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Report to the Administrator, Federal Aviation Administration

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AIR TRAFFIC CONTROL

Efforts to Modernize Oceanic System Delayed

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Information Management and
Technology Division

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The Honorable James B. Busey
Administrator, Federal Aviation Administration

Dear Mr. Administrator:

This report presents the results of our review of the Federal Aviation Administration's (FAA) efforts to provide automation support to improve oceanic air traffic control. We initiated this evaluation in view of the anticipated continued increases in oceanic air travel and the delays experienced by FAA in using automation to enhance oceanic control. Our objectives were to identify how air traffic over oceans is presently controlled and to review FAA efforts to improve oceanic air traffic control through the use of automation. A detailed explanation of our objectives, scope, and methodology is contained in appendix I.

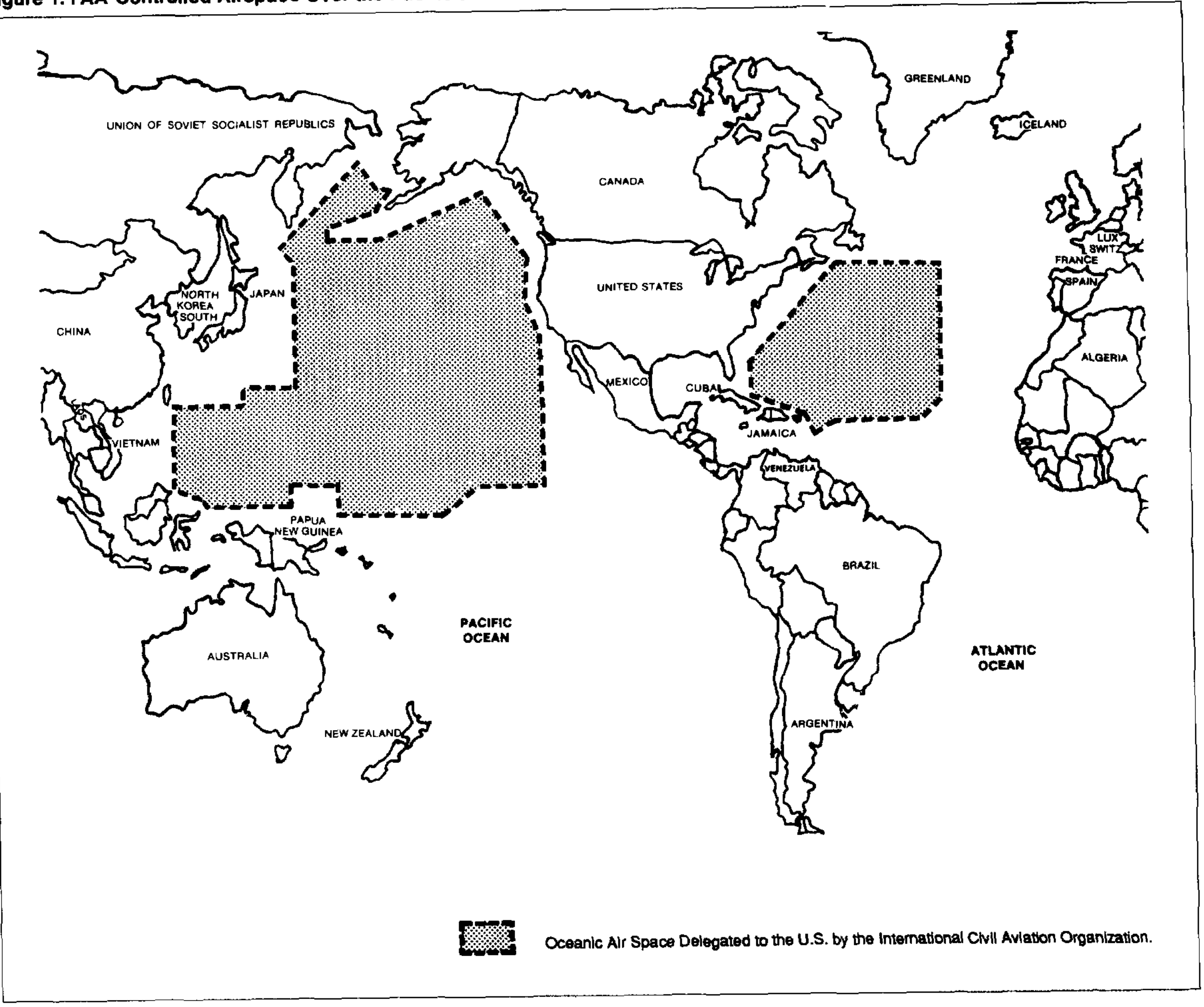
Results in Brief

Despite numerous advances in computer and communications technology, air traffic control services in oceanic areas not under radar surveillance have not changed significantly in the last 35 years. Because oceanic air traffic controllers do not have a modern automated system, they must manually update flight progress based on periodic radio reports received from pilots. This labor-intensive process requires controllers to maintain large distances between aircraft because of the lack of up-to-date information on airplanes' locations. A more efficient use of airspace could result in shorter flights and increased opportunities for fuel savings.

FAA has long recognized the need to address these deficiencies and has initiated projects to provide automation support to oceanic controllers. The agency's primary effort to date, the Oceanic Display and Planning System (ODAPS), was designed to provide an automated display of current traffic flow based on periodic radio reports from pilots and the capability to assure controllers that safe separation would be maintained when pilot requests for route and altitude changes were granted. However, this system, conceived over 10 years ago, is over 3 years behind schedule, has escalated in cost to about $40 million, and is still not fully operational.

FAA's strategy is to eventually use satellite technology to provide accurate, near real-time location information and air-to-ground communications on oceanic flights. However, this strategy, as currently planned,

Figure 1: FAA-Controlled Airspace Over the Pacific and Atlantic Oceans



FAA Uses Manual Processes to Control Oceanic Traffic

Airplanes in most of the area over the Atlantic and Pacific oceans are not tracked by FAA land-based radar because this technology is only able to identify aircraft up to about 175 to 225 miles from the radar's location. This makes air traffic control for most of the Atlantic and Pacific oceans quite different from that for the continental United States.

