.

Schedule

No schedule problems were identified during the audit.

Recommendations

The current FAA philosophy is aiming toward an integrated nationwide communications system, making maximum use of FAA-owned microwave transmission links. This is being accomplished under the RML Replacement and Expansion project. It is suggested that TML project be integrated into the RML Replacement and Expansion project and use the same standards, specifications, and procurement. The RML project already requires transmission of a wideband analog circuit such as the BRITE television signal. In this manner, equipment standardization will be obtained and the TML can act as local extensions of the RML, carrying common user circuits that are currently leased wherever it is cost effective.

Analyses/tests should be performed to assure that TML will support the BRITE display requirements. Requirement bases should be verified/modified on the results of these analyses/tests.

5.3.5 Airport Telecommunications

Role in NAS

Control, signal, and communications cables serving FAA facilities at many airports are reaching the end of their useful life or capacity for growth. Replacement with new loop cable systems will provide for increased capacity and future growth, eliminate outages caused by deteriorating cables, and increase facility availability through increased reliability provided by inherent redundancy. The cable loop system will permit incorporation of RMM without need for additional cable and will allow for repairs with a minimum of outages. Replacement of cables with fiber optic cable will allow collocation of telecommunication cables with power cables. Installation costs will be reduced if fiber optic cable is concurrently installed in common trench with power cable loop system. Fiber optic cable will also reduce cable damage from lightning surges and reduce interference from noise intrusion.

The tower sector suite, RMMS, MLS, and other airport-based systems could use the cable loop system for data communications; however, they are not dependent on the loop system since they can be implemented using other data communication options. Close coordination is needed with communications facilities consolidation and airport power cable loop system.

Products

This program provides for replacement of radially installed telecommunications cable systems at 100 high and medium activity airports and 300 low activity airports. Replacement systems will be arranged in a loop configuration around the airport and will use either conventional metallic multiple conductor cables or new technology systems such as fiber optics, packet radio, or other means.

Status

Each region will develop a master plan of the cable systems at each of its major airports. The most cost-effective solution based on guidelines for upgrading control/signal cable systems under FAA Order 6950.23A will be determined for each airport's specific needs. The regions will use the master

plan to assess facility importance, location, redundancy requirements, method of installation, costs, and the combination of multiple facility requirements within the same system. Priority will be given to airports requiring major replacements of cables.

A total of 115 high-and medium-activity regional airports have been identified as potential candidates from which to select 100 sites for this program. Airport selection criteria, RF link standards, and fiber optic specifications are under development and are scheduled for completion in late 1985. Implementation is scheduled to commence in late 1985 upon completion of these efforts.

Audit Findings

Technical

Project scope affecting costs includes 300 low-activity airports separated from the airport power cable loop system program. Funding remains under the power cable loop program and does not identify increased scope nor separation of installations.

Schedule

This program is proceeding on schedule, but needs resolution of scope and required funding.

Recommendations

None.

5.3.6 National Data Interchange Network (NADIN) 1A

Role in NAS

The NADIN is a store-and-forward message switching system that consolidates all of the FAA's low-speed teletypewriter networks into one network. This capability allows for discontinuance of obsolete systems, reduction in comparative leased costs, as well as expansion capability to meet the need for improved services and system expansion. This system provides for integrated data services and interoperability to be achieved on a phased basis for the NAS.

Products

The NADIN 1A system is the major part of FAA's data switching capability and is configured to meet the needs of the user population and backup requirements. A dual-star configuration is being implemented with a message switching computer being the hub for 11 or 12 concentrators. The concentrators are located at each en route facility, which are natural hubbing points for area circuits. Each connecting trunk circuit has an autodial backup path, as well as rehoming capability to an alternate switching center. Thus one surviving center can support the entire network. The two switching centers are also normally connected with trunk circuits.

System interfaces will be to the NAS 9020, FSDPS, WMSC, CNS, AFTN, NWS, ARINC airlines, military BASOPs, FAA communication centers, and USAF facilities at selected locations.

The program is supported by a concentrator and an abbreviated message switching center at the FAA Technical Center for hardware and software modification efforts. Two training concentrators, which are also available for relocation needs, are in place at the FAA Academy.

The current schedule calls for system cutover to commence in January 1985 and last approximately 3 months.

Status

The NADIN 1A system is currently in a state of operational software testing and debugging. By September 1984 it should be known if the start of cutover, scheduled to begin January 1985, is realistic.

Audit Findings

Technical

The operational requirements for NADIN 1A are still basically valid, and the system is projected to meet those needs. However, a plan needs to be developed that addresses three main areas for the post-implementation period to:

1) Identify and characterize the data volumes and interface requirements for new network users (not planned for in NADIN 1A capacity and interfaces) in 1985-1988 timeframe.

2) Identify and characterize NADIN 1A data flows and volumes that will evolve from initial implementation due to external actions. Example: Air Carrier IFR flight plans, NOTAM impact due to FSAS, VFR flight plans due to FSAS and ATMS.

3) Integrate new or changed user interfaces and capacity requirements into the network.

Some software upgrading is projected following cutover to provide the full range of message format conversion and processing services.

The technical process identified above must be accomplished to support the operational needs of the new or changed users. The greatest impact is to continue the process of data integration to avoid nonstandard and standalone networks from emerging because the user needs were not specifically addressed in the NADIN 1A specification. This has a leased service cost, I/O hardware and software cost for NADIN and the user system, and downsteam impact on NADIN 2. Plans for network support, resource management and planning, and user requirements analysis are lacking other than the hardware/software modification processes. The need for active network management processes to support NADIN operation have not been recognized or planned for.

The NADIN 1A program plan and FAA efforts have been directed at getting the system procured, installed, tested, and implemented. These are traditional program/project management functions that appear to be on track and obtainable on schedule. The traditional role of a headquarters project effort stops at this point. The needs of a system like NADIN, however, require a centralized management and planning function to effectively handle network enhancements and changes to user data flows and requirements, as well as provide operational expertise for NADIN 2 implementation planning. This has not been provided for in the NAS Plan or program plan.

Schedule

NADIN 1A schedule for initial implementation appears to be on track at this time. No schedule has been developed for handling the post-implementation period.

Recommendations

1) Determine system capacity, interfaces, and features necessary to support new or changed user requirement in the 1985-1988 timeframe. This effort should also address the issue of which users, and when, will transition to X.25 Packet Mode on X.25 PAD service, and which will be handled by store-and-forward service.

2) Determine the proper roles and requirements for network management and resource management for NADIN. Develop a plan to provide such support by FAA organizational responsibility or by subcontracting.

3) Update NAS Plan to agree with schedule in the smart sheets.

5.3.7 National Data Interchange Network (NADIN) 2

Role in NAS

The NADIN 2 Phase I system provides additional capacity and reliability to the network through the addition of packet switching nodes, and provides new services. These new services also furnish the transition mechanism for upgrading user interfaces and provides logical routing of data through the network. This is projected to provide significant cost savings and performance upgrading over that possible in the NADIN 1A configuration. NADIN 2 provides the majority of the data switching services needed by the FAA and interconnected aeronautical users.

The additional services in NADIN 2 will allow users to adopt standard medium and high speed interfaces that will allow a greater degree of integration and interconnectivity of NAS elements. A centralized network management center is planned to provide operational and technical monitoring of the network resources.

Products

The NADIN 2 project is a packet network comprising 20 nodes that will allow for standard and specialized interfaces, as well as a trunking system for store-and-forward (NADIN 1A) services. The trunking system will replace the dedicated circuitry (dual star) that was implemented to support NADIN 1A. The phase I competitive procurement effort will establish this basic packet network structure. Phase II expansion of the network will add additional I/O capacity, interfaces, and similar improvements to handle later stages of NAS automation and integration. Initial installation is planned for late 1985, with additional integration work continuing over approximately the next 1-1/2 years.

Status

The NADIN 2 procurement activity is in the final specification process that could lead to an RFP by late 1984. An industry review of the specification is planned before the RFP is released.

Audit Findings

Technical

The integration work that needs to be accomplished before implementation of the network is not identified on any of the project schedules. This is perceived as a major effort to ensure that those users who must transition to a new interface, or are new users, are properly documented. This process will provide for proper direction to project offices associated with the user systems and provide needed information to the NADIN 2 contractor to build the necessary adaptation and parameter tables for the network.

Situations are developing that could cause one or more users to implement discrete circuits to satisfy their requirements due to a NADIN 1A capacity problem pending availability of NADIN 2. The initial implementation of the NADIN 2 (Phase I) program has not specifically identified the users and interfaces of the packet network over and above the trunking needs of the store-and-forward service provided by NADIN 1A concentrators and switching centers.

Schedule

Assuming acquisition approval is on schedule, the schedule is realistic.

Recommendations

A network integration effort needs to be added to the program schedule.

An activity needs to be identified to do NADIN 2 transition planning before network implementation. This activity will identify when and how network users will be serviced by NADIN 2, and what users not serviced by NADIN 1A are to be included.

5.3.8 Radio Control Equipment (RCE)

Role in NAS

RCE, currently known as tone control equipment, provides the capability to control remotely located air-ground radios, an essential function in the direct controller-pilot voice communications concept. Current signalling/tone control equipment incorporates obsolete and troublesome tube relay devices with numerous deficiencies associated with the technology and age of the equipment.

Products

This project provides for procuring new solid-state RCE with added features. Components of the RCE will be installed in every control facility (ARTCC, TRACON, FSS, tower) and at every air-ground communications facility (RCAG, RTR, RCO). There are 725 existing control facilities and 2305 existing remote radio facilities. The RCE specification calls for development of modules that will be used as building blocks to meet a wide range of size requirements. The Type I equipment, used at the remote radio site, will control as few as two and as many as 4[illegible] transmitter/receiver pairs. The Type II equipment, used at control facilities, will control as few as two and as many as 113 air/ground channels.