routing of aircraft. As a result, planes cannot always take the most efficient routes to their destinations. This can lead to longer than necessary flights and lost opportunities for saving fuel. Recent FAA studies indicate that improved methods of oceanic air traffic control could save United States airlines millions of dollars in fuel costs annually.

FAA expects future growth of oceanic travel to be rapid. For example, FAA predicts that the number of commercial flights over the Pacific will approximately double between now and the year 2000. This expected growth will stress the current system's ability to control oceanic air travel. Although overall data was not available on the total number of delays airlines experience, some airlines are already reporting delays in oceanic flights at certain times because FAA is unable to allow more planes in the sky under the separation requirements of the current system.

FAA officials believe that the large separation requirements between aircraft and the highly structured approach to oceanic air traffic control have aided in minimizing incidents where aircraft either strayed off-course or came into close contact with other aircraft. At the same time, FAA officials point out that automation could further reduce the risk of these types of incidents over oceanic airspace and could permit safe operation in a more efficient environment.

FAA's Primary Effort to Enhance Oceanic Air Traffic Control Service Has Encountered Delays

FAA has long recognized the need to upgrade oceanic air traffic control procedures and services. Beginning in 1969 and through the 1970s, FAA considered several projects for improving oceanic control but none were ever implemented. In the late 1970s, FAA began moving toward the design and development of what is now known as the ODAPS program. ODAPS was intended to

- provide controllers with a computer-generated display of the location of oceanic air traffic based on data received from pilot reports submitted at least once per hour to Aeronautical Radio Incorporated radio stations;
- provide controllers with a key capability, known as conflict probe, that would assure controllers that a route or altitude change would continue to ensure safe separation; and
- automatically update displayed aircraft position and flight information based on data received from Aeronautical Radio Incorporated.

Although ODAPS is to provide an automated display of aircraft locations based on periodic radio reports, it will not change the current pilot

Because of the severity of the problems, New York officials raised concerns about whether ODAPS would ever be a useful tool for oceanic controllers. Eventually, these officials concluded that the system should not be operational in New York until problems were corrected. The New York Center is now not scheduled to begin operating the system until May 1991—nearly 4 years after the originally scheduled date. Although the Oakland Center also experienced problems with the system, Center officials decided to begin operating a system with limited capabilities in late 1989.