Status

The specification has been completed, and the RFP is scheduled for issue in late 1984 with contract award scheduled for mid-1985. System installation is scheduled to start in FY 87 and extends into FY 90. The RCE development and production contract allows for specified modules to be subcontracted to an SBA designated source under the 8a pilot program.

Audit Findings

Technical

There is a discrepancy between the NAS Plan, the smart sheet, and the RCE specification as to the number of control facilities and remote radio facilities that will receive the RCE. These discrepancies apply to the

smaller size facilities. The quantities will probably be revised as a result of the communications collocation/consolidation project and consolidation of control facilities.

The RCE specification defines a specific technical approach to building the RCE. Additionally, the use of a specified subcontractor for FAA-defined parts of the system is unusual for development and procurement projects of this size. These factors give the RCE program a higher-than-usual possibility of encountering technical risks and schedule problems.

Schedule

The RFP release date has slipped at least one quarter, and the project may encounter further slippage because of the unusual acquisition approach.

Recommendations

The quantity discrepancies between NAS Plan, the smart sheets, and the RCE specification should be resolved.

The RCE specification defines both physical and functional partitioning of the equipment, which must be followed by the developer to be responsive to the specification. This level of detail should be re-evaluated to determine if it unduly restrains the developer or increases the uncertainty of cost or schedule performance by the contractor.

3) The contract should include development of special module-to-module interface controls for the design and test of the RCE, as well as more-frequent-than-usual contract progress milestones and FAA reviews.

5.3.9 Model 28 Teletypewriter Replacement

Role in NAS

This project replaces old and hard to maintain teletypewriter (TTY) equipment used for Service A and B at NAS facilities. The project will provide higher availability and lower cost to the NAS for Service A and B.

Products

This project involves replacing older Model 28 TTY equipment with new leased CRT TTYs provided by Western Union. The study to select the desired equipment and supplier was completed in 1982. Approximately 590 TTY equipments for Service A and B will be replaced at FSSs, ARTCCs, military bases, and other FAA offices. An additional 100 units may be leased during expansion.

Status

There is a phased plan for replacement of the older units in the field. It is anticipated that the plan will be fully implemented by the end of 1986.

Audit Findings

Technical

Easier-to-use CRT TTYs will replace obsolete TTY equipment, providing higher availability of the services needed and significant annual savings in maintenance costs ($7M to $8M per year is predicted).

Schedule

The project is on schedule. Service B implementation is dependent on cutover of NADIN 1A. NADIN 1A cutover is scheduled to begin in January 1985 and be completed by April 1985. No schedule problems are anticipated at this time.

Recommendations

None.

5.4 MAINTENANCE AND OPERATIONS SUPPORT SYSTEMS

The maintenance and operations (M&O) support systems projects are required for general support and enhancement of the NAS. These projects provide systems to implement and manage maintenance operations and upgrade existing NAS facilities and equipment, laboratories to support research and development and integration, FAA aircraft fleet improvements, and special technical and management support.

These 18 projects are grouped into 5 functionally related areas and are summarized in Table 5.4-1. Each of the areas are identified and discussed as a related group in this review. Our audit identified no significant technical, cost, or schedule risks for these projects. Minor concerns on several projects are presented in later project-level subsections. The five functionally related areas are:

1) Maintenance Improvement Projects
   - Remote Maintenance Monitoring System (RMMS)
   - Computer-Based Instruction (CBI)
   - Central Repair Facility (CRF)
   - Maintenance Control Center (MCC).

The above area is most fertile for M&O system improvements resulting in potential of long-term recurring operating cost reductions. It is critical that a top-down definition of system requirements be initiated as soon as possible, with subsequent allocation and derivation of requirements at the project level. The system requirements need to be driven by the maintenance philosophy required for the 1995 era. This is an area of concern because any change in maintenance philosophy will have significant impact on each of these projects with resultant schedule and cost impacts. Additionally, any change in maintenance philosophy can impact the overall communications systems including leased-line cost.

2) Power Improvements
   - Airport Cable Loop Systems
   - Power Conditioning System for Automated Terminal Systems III (ARTS-III)
   - Power Systems.

Table 5.4-1 Maintenance and Operations Support System

Project	Category	Next CDP	1st ORD	SEI Role
RMMS	TPL	Core System Plan	Phase II Mid 1986	Tech Support
Computer-Based Instruction		In Progress		
Central Repair Facility			Mid-1986	
Maintenance Control Center			Early 1986	
Airport Power Cable Loop System			9-85	
Power Conditioning System - ARTS-III			12-84	
Improved Power System		In Progress		
Nodernization of Unmanned Facility		In Progress		
ARTCC Bldg Modernization		In Progress		
Acquisition of FSS		In Progress		
Air Fleet Conversion	MSA		Mid-1984	
Aircraft and Related Equip			Mid-1986	
Systems Engineering and Integration		In Progress		
National Radio Communications	TPL		Late 1985	Monitor (1-85)
NAS Spectrum Engineering		In Progress		
General Support		In Progress		
System Support		N/A		
General Support Laboratory		N/A		

3) Structures Improvements
   - Unmanned FAA Airway Facilities Buildings and Plant Equipment
   - ARTCC Plant Modernization
   - Acquisition of Flight Service Facilities.

4) Aircraft Improvements
   - Aircraft Fleet Conversion/Flight Inspection Modernization
   - Aircraft and Related Equipment.

All of the projects in items 2, 3, and 4 above are straightforward solutions to problems currently encountered in the field due to aging facilities, environmental problems, etc. Each project is essentially a standalone requirement (no other project is dependent on these projects) to resolve immediate needs and appears to be both technically and programmatically sound. There were no significant issues to be addressed relative to these projects.

5) System Improvements
   - System Engineering and Integration Contract
   - National Radio Communications System (NARACS)
   - NAS Spectrum Engineering
   - General Support
   - System Support Laboratory (SSL)
   - General Support Laboratory (GSL).

Project integration testing will be accomplished and operational procedures will be verified at the FAA Technical Center. Two projects, System Support Laboratory and General Support Laboratory, provide the capability for a high fidelity test bed. All projects that require integration testing should supply equipment to support the FAA Technical Center activity before production equipment is sent to the field.

Projects that do not provide prototypes or first articles for this purpose create the potential for disruption of site operations if interface problems remain unsolved. Problems that are not resolved until after production start result in costly modifications and delayed schedules.

These types of undesirable delays and cost overruns can be reduced by ensuring project requirements are verified within a test bed configuration before field implementation. The SSL and GSL must be of high priority to ensure the necessary environment to accomplish system integration testing.

Of the 18 M&O systems, 6 will enhance NAS safety, 5 slightly, and 1 moderately. The remaining 12 do not affect NAS safety; but, the NAS spectrum engineering program is critical to resolution of EMI/EMC and coverage considerations in other areas.

5.4.1 Remote Maintenance Monitoring Systems (RMMS)

Role in NAS

RMMS is key to the FAA's ability to move into the maintenance program for the 1980's and to take advantage of the personnel reductions, cost reductions, and efficiencies of operations contained in that program.

Products

The RMMS is a system to provide monitoring for status and maintenance, as well as control and certification of equipment from remote work centers. The NAS equipment being monitored interfaces with the RMMS. The monitored information is transmitted, analyzed, and displayed by the RMMS processing system at the Maintenance Monitor Control (MMC). In addition, monitored data are sent to the Maintenance Management System (MMS) to establish a data base. The RMMS can monitor, alarm, certify, remote control, record-keep, diagnose, provide trend data, etc. The continuous monitoring from the MMCs will eliminate most periodic maintenance onsite visits, reducing travel costs and minimizing maintenance crew sizes. Isolation to lowest replaceable unit (LRU) by the RMMS will shorten service restoration time, minimize necessary test equipment, and simplify repairs—all this resulting in significant cost savings in personnel, time, and material. For example, RMM monitoring of 95 long-range radar sites can reduce one entire shift of monitor/maintenance personnel with a yearly estimated cost savings in excess of $4M. In summary, it is being implemented as a tool for the agency's 1980's maintenance program.

Status

The NAS Plan schedule had the project divided into three phases: Phase I, operation of 25 maintenance processor systems (MPS) monitoring RCAGs, second generation VORTAC, and limited remote control of ARSR-1's and 2's (by mid-1984); Phase II, addition of 65 to 86 MPSs at General National Airspace System (GNAS) sectors with remote maintenance monitoring of additional airport facilities and equipment such as DVOR, ARSR-3, navigation, and communications facilities associated with FSS (by 1988); and Phase III, RMMS enhancements to add uplink command and adjustment capabilities, remote diagnostics to further reduce onsite maintenance visits, and RMM of all new NAS equipment systems by 1992.

Phase I has not been completed as planned (mid-1984). Although all scheduled MPSs have been installed, the lead sector at Kansas City (Central Region) currently has the only MPS up and running for RMMS monitoring. As lead sector, Kansas City has not only developed the MPS maintenance and control software (MCS), but is now remotely monitoring several types of hardware (e.g., small airports package, ARSR-3), including archiving data and limited certification capabilities. Although Central Region's work has progressed well, it has not matured sufficiently for national distribution. Cancellation of the RCAG RMM equipment contract has compounded RMMS Phase I delays.

Because of the delay in Phase I, plans for beginning Phase II early next year have been revised since issuance of the NAS Plan, and the Phase I and II configuration goals have been adjusted into a so-called transition system, to be up by 1988. Current planning for Phase III (now called the final system) is projected to come online between 1990 and 1995.

The transition system will add 10 sector MPSs to the 25 en route units with interim MCS controlling the MPSs. Equipment to be monitored/controlled is planned to include RCAG, ARSR-1, -2 and -3, VOR, second generation VORTAC, ASR-9, and MLS. The final system will include up to 83 total MPSs monitoring all of the equipment planned for monitoring by the RMMS.

Audit Findings

Technical

Operational and functional requirements definition, currently underway, from a top-down system engineering approach, have not yet been completed in sufficient detail to allow performance requirements to be specified.

The interim guidelines for specific equipment managers and types of data requiring monitoring, now currently in development, need to be completed and published as a full set of guidelines.

Approximately 33 Tandem computers have been purchased, but a detailed Tandem computer timing and sizing study baselined against the latest RMMS requirements needs to be consolidated with previous and presently being updated MITRE studies. All new studies should consider MMS sizing needs.

Four key RMMS documents (NAS-MD-790, ICD, MCS-to-RMS; NAS-MD-791, ICD, MCS-to-MMS; NAS-MD-792, RMS Operational Requirements; NAS-MD-793, RMMS Functional System Description) are recognized as required and effort for same is underway. MCS-to-MMS interface efforts have begun with NAS-MD-791 scheduled to define that interface. Definition of this ICD needs added requirements identification and increased coordination between subsystems to make this a complete document.

Telecommunications needs, reliability, and redundancy requirements, as well as documented detailed technical requirements for RMM data flow, have been extensively addressed but have not been collected into an integrated set of requirements for communications interfaces.

FAA has laid out a new procurement strategy to take advantage of the Tandem MPS hardware already purchased, the software efforts completed by the Central Region, and other design and breadboarding accomplished by the FAATC (and others) of necessary RMMS hardware. This new strategy redefines the NAS Plan phases into the transition and final RMM systems described above.

Schedule

Because of the delays described above, and due to the fact that only one sector has even limited RMMS operating, the NAS Plan Phase I goals and objectives have not been met. It appears, at the earliest, that 1986 will see RMMS benefits accrue that were originally envisioned for 1984. The loss of these benefits was not quantified by the SEI audit team.

Recommendations

An in-depth systems requirements review should be undertaken to update the program definition and compare the results to the NAS-MD-792, RMMS Operational Requirements.

The FAA should augment present project management authority by establishing a charter for the program manager which would provide him the direction and latitude to tie all facets of the overall RMM program toegether.

A Systems Requirements Review (SRR) and/or a Systems Baseline Review (SBR) should be held subsequent to the requirements definition. These reviews should address both the transition (Phase II) and final (Phase III) systems.

An end-to-end procurement strategy for the RMMS final system should be prepared and a program implementation plan written. Effect on the transition system of such final system strategy should be examined.

An in-depth telecommunications study should be undertaken to identify data flow needs and technical and programmatic requirements on the communications system.

Further study on the Tandem computer's current and growth capability to meet the requirements of the final system is required.

Interface controls need to be implemented. Formal ICDs and ICD working groups should be established. Monitoring philosophy and guidance should be prepared for all program managers of equipment to be monitored.

5.4.2 Computer-Based Instruction (CBI)

Role in NAS

This project will provide an updated, computer-based instructional system for providing high quality, cost-effective training of FAA personnel. Travel costs associated with centralized, resident training are currently running $20M per year. CBI can significantly reduce these costs, while providing improved training productivity inherent in a self-paced, modular course of instruction, especially in view of the training efforts that will be required to support the new and enhanced systems currently being developed.

Products

The current program involves updating and expanding the existing CBI system, specifically the procurement and installation of new computer terminals (CDC Viking 721-731), video equipment (Sony), and printers (contract yet to be awarded) at both new and existing training centers. Installation is to be completed by 1985.

The updating of the CBI system with new CDC terminals will eliminate leasing costs for existing terminals and will provide the capability to interface with a variety of telecommunication links, thus significantly reducing the rapidly increasing lease costs for telecommunication lines required by the current equipment. In addition, the new terminals are considered more user friendly and more appropriate for training applications (e.g., improved graphics capability), thereby providing for more efficient and productive training as specified by the NAS maintenance program for the 1980's.

Status

The current approach is to update existing equipment and establish new CBI training centers throughout the NAS, especially where there are large concentrations of Air Traffic, Airway Facilities, and Aviation Standards personnel, such as sector field offices, ARTCCs, towers, flight inspection field offices, and regional offices. In some cases, CBI will be coupled with specific hands-on equipment training at the FAA academy. Whenever feasible,

CBI will be used at local or field sites and will form the nucleus of field-conducted training. New instructional technologies will be evaluated for potential benefit as an approved approach for accomplishing CBI training.

Current planning calls for 429 terminals to be installed by 1985 as follows:

AF sites (sector field offices, etc)	128
Flight inspection field offices	7
ARTCCs	150
Airport traffic control towers (Levels IV and V)	83
FAA Academy	49
Regions (9)/Technical and Aero Centers (2)/ Washington Headquarters (1)	12

Audit Findings

Technical

The use of computer terminals did provide a cost-effective means to conduct field training. Excessive costs for lease of AT&T telecommunication lines has eroded savings. Use of new CDC terminals will provide for use of numerous available links, including co-use of existing NAS communication links, thereby significantly reducing communication costs. Additional savings will be realized by proposed co-use of the U.S. Army's CBI processor at Redstone Arsenal, Huntsville, Alabama, thereby eliminating lease costs associated with nongovernment equipment.

The exact levels of training required to support NAS maintenance activities are in a state of flux due to significant changes being considered for the NAS maintenance concept, i.e., structured (shared) maintenance versus contractor maintenance (new equipment only). Depending on the final outcome, the CBI project could be significantly impacted since a number of anticipated courses may no longer be required.

The FAA is attempting to stay abreast of technological improvements being made in the field of CBI and of any other training methods being developed by

conducting a continuing study of these changes. It is anticipated that state-of-the-art improvements will make it attractive for CBI training centers at approximately 7-year intervals.

Schedule

This project is apparently on schedule, with a total of 65 terminals having been installed to date at AF sector offices, with the balance of AF terminals to be installed by September 1984. The remainder are scheduled for installation following identification of locations. Video equipment (recorders, tapes, and discs) are also being delivered, with printers awaiting award of a contract to a supplier.

Recommendations

CBI training should be expanded and used to the extent possible for existing systems within the FAA and for new systems that are not contractor-maintained.

Existing equipment should be updated to take advantage of FAA-owned links on a cost versus benefit basis.

Funds should be reprogrammed to accommodate funding shortfall.

5.4.3 Central Repair Facility (CRF)

Role in NAS

The establishment of nine central repair facilities supports the NAS Plan goals by providing for repair of more complex equipment at a reduced number of sites (one per region), thereby providing for reduced maintenance costs. Each CRF is to be equipped and staffed to make necessary repairs on digital, analog and hybrid modules, as well as PCBs using automated PCB testers and diagnostic software (to be developed by 1985).

Products

As currently planned, the Central Repair Facility (CRF) project involves the initiation and continuation of lead sector engineering studies (to be completed in 1984) to provide the necessary implementation guidelines and plans to establish a specific number of CRFs, and the actual establishment of those CRFs by 1986. These facilities would provide repair for those line replaceable items (LRI) which could not be reasonably repaired on site or must be sent to a higher level repair facility.

In addition to LRI repair and adjustments, it is anticipated that test equipment repair and calibration would be accomplished at the CRF by 1986. The CRF is also being considered as a storage depot for LRIs as well as storage for repair piece parts.

Status

The approach, as described in the NAS Plan, involves establishing a CRF in the Central Region as part of the lead sector program. This CRF is being used to establish concepts, procedures, and requirements for future CRFs. These include: (1) total required number; (2) staffing requirements; (3) space requirements; (4) training procedures; (5) type and level of repair; (6) logistic support requirements; and (7) type and number of support equipment required. By 1986 there is to be a CRF in each region. Special tools, furniture, diagnostic software for existing automated test equipment, and a test equipment calibration laboratory will be provided at each location.

Audit Findings

Technical

The CRF project is currently being re-evaluated due to possible changes in the NAS maintenance concept. Serious consideration is being given to maximizing contractor maintenance for all new equipment which, if adopted, could significantly modify the role of the CRF.

Adding to the problems is the difficulty incurred in trying to develop diagnostic software for use with the automated test equipment (AUTEK). Although several simple programs were developed, the vast majority of an estimated 300 programs (ARTS-II/III) have yet to be developed. Since the FAA lacked the personnel to undertake such a development program, most of the work was to be done by contractors. Funds had been allocated from the FY 1984 budget for development of approximately 100 programs; additional funding is to be requested in future budgets. In addition, most major equipment procurement contracts now being awarded specify delivery of appropriate diagnostic software with the hardware.

The decision has now been made to reduce the number of automated testers to only that number required to support the CRFs that are established in the regions. If, as the result of proposed changes to the NAS maintenance concept, the requirement for CRFs is downgraded by maximum contractor support, any existing testers would be provided to contractors as GFE. No effort will be made to develop diagnostic software for systems that will be phased out in the next 5 years.

A further reduction in maintenance costs is possible by limiting repair performed within the regional CRFs to existing equipment, while repair of new and replacement equipment would be performed at one national depot-level CRF serving all 9 regions. Current technical field personnel would be retained to continue servicing existing systems, while being provided the opportunity to retrain as system analysts who would perform fault detection/fault isolation tasks using the RMMS on the newer systems. As new systems continue to be introduced and old systems are phased out, an increasing amount of repair would be performed at the depot CRF until such time that all systems would be remotely monitored at the Maintenance Control Center. Once a failure is

identified and isolated by the system analyst, the failed item would be removed/replaced by a maintenance technician and the removed PCB/module sent to the depot CRF for repair/disposition.

If contractor support is considered for repair and calibration of all new equipment, the role of the CRFs would be greatly reduced. Old equipment could continue to be maintained using existing facilities, until such time that it was phased out. New equipment would be maintained by contractors.

Schedule

Diagnostic software supplied by hardware contractors of other projects will extend the CRF project schedule.

Recommendations

A formal review team should be established to perform a systems requirements analysis and define those requirements necessary for a viable CRF program. The review areas would include contract versus FAA maintenance issue, appropriate number of CRFs, and calibration laboratories and their disposition.