Uncertainty surrounds the future of ODAPS while the contractor continues to attempt to correct problems. Although contractor and several FAA officials state that they expect many of the outstanding problems to be resolved soon, recent reports suggest that problem resolution may be difficult. For example, in an April 1990 memorandum FAA officials pointed out that there were at least 57 open problems with ODAPS, including 6 critical open problems that were preventing continued system testing. In addition, an August 1990 report of an FAA-sponsored review team found that ODAPS suffered from serious and significant computer program errors. One of the report's most serious findings was that the system was incorrectly displaying an aircraft's position when speed was reported to change.

Given these problems and the continuing delays in acquiring a fully operational system, some FAA officials have expressed concern that the agency needs to reexamine the viability of the ODAPS project. However, other agency officials, while recognizing that the system has deficiencies, believe that the problems are correctable and that full deployment of ODAPS is a prudent course of action.

FAA's Long-Term Strategy for Improving Oceanic Air Traffic Control Is to Use Satellite Technology

FAA's long-term plan for improving oceanic air traffic control is to use satellites to provide position information on a near real-time basis rather than continuing to receive periodic position information via high-frequency radio. FAA's ongoing effort to accomplish this is the Automatic Dependent Surveillance (ADS) project. This project is designed to use commercially available communications satellites to relay aircraft position data from navigation equipment onboard aircraft to ground-based air traffic control facilities. This design is intended to provide controllers with near real-time information on aircraft positions and eventually provide two-way data communications between pilots and controllers.

strategy currently relies on the successful deployment of ODAPS, the outcome of this approach is currently unknown.

Recommendations

Because of the many problems experienced in implementing automated support for oceanic air traffic control, we recommend that you evaluate the feasibility of successfully developing and deploying ODAPS. This evaluation should include an assessment of the likelihood that FAA will receive a system meeting requirements within reasonable costs, and consider whether other automation alternatives could better provide automated support to the oceanic environment.

We also recommend that you reassess FAA's current strategy of using ODAPS as a baseline for developing a modern, satellite-based oceanic air traffic control system.

Agency Comments and Our Evaluation

We obtained official oral comments from Department of Transportation and FAA officials on a draft of this report. The officials acknowledged that the ODAPS project has experienced cost growth and deployment delays. They added that while the ODAPS system at the Oakland, California Air Route Traffic Control Center has had some problems, it has improved oceanic air traffic control services. However, in view of the difficulties ODAPS has encountered, officials stated that FAA is conducting a thorough review of the program.

We acknowledge that the ODAPS system in Oakland may have provided some air traffic control benefits. However, this system currently does not provide all planned capabilities and still has several unresolved problems. We are encouraged by officials' intent to conduct a review of ODAPS.

This report contains recommendations to you. The head of a federal agency is required by 31 U.S.C. 720 to submit a written statement on actions taken on these recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

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Objectives, Scope, and Methodology

Due to the expected continued increases in oceanic air travel and delays in FAA's efforts to use automation to enhance control of oceanic flights, we initiated this review of oceanic air traffic control. Our objectives were to (1) identify how oceanic air traffic is currently controlled, and (2) review FAA efforts to improve oceanic air traffic control through the use of automation.

To determine how oceanic air traffic is currently controlled, we reviewed oceanic control policies and procedures and interviewed staff members and officials involved in international operations at the New York and Oakland Air Route Traffic Control Centers. We also discussed oceanic operations with representatives from several major commercial airlines and from the Airline Pilots Association. In addition, we observed operations at the New York and Oakland Centers.

To review FAA's efforts to improve oceanic air traffic control, we reviewed requirements specified in automation and support contracts and other documents prepared by the agency and contractors. To obtain information on contract management, cost, schedule, and performance, we reviewed documents, contract files, contractor progress reports, and agency progress reviews. We also discussed planned oceanic automation systems' progress and problems with FAA headquarters officials, including appropriate program managers, and staff located at the New York and Oakland Centers, the FAA Eastern and Western Pacific regional offices, and the FAA Technical Center. In addition, we spoke to officials of STX Corporation, FAA's contractor for ODAPS.

We performed our work at Department of Transportation and FAA headquarters in Washington, D.C.; the New York Center in Ronkonkoma, New York; and the Oakland Center in Fremont, California. We also did work at the FAA Eastern Region in Jamaica, New York; the FAA Western Pacific Region in Hawthorne, California; and the FAA Technical Center in Pomona, New Jersey.