5.4.4 Maintenance Control Center (MCC)

Role in NAS

The MCC provides a focal point for continuous monitoring of all remote facilities through the use of the RMM networks and for managing/dispatching the center's maintenance work force as required. The Maintenance Processor System (MPS) will normally be placed in the MCC.

Products

As currently planned, the MCC project involves the initiation and continuation of lead sector engineering studies to provide necessary guidelines and specifications for establishment of MCCs (to be completed in 1984), the actual establishment of nine MCCs by 1985 (one per region), to be followed by the establishment of one MCC at each sector office or other suitable location (to be completed by 1988). Monitoring and control of remote facilities is essential to minimize the risk of service outages. When implemented, the MCC located at the general NAS and ARTCC Sector offices will be the central focus for all maintenance functions of remote maintenance monitor (RMM) facilities. All RMM data within the sectors boundaries will be routed to the MCC which will have the computer/data processing and network capability necessary to monitor performance parameters, make up-link adjustments, reconfigure, perform trend analysis, and certify on selected systems.

Status

The current approach is to establish MCCs in lead sectors as part of the lead sector program. The first of these centers is under development at the St. Louis AF Sector in the central region. The lead sector engineering studies will then be evaluated to establish procedures and finalize requirements for: (1) training, (2) certification, (3) communications, (4) hours of operation, (5) staffing requirements, (6) administrative support, and (7) space requirements. Standards for regional and sector implementation will then be developed to provide the continuity required for integration of new facilities into the RMM/MCC.

Audit Findings

Technical

The MCC project appears to be a viable program within budget. The project is currently in the engineering studies phase, with studies to be completed by the end of 1984. Whereas the current concept of one MCC at each sector office is considered a valid approach at this time, significant changes to other aspects of the NAS maintenance concept (i.e., contractor maintenance vs FAA maintenance and resultant role of Center Repair Facilities) could impact this project.

Schedule

No schedule problems were identified.

Recommendations

The results of the Fredericksburg maintenance conference to define system maintenance requirements to support the goals of the NAS Plan, especially as they pertain to the role of the MCC, should be evaluated. Results of other current engineering studies and the SEI/FAA maintenance role definition should be merged with the Fredericksburg maintenance conference results.

5.4.5 Airport Power Cable Loop System

Role in NAS

Power cables serving FAA facilities at many airports are 25 to 30 years old and are reaching the end of their useful life and capacity for growth. Replacement, as well as changing their configuration from a radial distribution to a loop system, will provide for increased capacity and future growth, or outages caused by deteriorating cables, and improve facility availability through increased reliability provided by inherent redundancy. The cable loop system will permit and will allow for repairs with a minimum of outages. Replacement of signal and control cables under Airport Telecommunications Program with fiber optic cable will allow collocation of power cables with telecommunication cables. Installation costs will be reduced if cable is concurrently installed in common trench with fiber optic cable loop system.

The Low Level Wind Shear Alert System, Microwave Landing System, and other airport based systems will use the cable loop system for power feed, however, they can be fed power using conventional (radial) power feeders if necessary. Close coordination is needed with Communications Facilities Consolidation and Airport Telecommunication Program.

Products

This program provides for replacement of radially installed electric power cable systems at 100 high- and medium-activity airports. Replacement systems will be arranged in a loop configuration around the airport and will use conventional metallic conductor cables.

Status

Based on FAA policy and guidance provided in Order 6950.23, Policy for Cable Loop at Terminal Facilities, FAA regions will prioritize the upgrading of those terminal locations that will continue to be major facility locations into and beyond the 1990's. The plan to upgrade the cable system at each location will be developed by the regions to support the NAS Plan activities at each location and the Airport Master Plan developed by the airport owner and the FAA region.

The plan is to have all the major hub airports in the NAS provided with a power cable system configured in a loop around the airport, where cost effective. The regions will assess facility importance, location, redundancy requirements, method of installation, costs, and the combination of multiple facility requirements within the same system. Priority will be given to airports requiring major replacements of cables.

A total of 115 high- and medium-activity regional airports have been identified as potential candidates from which to select 100 of the 163 level II, III, and IV hub airports for this program. Airport selection criteria and power loop standards are under development by FAA and are scheduled for completion in late 1985. Implementation is scheduled to commence in late 1985 upon completion of these efforts.

Audit Findings

Technical

This program is proceeding on schedule. The project scope, affecting costs, has been modified by the separation of signal and control cable from this program into the Airport Telecommunications program. Funding for signal and control cable systems remains under Power Cable Loop program and does not identify reduced scope due to separation of installations. Funding required for this project is highly dependant on regional studies to refine assessment of replacement costs. These studies will be funded out of F&E budget during FY 85.

Schedule

No schedule problems were identified.

Recommendations

The candidate airports should be analyzed in more depth, and number of systems should be recommended on basis of need and cost/benefit in lieu of current basis of available funding.

5.4.6 Power Conditioning Systems for Automated Radar Terminal Systems-III (ARTS-III)

Role in NAS

The ARTS-III, presently in use at medium- and high-activity airport terminals, is sensitive to small transients in the electric power supply. As little as a 17-ms perturbation (one cycle at 60 Hz) may cause the system to go into a save-data mode, whereby digital information is frozen on the display. It takes 30 to 45 seconds for digital (flight information) display to return to normal after each interruption caused by these small transients. Transients of this magnitude are not of sufficient duration to activate existing engine-generator type standby power system. Utility power must be 10 percent below rated system voltage for a duration of 2 seconds before normal standby power system is activated.

The power conditioning system (PCS) is designed to ensure that stable electrical power with precisely regulated voltage and frequency characteristics approaches 100 percent availability for automated function of the ARTS-III equipment. The installation of PCS in ARTS-III facilities will increase operational reliability, reduce operational downtime, and increase controller productivity. The power conditioning system provides for these NAS Plan goals and objectives in the near-term years until ARTS-III equipment is replaced by the Advanced Automation System (AAS).

Products

Qualifying ARTS-III facilities will be provided with commercially-available, off-the-shelf Power Conditioning Systems (PCS) consisting of one cabinet housing the rectifier, controls, and inverter.

Status

FAA Headquarters will procure PCS units through award of multiyear, firm, fixed price contract. National standard design for facility modifications and installation will be prepared by FAA Headquarters through task order to an A&E service contractor. Regions will prepare site-specific adaptations to the standard design for field implementation.

Sixty facilities have been identified to receive PCS for ARTS-III; 30 units are funded for FY 84 with the remainder scheduled to be funded in FY 85. Installation scheduled to begin in late 1984 and completed in late 1986 is delayed due to protested bid procedure lodged by two prospective bidders. Protest has been resolved with contract award rescheduled for late July 1984.

Delivery of the first unit is expected to take 6 months from contract award. NAS Plan installation schedule is anticipated to slip as a result of this delay.

A&E services for standard installation and facility modifications have been put on hold pending outcome of the bid protest, since these modifications must be tailored to suit the specific PCS unit purchased. Preliminary engineering work for site-specific modifications by the regions has also been put on hold.

Audit Findings

Technical

The power conditioning system is state-of-the-art technology with little to no technical risk. Prototype systems have been successfully installed and operated at Los Angeles, Chicago, and Atlanta for approximately 2 years. Systems have been functioning with no problems, and performance is reported to be outstanding.

Implementation of PCS for existing ARTS-III facilities generally requires isolation of critical power loads from electrical distribution system to optimize life-cycle cost. New tower facilities built from FAA standard designs have provisions for isolating these loads. At these locations, implementation design will be simplified with facility modifications at a minimum. Older and sponsor-owned towers are of nonstandard design and generally do not have these provisions. Isolation of critical equipment at these sites will pose special problems in segregating the electrical distribution system and in finding space for additional equipment to do so. Close coordination and planning with tower operations will be required to minimize risks to operations during implementation.

Schedule

Installation schedule attached to the project resume (smart sheet) calls for 32-month installation period with first-unit installation in July 1984 and final unit installation in March 1987. NAS Plan schedule begins in September 1984. Delayed delivery of first PCS unit will likely require program schedule adjustment.

Further slips in schedule are possible since PCS units procured under this contract can be used to support other NAS Plan programs. The contract will be for a fixed (unit) price to supply a maximum of 200 units of various sizes from 50 kVA to 200 kVA over a 5-year period with 60 units designated for this program. Units will be procured as funded.

Recommendations

1) Identify facility modifications to mechanical and electrical systems required to support program.

2) Revise schedule to reflect delay in equipment procurement and lengthened installation period.

5.4.7 Power Systems

Role in NAS

This project will provide for optimum type and quality of electrical power necessary to ensure high facility availability and reliability, and to reduce energy consumption of standby power systems at unmanned facilities.

The project provides for the upgrading of existing electrical power systems by replacing small engine generators with batteries.

Many FAA structures and facilities do not have lightning protection systems installed, while existing, installed systems are marginal. Lightning surge protection devices must be improved at many facilities, and deficiencies in wiring, grounding, bonding, shielding, and code violations must be corrected.

Environmental control centers will provide means to save energy by raising or lowering the temperature at unmanned facilities during site visits by maintenance personnel.

This project is closely coupled with unmanned FAA Airway Facilities Buildings and Plant Equipment project. It provides for the upgrading of the mechanical and electrical systems while the unmanned FAA Airway Facilities Building and Plant Equipment project generally provides for the building thermal and physical envelope. Scheduling of the work implemented under these two projects requires close coordination to assure lowest implementation costs. The project is dependent on the Communication Facilities Consolidation project for actual definition of the number of facilities needing upgrading.

Products

This project provides for the implementation of a national plan to improve power and environmental systems and power transfer systems. Batteries and direct current distribution systems will replace approximately 2500 small (30 kW and below) engine generators. Approximately 600 large engine generators will be overhauled or replaced. Other commercially-available power sources will be introduced for use in the FAA as standby power sources.

Obsolete wiring will be replaced at unmanned facilities and lightning protection will be provided at approximately 150 RCAGs, 80 ATCTs, and 100 miscellaneous facilities. Surge protection will be provided at ILSs, RTRs, ARSRs, and high-frequency cables at various locations. Grounding, bonding, and shielding will be provided at 23 ARTCCs, 160 ARTS, and 150 miscellaneous facilities. Environmental control centers will be provided for temperature control of unmanned facilities. RMM equipment will also be provided for environmental control equipment to enable its control and monitoring from a remote point.

Audit Findings

Technical

A large number of facilities are approaching 25-30 years of age, and most of the engine generators are of the same age. The replacement schedule shows some will be replaced in another 20 years or at an age of 50 years. The replacement schedule of this aging equipment can be expected to result in reduced reliability and increased maintenance.

Although solid-state electronic equipment can tolerate harsher environmental conditions than its vacuum-tube predecessors, care has to be exercised in the design of the environmental control center to consider the efficiency, aging, and capacity of the battery system, which is environmentally sensitive.

Upgrading of the different systems, especially lightning and surge protection, grounding, and bonding, before installation of new equipment would eliminate present problems and increase the availability of the unmanned facility.

Recommendations

Compression of the installation and upgrading schedule should be considered to replace some obsolete equipment sooner.

5.4.8 Unmanned FAA Airway Facilities Buildings and Plant Equipment

Role in NAS

A large percentage of unmanned facilities buildings are approaching the end of their normal service life of 20 to 30 years. Many of these buildings will continue to be used for the next 20 years. Much of the original electronic equipment has been or will be replaced with solid state equipment having substantially reduced space and maintenance requirements. This program provides for (1) the development of new standard design specifications for energy efficient new buildings to replace those buildings for which modifications and improvements are not cost effective; (2) modifications to existing repairable buildings for efficient operation through year 2000; (3) modifications to existing repairable buildings for efficient operation and collocation of navigation and communications systems at some sites; (4) new standard design specification for new buildings to house new facilities such as consolidated communications facilities, ASR9, 3D radar, etc; and (5) cost-benefit analysis, design, specification, and construction of tramway access systems for mountaintop long-range radar sites.

Products

Approximately 800 separate improvements will be made at 300 facilities during each of the first 8 years of the program. Approximately 150 separate improvements will be made at 60 facilities each year for the remainder of the program. Depending upon the outcome of the cost-benefit analysis, five tramway access systems will be built to service mountaintop radar sites.

Status

A system-wide, integrated approach will provide improved standardization and decreased support costs. A comprehensive national plan will be developed by an A&E support contractor for FAA Washington Office to provide new standards and implement modernization and improvements projects. A list of typical projects applicable to unmanned facilities was developed, and regions were requested to select projects and prioritize them including facility place, name, and type with specific work to be accomplished at each facility. The program is expected to be accomplished on a year-to-year basis through individual FY appropriations with funds partially allocated to projects as determined to

be most needed by the individual regions and the remaining funds allocated to projects defined by Headquarters to support specific aspects of the NAS Plan. Projects will be justified on a life-cycle cost versus benefits basis.

The major facility consolidations/collocations planned in conjunction with the NAS Plan will affect the number and type of facilities. The requirements study for facility consolidation has been delayed resulting in some slippage of planned program activities. This is not expected to delay availability of first new standard design specification.

Audit Findings

Technical

In the 1983 NAS Plan, this program included all of the work that is now described in the Power System program in the 1984 NAS Plan. The 1984 NAS Plan program for unmanned airways facilities describes four major areas of work: (1) modifications to existing repairable facilities for extended life and improved thermal efficiency through the year 2000, (2) modifications to some existing buildings for collocation of navigation and communication systems, (3) development of new standard building designs and provision of new buildings to support Communication Facilities Consolidation Program, and (4) development of cost versus benefit analysis and design of tramway systems for access to five mountaintop long-range radar sites.

The power systems program provides for all remaining improvements to unmanned facilities such as lightning protection; grounding, bonding, shielding and wiring deficiencies, removal of small engine-generators, provisions for RMM, and addition of environmental control centers for efficient maintenance of temperature.

The project resume sheet, dated 19 January 1984, for unmanned facilities retains the title, "Modernize and Improve Unmanned FAA Airway Facilities Buildings and Equipment," as it appeared in support of the 1983 Plan. It continues to address HVAC systems, engine-generators and battery standby power. Since these elements are now included under Power Systems Program, it

raises the question whether funding for these elements is provided under power systems or unmanned facilities. Estimates supporting the funding were not traceable to verify this.

Recommendations

None

5.4.9 ARTCC Plant Modernization

Role in NAS

This project provides for the upgrade of existing ARTCC building and replacement or upgrade of environmental systems to extend useful life of ARTCC buildings for 20 years. Rehabilitation and modernization work will principally focus on deteriorating mechanical, electrical and architectural systems, energy conservation measures, OSHA compliance and security enhancements.

Center facilities deterioration occurring due to use, age, and weather require refurbishment and upgrading to provide adequate facilities into the year 2000. In addition, there are potentials for support of energy conservation goals when the heating, ventilating, and air conditioning (HVAC) systems are upgraded. In some centers, roofs, cooling towers, and other equipments are approaching the end of their useful life and must be replaced. When they are replaced, more energy efficient equipment and structures can be utilized for energy conservation.

Products

A total of 25 (23 if Panama and Guam are not considered) en route ARTCC facilities will be modernized/rehabilitated including, in some centers, replacement or renovation of cooling towers to maintain operation of air conditioning systems. In some centers, there is a potential for energy conservation by upgrading or replacing curtain wall systems and/or installing solar screens and increasing building insulation. Exposed asbestos surfaces will be treated or removed to comply with OSHA regulations. Roofs will be resurfaced to prevent water damage.

Status

The Washington office will provide designs and or specifications for plant modernization through an engineering services contract. Construction will be accomplished by regional contracts. Except for critical projects requiring immediate action, the center modernization, where possible, will be coordinated with the ongoing center expansion projects. Construction in en route centers specifically required for the implementation of the host

computer and the advanced automation system will be funded under the advanced automation program. Cost-versus-benefit life cycle studies will be developed to support major systems upgrades or replacements.

Audit Findings

Technical

No technical problems identified.

Schedule

Program scope will depend on outcome of the cost versus benefit study of the Engineering Services Contract, Task 5, awarded to Kentron on February 14, 1984. Additional submission (required for the proposal) delayed the award 3 months. This delay will cause slippage in planned milestones for studies and design process but should not affect overall program schedule. The engineering services contractor has completed a status review of Task 5 by FAA Headquarters on April 5, 1984, and has made a preliminary site visit to the Washington Center on April 3, 1984.

Recommendations

None.

5.4.10 Acquisition of Flight Service Facilities

Role in NAS

The purpose of this project is to provide new sponsor furnished Flight Service Stations to house the personnel, equipment, and administrative and other support functions associated with consolidated facilities.

Products

Facilities for 61 FSS locations will be obtained on a sponsor provided leased basis to consolidate 317 existing FSS locations. The facilities will be designed in accordance with standard FAA operational and technical requirements. They will range in size from 8,000 to 12,000 square feet.

Status

The design and lease requirements have been developed and serve as guidance for acquiring these facilities. Approximately 44 sites have been selected and 15 are in evaluation at this time. Construction and site preparation at the selected sponsor locations has started. It is anticipated that all selections will be made by the end of 1984. The schedule for acquisition process extends thru mid-1988.

Audit Findings

Technical - The facilities to be leased will meet FAA requirements for consolidation of FSASs.

Schedule - All sites are expected to be selected by the end of 1984. Acquisition is expected to be completed in 1988.

Recommendations

None.

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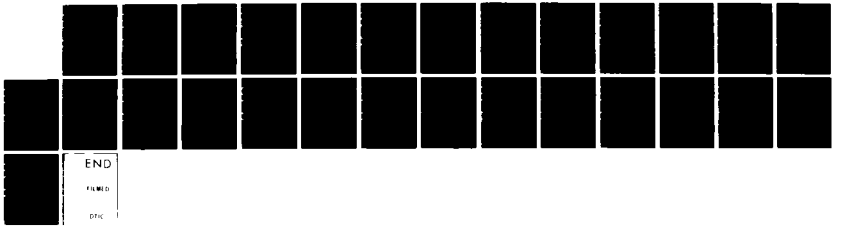

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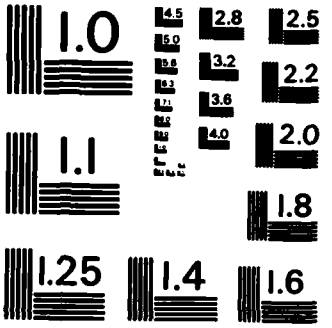

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5.4.11 Aircraft Fleet Conversion/Flight Inspection Modernization

Role in NAS

The aircraft fleet conversion/flight inspection modernization project will meet the FAA's requirement to maintain a high level of safety with flight inspection programs and comply with the 1980 OMB mandate on fuel conservation.

This program is intended to reduce the cost of maintaining the FAA flight programs needed to ensure a high level of aviation safety. By replacing current flight inspection aircraft with more fuel-efficient aircraft, and by replacing current flight inspection equipment with equipment packages that are lighter in weight, the annual operating costs are expected to be reduced by $9.7M, with a commensurate reduction of 3.5 million gallons in fuel consumption. In addition, by replacing aircraft related to other FAA flight programs, an additional savings in annual operating costs of $6.2M with a 2.0 million gallon reduction in fuel consumption can be achieved. These fuel-efficient aircraft and light-weight flight inspection systems are expected to become available beginning in CY 84 with the last replacements being available near the end of CY 86.

Products

The aircraft fleet conversion project was approved by the FAA in April 1981. This program provides for the acquisition of new production aircraft with state-of-the-art systems, and specific flight inspection equipment capable of handling today's flight inspection requirements with systems growth capability for future requirements. This acquisition will: (1) enable the FAA to phase out a number of obsolete, inefficient aircraft, some of which have been in service for over 25 years; (2) reduce program costs; and (3) achieve the fuel conservation goal, which is an integral part of the FAA Ten-Year Plan For Energy Conservation in General Operations, dated February 1981. A summary of funding appropriation/requests is shown below:

FY 1981: (Approved)
B-727 Simulator
(Reprogrammed Funds)

FY 1982: (Approved/Reprogrammed)

Digital VOR/ILS
Alpha/Graphic Display Terminals
Printer/Plotter Recorders
Portable Data Loaders
Automatic Runway Fix Sensor
System Upgrade Components

FY 1983: (Approved)

15 Twin Turboprop
2 Long Range Jets
1 Multipurpose Turboprop
3 Special Mission Turboprop
42 Upgraded AFIS Nav Computers
5 Portable Flight Inspection Package
4 Twin Turboprop (on Lease/Purchase)
(Reprogrammed for B-727 Simulator)

FY 1984: (Approved)

4 Twin Turboprop
2 Special Mission Turboprop

FY 1985: (Approved)

3 Multipurpose Aircraft
MLS Avionics

Status

The plan for acquisition of aircraft for the Fleet Conversion Program is designed to enable the agency to acquire off-the-shelf, current production aircraft, with state-of-the-art systems and components.

The acquisition will be in three increments:

1) 15 light, twin engine, turboprop airplanes; two light long-range jets; three special mission turboprop airplanes; and a multipurpose flight inspection/logistics turboprop airplane. The upgraded flight inspection equipment will be part of this increment.

2) Procurement of four light twin turboprop and two special mission turboprop airplanes. these aircraft are planned to supplement the first phase of aircraft and allow for growth in the NAS. The special mission aircraft, of heavier payload capability, will provide the agency with full capability for mass sampling measurement programs, frequency spectrum analysis programs, and the flight inspection support for commissioning of the Microwave Landing System (MLS).

3) Acquisition of three multipurpose turboprop airplanes. These aircraft are to replace and reduce the number of aircraft assigned to the Research and Development and Training programs, while the MLS equipment provides full capability for continuing flight inspection of the ground-based MLS.

The flight inspection systems for aircraft will be installed by the contractor using government-furnished equipment (GFE). The equipment common to government supply sources is being purchased through the General Services Administration (GSA). Other equipment will be procured through invitation for bid (IFB) processes.

Audit Findings

Technical

The aircraft fleet conversion/flight inspection modernization project appears to be well-managed program that is progressing to realizing a more cost-efficient fleet with as many similar fuel-efficient aircraft as possible to reduce maintenance and fuel costs, and through new state-of-the-art lighter systems.

Schedule

The project is approximately 9 months behind schedule. With TSARC being postponed indefinitely, this postpones the potential maintenance and fuel savings.

Recommendations

Senior FAA management should aggressively puruse continuing the TSARC to preclude further schedule delays and attendant loss of revenues.

5.4.12 Aircraft and Related Equipment

Role in NAS

The project provides direct support to the FAA aircraft fleet to maintain its mission readiness. It is an adjunct to the aircraft fleet conversion/flight inspection modernization project (section 5.4.11). It provides the FAA with the capabilities to perform flight inspection and evaluations of navigation, landing, surveillance and communications facilities along with operational procedures. Specifically the project provides for the continuing change in requirements anticipated from 1986 to 2000.

Products

The products presently identified include airborne equipment that will support the requirements for LORAN-C, MLS, Mode-S, and GPS. Additional equipment will be added as required as other systems are implemented.

Status

Current planning has identified the products listed above to be available in the 1985-1989 timeframe.

Audit Findings

Technical/Cost - The actual types and quantities of airborne equipment to be purchased will be dependent upon new systems that may evolve and user demand. Budget planning indicates $2.5M for FY 86 and $13M for each of the succeeding years of the NAS Plan. Specific planning at this time does not adversely impact the NAS since near-term requirements are addressed in section 5.4.11, aircraft fleet conversion/flight inspection modernization.

Recommendations

None.

5.4.13 System Engineering and Integration Contract

Role in NAS

The purpose of this project is to provide the FAA with task oriented support and mission accountability in implementing the NAS Plan. The project contractor, Martin Marietta, is responsible for work in such areas as NAS Planning, NAS Program Management, and Execution and NAS Project Management.

Products

Among the products to be provided under this project are a NAS Plan audit and update, cost, schedule and risk analyses, functional requirements statements for systems and subsystems and performance specifications, interface data and test specification for NAS system and subsystem.

Status

The preparation and delivery of required contract documents has been accomplished. The Contract Management Plan, the NAS SEI Program Plan, Financial Performance Report, and monthly program status reports were delivered as scheduled. Interchange meetings with key FAA counterparts are continuing and technical assistance has been accomplished as required.

Audit Findings

Schedule

As part of the contractors transition into full mission accountability, a NAS Plan status baseline was established stemming from the NAS Plan audit. During the initial period of performance and as a part of the NAS Plan audit process several concerns have surfaced bearing directly on the role of the contractor as defined in the project and their ability to exert a major influence on the NAS Plan implementation. Significant among these are:

1) SEI contractual schedules are not optimized to NAS Plan schedules.

2) Major system milestones (Level II, III, and IV design) need to be advanced by up to 6 months to be consistent with individual project procurement activities.

3) SEI technical involvement is required earlier and more extensively than currently envisioned in the Contract.

Recommendations

1) Review and adjust as necessary SEI contractual schedule to NAS Plan schedules.

2) Review major system milestones in light of project procurement activities and propose changes as necessary.

5.4.14 National Radio Communications System (NARACS)

Role in NAS

The NARACS project enables the FAA to accomplish the requirements of several presidential directives (PD) and national security decision directives (NSDD) for governmental communications. The project will enable the FAA to reestablish command and control communications by radio in the event a national or local emergency which may temporarily disrupt landline communications between NAS facilities. It will provide essential communications between the FAA Headquarters, regions, traffic management system, field facilities, aircraft accident sites, and other government agencies. The network will also be available for routine daily use such as dispatching AF maintenance technicians, aviation security, and other FAA activities. In its later phases it will allow limited interface of other FAA voice and data user systems for emergency communications.

Products

The NARACS is a multielement phased project that will provide several types of capabilities to the NAS. These are:

1) Phase I provides a high frequency/single sideband (HF/SSB) backbone system at the FAA Headquarters and three emergency operating facilities (1983 through 1986).

2) Phase IA will consist of an upgrade enhancing the COMSEC interface to AUTODIN. It will also make available secure voice using the STU II equipments (1985 through 1987).

3) Phase II will establish two geographical radio networks. An Eastern network and a Western network will be established. The networks will include region offices, ARTCCs, major airports, FAA support aircraft and other key facilities (1983 through 1986).

4) Phase III will provide regional radio networks with linking to other networks of the NARACS (1984 through 1989).

5) Phase IV will expand the HF/SSB network to accommodate full-duplex voice and data transmission (1985 through 1988).

6) Phase IVA will bring the FAA Headquarters, Regional offices, ARTCCs and other major field offices into the FSTN (Federal Secure Telephone Network) (1984 through 1986).

Status

Phases I, II, III, and IVA are underway. Phases IA and IV are scheduled to start in 1985.

Audit Findings

Technical - The technical objectives of the NAS Plan for the project will be accomplished. The project will provide the FAA the minimum essential communications needed for command and control during emergency situations as required by the NAS Plan.

Schedule - The project generally is on schedule. Slight delays have occurred in issuing project RFPs but adequate time remains for management action to meet project installation and activation schedules required in the NAS plan.

Recommendations

None.

5.4.15 NAS Spectrum Engineering

Role in NAS

The FAA is a major user of the radio frequency spectrum, primarily with regard to radar, communications, and navigation devices. Limited spectrum is available for these uses, hence frequencies are reused whenever possible. Spectrum Engineering provides the planning, analysis, and assignments needed to ensure an interference-free environment, to optimize frequency usage, and to support facility consolidation.

Products

Spectrum engineering product include:

1) Engineering planning in support of the NAS modernization including development of coverages, interference analysis and frequency assignments for each of the RF elements in the NAS.

2) Electromagnetic Compatibility (EMC) guidelines frequency analysis and assignment in support of facility consolidation activities.

3) Authorization allocation of frequencies needed to support NAS requirements from the National Telecommunications Information Agency (NTIA).

4) Frequency coverage charts to support proper Engineering of frequencies as well as networking and facility consolidation. This may involve the services of the Electromagnetic Comp]ability Analysis Center (ECAC).

The FAA is a major user of RF spectrums and must contend, both nationally and internationally, for frequency allocations. The limited availability of spectrum mandates its reuse whenever possible on a non-interfering basis. The advent of the NAS modernization adds a significant load to the ongoing spectrum engineering which supports RF equipment. Support is required for all new RF elements including planning for MLS, EFAS, 25 kHz communication channels, RML, NARC, etc. Spectrum Engineering activities may be the

determining factor with regard to some facility consolidation, in determining the viability of Terminal Doppler Radars to coexist with ASRs, and in support of the radar leapfrog program. Much of this work is still in the planning stage and its completion is tied to specific projects in the sense that these plans and guidelines are needed prior to detailed site selection and site design, i.e. Level IV design.

Audit Findings

Technical - Two concerns surfaced during the audit:

1) If the coverage analysis of the Level II Design frequency requirements is accomplished through ECAC (and under the leadership and cognizance of Spectrum Engineering), additional funds may be required, amount to be determined. Recent ECAC support for regional coverage studies performed on Air/Ground Communications and navigation aids resulted in a request by ECAC for more money. If the coverage analysis is accomplished by SEIC then this concern is no longer valid.

2) The amount of day-to-day workload stemming from regional site requests for spectrum changes and the resulting analysis/coordination for approval is significant. It is expected that when the implementation stage is reached (Level IV design and siting of equipment) there will be a significant increase in this work. It is estimated that about six additional people would be required beginning with Level II Design through NEXRAD installation (October 1985 - June 1992).

This would add another task (or product) to the project, i.e., the NAS Centralized Frequency Assignment Program.

Schedule - The project is essentially on schedule.

Recommendations

1) A determination should be made on whether there is a need to utilize ECAC services in providing coverage charts and if affirmative, submit cost estimates for funding.

2) Recommend FAA management consider budgeting for additional people to assist in implementing NAS Plan (Level IV Design/siting of equipments) specifically as required for spectrum changes and/or analysis of spectrum compatibility.

5.4.16 General Support

Role in NAS

The general support project covers efforts in direct support of the overall NAS and the ongoing F&E investments that are not covered elsewhere in the plan. They consist of seven nonrecurring projects and six ongoing projects and generally improve operations, provide added capabilities, and promote safety in support of NAS Plan goals.

Products

This report will address three of the seven nonrecurring projects: (1) mechanized material handling system (also known as the warehouse mechanization system), (2) automated logistics, inventory and field requisitioning system [also known as the logistics inventory system (LIS)], and (3) the four explosive detection systems. The material handling project is an on-going project having started in 1982 and is scheduled for completion by 1985. The LIS is also an ongoing project, having started in 1983 and scheduled for completion by 1987. The explosive detection systems are ongoing projects, scheduled for completion through June 1986.

Status

A mechanized material handling system will increase efficiency in the receipt, issue and transportation of NAS material by: (1) replacing the current labor intensive system and providing better space utilization; (2) reducing manual involvement in warehouse facilities; (3) accommodating increased workload of supporting second generation facilities as well as first generation facilities being phased out of the NAS; (4) reducing inventories through better inventory control and service to field facilities as well as improving security, and (5) increasing productivity, thus eliminating the need for staffing increases.

The approach for the mechanized system includes the installation of an Automatic Storage and Retrieval System (ASAR) for small parts, an automated distribution system, and a mechanical packing area. Other additions include (1) a computerized dispatch system; (2) riderless tractor system capable of

automatically loading and unloading materiel; (3) delivery conveyor to the shops area; and (4) a receiving conveyor system. This system is currently under development at the depot facility in Oklahoma City, Oklahoma.

The LIS will provide improved support by providing the following:

- Availability of an online equipment population data base
- An on-line capability for field maintenance personnel to requisition parts
- Availability of an online system with which to redistribute material and market excess material
- Implementation of an online catalog system.

Using inputs from RMMS and MMS, the LIS will also improve stock availability through improved analysis of part and component failures and accurate computation of stock levels based on actual and projected equipment failures.

Terminals will be required in Airway Facilities (AF) field offices. The system will be integrated with the Personal Property In-Use Management System (PPIMS), Automated Utilization Screening and Disposal System (AUSDS), and the Project Materiel Management System (PMMS) and will interface with external projects to the materiel resources area such as the Maintenance Management System (MMS).

The current approach for implementation of the LIS includes four phases as follows:

- Implement an equipment population data base (Phase I) (1984)
- Implement online requisitioning system with field (Phase II) (1985)
- Implement redistribution and marketing system (Phase III) (1986)
- Implement online processing for cataloging data (Phase IV) (1987)

Phase I is currently underway at various locations throughout the NAS.

The explosive detection systems are in various stages of development:

1) X-ray system - Under development, with a decision to procure expected to be made by October 1984.

2) Nuclear magnetic resonance - Under development, with a prototype to be evaluated at an airport by August 1984.

3) Thermo-neutron - Documentation for procurement purposes to be completed by December 1984.

4) Vapor detection - A 3-phase development contract has been awarded with completion scheduled for June 1986.

Audit Findings

All three projects appear to be on schedule and within budget. No technical or operational issues were noted except the possible duplication of the data base for LIS and the MMS.

Recommendations

The LIS design should be reviewed to ensure that no unnecessary duplication of data bases is contained in the MMS.

5.4.17 System Support Laboratory (SSL)

Role in NAS

The SSL at the FAA Technical Center (FAATC) provides a viable, critical need in achieving the goals and objectives of the NAS Plan. The SSL provides technical support for current field systems and for test evaluation and integration of new systems.

Products

The laboratory will have six engineering test beds duplicating the systems installed in the Regions and provided by the various projects defined in the NAS Plan. These test beds will be functionally grouped by system as follows: En Route Systems, Terminal Systems, Air-to-Ground Systems, Flight Service Systems, Interfacility Communications Systems, Maintenance and Operations Support Systems.

Status

This project is scheduled in the Strategic Plan for FAA Technical Center Facilities, which tracks and defines an integrated plan to implement all FAATC laboratory activities, however not all projects are scheduled for FAATC integration testing. It should be noted that even though development of the test bed facilities are not directly dependent on specific programs, the ultimate benefits to be achieved depend on obtaining candidate project hardware and software as early in their development cycle as possible.

Audit Findings

All NAS Plan projects are not scheduled for integration testing at the FAA Technical Center. The role of the SSL as the system test bed for project development, verification, and system integration the planning needs additional definition and needs to include all NAS Plan projects. There is a possibility that long-lead time requirements will not be available in time to support project testing if they are not identified soon enough. Coordination with the Technical Center is not always accomplished in a timely manner on project changes.

Our experience on programs of similar complexity indicates it is imperative that a true, hi-fidelity system test bed such as provided by this project must be established early to support NAS Plan project development and integration activities if the NAS Plan is to be implemented efficiently, on schedule, and with minimum system disruption.

Recommendations

1) Detail requirements must be defined in Level III design and preliminary requirements that require long-lead items must be identified early.

2) Project updates and changes should be assessed for potential FAA Technical Center requirements and transmitted to ACT as soon as possible.

3) Projects selected for the SSL test bed will be determined by system complexity, interfaces, etc., and will be determined on a case-by-case basis. Those projects so selected should be directed to schedule their first prototype/production article into the SSL test bed for full development and system integration testing. Exceptions may be necessary but only when pre-coordinated and approved by the NAS Program Director (ADL-2). If currently contracted projects are not complying with these objectives/goals, units must be scheduled into the test beds as early as possible to increase the fidelity of the test bed for future system testing and trouble-shooting of field-related problems.

4) The Strategic Plan for FAA Technical Center Facilities needs to be expanded in scope to specify development of a FAATC/SSL specification/ documentation tree in support of NAS Plan implementation.

5) Development of a test and integration plan to define required FAATC tasks, roles and responsibilities, and responsibilities for each of the F&E Plan projects.

5.4.18 General Support Laboratory (GSL)

Role in NAS

The GSL provides those facilities required for test and evaluation of several program areas and includes the aircraft; range; general purpose computers used for data collection, data reduction, and analysis; and the administrative functions.

This project will provide general systems, equipment, and aircraft for support of the System Support Laboratory and other laboratories supporting R&D project and NAS PLan integration testing and operational requirements.

The detail support and interfaces required will be defined in the Level III design documentation.

Products

The GSL consists of the following six complexes:

1) Airborne Support Complex
2) ELectromagnetic Support Complex
3) Simulation Support Complex
4) Test Integration Command and Control Complex (TIC)
5) General Purpose Processing Support Complex
6) Plant Support Complex.

The following table defines the elements that comprise the various complexes and indicates the present schedule.

Complex	1983	1985	1990	2000
Airborne Support	B-717 (1) CV-580 (2) Aerocommander S-76	B-727 CV-580 (2) Aerocommander S-76	S-76	S-76
	Airport Heliport	Airport Heliport	Airport Heliport Twin Engine Jet Twin Eng Turboprop GA Turboprop	Airport Heliport Twin Engine Jet Twin Eng Turboprop GA Turboprop
Electromagnetic Support	EAIR Radar Nike Radar (2) Laser	Nike Radar (2) Laser (2)	Nike Radar (2) Laser (2)	Nike Radar (2) Laser (2) Range/Project Data Coll Facility Air/Ground/Air Wideband Telemetry
		Photometric Lab	Photometric Lab Test Equipment/ Spectrum Testing	Photometric Lab Test Equipment/ Spectrum Testing
Simulation Support	NSSF CSF	NSSF	NSSF	NSSF
Test Integration Command Control	Manual System	Semiautomated	Automated	Automated
General Purpose Support	General Purpose Data Center Admin Computer Complex	General Purpose Data Center Admin Computer Complex	General Purpose Data Center Admin Computer Complex	General Purpose Data Center Admin Computer Complex
Plant Support	Technical Bldg Airplane Hangar R&D Support Bldgs	Technical Bldg Airplane Hangar R&D Support Bldgs	Technical Bldg Airplane Hangar R&D Support Bldgs	Technical Bldg Airplane Hangar R&D Support Bldgs
	World War II Bldgs	World War II Bldgs		
		Technical Support Facility	Technical Support Facility	Technical Support Facility

Status

This project is developing on schedule. The Strategic Plan for FAA Technical Center Facilities tracks and defines an integrated plan to implement all FAA Technical Center Laboratory activities. The GSL is contained in this plan.

Audit Findings

1) Immediate activities are on schedule.

2) All NAS Plan projects are not scheduled for integration testing at the FAATC.

3) There is a possibility that long-lead time requirements will not be available in time to support project testing if they are not identified soon enough.

4) Information of project changes that affect the FAATC do not reach the technical center in a timely fashion.

Recommendations

1) Detail requirements must be defined in Level III Design and preliminary requirements that require long-lead items must be identified early.

2) Authority to acquire long-lead items must be provided.

3) Project updates and changes should be assessed for potential FAATC requirements and transmitted to ACT as soon possible.

ABBREVIATIONS AND ACRONYMS

A/C	Air Conditioning
A/G	Air to Ground
AAP	Advanced Automation Program
AAS	Advanced Automation System
ACCC	Area Control Computer Complex
ACF	Area Control Facility
AERA	Automated En Route Air Traffic Control
AF	Airway Facilities; Air Force
AFSS	Automated Flight Service Station
AFTN	Aeronautical Fixed Telecommunications Network
AIF	Airport Improvement Fund
ALPA	Airline Pilots Association
ALSF	High Intensity Approach Lighting System with Sequenced Flashers
ALSIP	Approach Lighting System Implementation Program
AOPA	Aircraft Owners and Pilots Association
AP	Acquisition Phase
ARF	Airport Reservation Function
ARSR	Air Route Surveillance Radar
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System (ARTS-II, ARTS-III)
ASAR	Automatic Storage and Retrieval System
ASDE	Airport Surface Detection Equipment
ASR	Airport Surveillance Radar
AT	Air Traffic
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
ATCT	Air Traffic Control Tower
ATIS	Automatic Terminal Information Service
ATS	Air Traffic Service
AUSDS	Automated Utilization Screening and Disposal System
AWOS	Automatic Weather Observing/Reporting System
AWP	Aviation Weather Processor

BAN	Beacon Alphanumerics
BASOPS	Base Operations (Flight)
BDAS	Beacon Data Acquisition System
BOE	Basis of Estimate
BRITE	Bright Radar Indicator Tower Equipment
C	Completion
CA	Conflict Alert
CAB	Civil Aeronautics Board
CARF	Central Altitude Reservation Facility
CBI	Computer-Based Instruction
CCB	Configuration Control Board
CD	Common Digitizer
CDC	Computer Display Channel
CDR	Critical Design Review
CDRL	Contract Data Requirements List
CERAP	Combined Center/Radar Approach Control
CFCF	Central Flow Control Facility (Function)
CFWP	Central Flow Weather Processor
CFWSU	Central Flow Weather Service Unit
CNS	Consolidated NOTAM System
CONUS	Contiguous (Conterminous) United States
CRA	Conflict Resolution Advisory
CRF	Central Repair Facility
CRT	Cathode-Ray Tube
CSC	Computer Science Corporation
CWP	Center Weather Processor
CWS	Central Weather Service
CWSU	Center Weather Service Unit
CY	Calendar Year
DARC	Direct Access Radar Channel
DCP	Design Competition Phase
DECCO	Defense Commercial Communications Ordering Office

DF	Direction Finder
DME	Distance Measuring Equipment
DMSA	Designated Major System Acquisition
DOC	Department of Defense
DOD	Department of Defense
DUAT	Direct User Access Terminal
DVOR	Doppler Very-High Frequency Omnidirectional Range
E&D	Engineering and Development
E-DARC	Enhanced-Direct Access Radar Channel
EARTS	En Route Automated Radar Tracking System
ECAC	Electromagnetic Compatibility Analysis Center
EDCT	Estimated Departure Clearance Time
EFAS	En Route Flight Advisory Service
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
ERM	En Route Metering
ERM-Ia	En Route Metering-Ia
ERM-II	En Route Metering-II
ETG	Enhanced Target Generator
F&E	Facilities and Equipment
FAA	Federal Aviation Administration
FAATC	FAA Technical Center
fac	Facility
FAX	Facsimile
FDAD	Full Digital ARTS-III Display
FDEP	Flight Data Entry and Printout
FDIO	Flight Data Input/Output
FSAS	Flight Service Automation System
FSDPS	Flight Service Data Processing System
FSP	Flight Strip Printer
FSS	Flight Service Station
FY	Fiscal Year

G/A	Ground to Air
GFE	Government-Furnished Equipment
GMT	Greenwich Mean Time
GNAS	General National Airspace System
GOES	Geostationary Operational Environmental Satellite
GPS	Global Positioning System
GSA	General Services Administration
GSL	General Support Laboratory
HCS	Host Computer System
HCVR	High Capacity Voice Recorder
HF	High Frequency
HIWAS	Hazardous Inflight Weather Advisory Service
Host	Air Traffic Control Host Computer
HVAC	Heating, Ventilating, and Air Conditioning
ICD	Interface Control Document
ICSS	Integrated Communications Switching System
IDAT	Interfacility Data
IFB	Invitation for Bid
IFR	Instrument Flight Rules
ILS	Instrument Landing System; Integrated Logistics Support
IOCS	Input-Output Computer Systems
ISSS	Initial Sector Suite System
IVRS	Interim Voice Response System
JAWS	Joint Aviation Weather Studies
JPL	Jet Propulsion Lab
JSS	Joint Surveillance System
LCN	Local Communication Network
LIS	Logistics Inventory System
LLWAS	Low Level Wind Shear Alert System
LORAN	Long-Range Navigation (System)

LRI	Line Replaceable Item
LRR	Long-Range Radar
LRU	Line Replaceable Unit
M&O	Maintenance and Operations
MALSR	Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights
MCC	Management Control Center
MCS	Maintenance and Control Software
MCVR	Multichannel Voice Recorder
MEA	Maintenance Engineering Analysis
MLS	Microwave Landing Systems
MMC	Maintenance Monitor Control
MMS	Maintenance Management System
Mode-C	Altitude Reporting Mode of Secondary Radar
Mode-S	Discretely Addressable Secondary Radar System with Data Link
MPS	Maintenance Processor Subsystem
MSAW	Minimum Safe Altitude Warning
MSL	Mean Sea Level
MSPE	Modeling and Simulation Program Element
MTBF	Mean Time between Failure
MTD	Moving Target Detection
MTI	Moving Target Indicator
NADIN	National Data Interchange Network
NARACS	National Radio Communications System
NAS	National Airspace System
NAVAID	Navigation Aid
NDB	Nondirectional Beacon
NEXRAD	Next Generation Weather Radar
NICS	National Interfacility Communications System
NOTAM	Notice to Airmen
NSDD	National Security Decision Directives

NTIA	National Telecommunications Information Agency
NTSB	National Transportation Safety Board
NWS	National Weather Service
O&M	Operations and Maintenance
ODALS	Omnidirectional Airport Lighting System
ODAPS	Oceanic Display and Planning System
OMB	Office of Management and Budget
OMEGA	VLF Navigation System
ORD	Operational Readiness Demonstration
ORT	Operational Requirements Team
OSHA	Occupational Safety and Health Administration
PAM	Peripheral Adaptor Module
PAPI	Precision Approach Path Indicator
PCS	Power Conditioning System
PD	Program Directive; Presidential Directive
PDR	Preliminary Design Review
PMMS	Project Materiel Management System
PPI	Plan Position Indicator
PPIMS	Personal Property In-Use Management System
PVD	Plan View Display
R&D	Research and Development
R&M	Reliability and Maintainability
RANK	Replacement Alphanumeric Keyboards
RCAG	Remote Communications Air/Ground Facility
RCE	Remote Control Equipment; Radio Control Equipment
RCIU	Remote Control Interface Units
RCO	Remote Communications Outlet
RDCC	Research Development Computer Complex
REIL	Runway End Identification Lights
RF	Radio Frequency

RFA	Request for Action
RFI	Radio Frequency Interference
RFSP	Replacement Flight Strip Printers
RMA	Reliability, Maintainability, and Availability
RML	Radar Microwave Link
RMM	Remote Maintenance Monitoring
RMMS	RMM System
RRWDS	Radar Remote Weather Display System
RTCA	Radio Technical Commission for Aeronautics
RTR	Remote Transmitter/Receiver
RVR	Runway Visual Range
RVV	Runway Visibility Value
S	Start
SB/SDB	Small Business/Small Disadvantaged Business
SBA	Small Business Administration
SBR	Systems Baseline Review
SCIP	Surveillance and Communication Interface Process
SEI	System Engineering and Integration
SEIC	System Engineering and Integration Contractor
SIAP	Standard Instrument Approach Procedure
SOW	Statement of Work
SRR	System Requirements Review
SSALF	Simplified Short Approach Lighting System with Sequenced Flashers
SSALR	Simplified Short Approach Lighting System with Runway Alignment Lights
SSALS	Simplified Short Approach Lighting System
SSB	Single Sideband
SSCC	System Support Computer Complex
SSL	System Support Laboratory
SSRVT	Sector Suite Requirements Validation Team
T&E	Test and Evaluation
TACAN	Tactical Air Navigation Facility

TBD	To Be Determined
TCAS	Threat Collision Avoidance System
TCCC	Tower Cab Computer Complex
TCS	Tower Communications System
TELCO	Telephone Company
TIC	Test Integration Command and Control Complex
TML	Television Microwave Link
TMS	Traffic Management System
TMU	Traffic Management Unit
TPL	Transportation Procurement List
TPX-42	Radar Beacon Decoder
TRACAB	Terminal Radar Approach Control in Tower Cab
TRACON	Terminal Radar Approach Control Facility
TRVT	Transition Requirements Validation Team
TSARC	Transportation Systems Acquisition Review Council
TSC	DOT Transportation Systems Center
TSSF	Terminal System Support Facility
TTG	Training Target Generator
TTY	Teletypewriter
TVOR	Terminal VOR
TWEB	Transcribed Weather Broadcast
twr	Tower
VASI	Visual Approach Slope Indicator
VFR	Visual Flight Rules
VHF	Very-High Frequency
VLF	Very-Low Frequency
VOR	VHF Omnidirectional Radio Range
VORTAC	Collocated VOR and TACAN Facility
VOT	VOR Test Signal
VRS	Voice Response System
VSCS	Voice Switching and Control System
WCP	Weather Communications Processor
WMSC	Weather Message Switching Center
WMSC-R	Weather Message Switching Center-Replacement
WRP	Weather Radar Program

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