Our review was performed from November 1989 through December 1990. We conducted our review in accordance with generally accepted government auditing standards. We discussed the contents of this report with FAA and contractor officials and have reflected their views in the report where appropriate. In addition, we obtained official oral comments from Department of Transportation and FAA officials on a draft of this report. These comments and our analysis are also included in this report. We also obtained oral comments from the contractor for ODAPS on a draft of this report.

We are sending copies of this report to the Secretary of Transportation, other interested parties, and will make copies available to others upon request. This report was prepared under the direction of JayEtta Z. Hecker, Director, Resources, Community, and Economic Development Information Systems, who can be reached at (202) 275-9675. Other major contributors are listed in appendix II.

Sincerely yours,

Ralph V. Carlone
Assistant Comptroller General

The availability of near real-time position information on aircrafts' locations and two-way data communications is expected to permit closer spacing of aircraft. To operate, ADS will require, among other things

- existing commercial satellites and commercial ground stations through which ADS messages can be transmitted to FAA;
- appropriate FAA hardware and software to receive, process, and display data received from satellite transmissions; and
- aircraft equipped with a suitable transmitter/receiver, and an antenna to communicate with satellites.

Planned ADS Deployment Is Dependent Upon Successful ODAPS

Under its current plans, FAA intends to initially implement ADS using ODAPS as the technical platform in air traffic control facilities. Specifically, FAA plans to begin modifying fully operational ODAPS software in 1991 to receive, process, and display the data received from satellite transmissions. FAA then plans, starting in 1993, to develop a data link to provide controllers with direct two-way data communications with aircraft.

As previously discussed, ODAPS is not yet fully operational and still has several unresolved problems. However, under FAA's current plans, ADS requires a fully operational ODAPS. Therefore, uncertainty exists on whether this current strategy can be implemented as planned.

Conclusions

Air traffic control services in non-radar oceanic areas remain essentially unchanged from the 1950s. Oceanic air traffic controllers still manually update flight progress based on periodic radio reports received from pilots, a labor-intensive and time-consuming process that requires controllers to maintain large separation distances between aircraft. This inefficient use of airspace can lead to flights that are longer than necessary and lost opportunities for fuel savings.

Recognizing the need to modernize oceanic air traffic control, FAA initiated projects to provide automation support to oceanic controllers. The agency's primary effort to modernize the current environment is still not fully operational, is over 3 years behind schedule, and is now more than three times the original contract cost.

FAA's long-term strategy is to use satellites to provide accurate, near real-time control information on oceanic flights. However, because this reporting communications procedures. In addition, ODAPS will not permit a reduction in separation standards.

FAA awarded a $12.2 million contract for the design, development, installation, and testing of ODAPS in October 1984. Work under the contract, awarded to the Systems and Applied Sciences Corporation (now known as STX Corporation) via the Small Business Administration, was to be performed in two phases. During phase I, the contractor was responsible for establishing functional specifications and a preliminary design at a total estimated cost-plus-fixed-fee amount of $7.2 million. Phase II called for the contractor to develop, install, and test the system. At the time of contract award, $5 million was allocated to this phase although the scope of work was not totally defined. The ODAPS contract was originally scheduled to be completed by August 1987, 34 months after contract award.

ODAPS Has Experienced Cost Growth, Significant Delays, and Is Not Yet Fully Operational

The ODAPS project has encountered severe cost increases and schedule delays. As of June 30, 1990, FAA had already obligated approximately $40 million on ODAPS. Under the contract, three systems were to be provided by August 1987. However, as of December 1990, FAA has still not received one fully functioning system.

During the development of ODAPS, FAA changed its test plans for the system. FAA originally planned to have the contractor deliver the first system to the FAA Technical Center located at Pomona, New Jersey in late 1986, and test its functionality and suitability for use in an operational environment. Subsequent to this testing and resolution of any problems that were discovered, the original plan was then to deliver two additional fully operational systems to the Oakland and New York centers by August 1987. However, in May 1987, FAA advised the contractor that the planned system for the FAA Technical Center would be eliminated to save money and system testing would instead occur at both operational sites. After this decision, several agency officials warned management that such action would likely lead to cost increases and delays.

FAA delivered systems to the Oakland and New York centers in the Spring and Summer of 1988, respectively, for user acceptance and system testing. Because of the many problems that resulted, testing continued for over a year at these two facilities. One such problem was the inability to get the conflict probe feature to work properly, a function considered crucial to the success of the project.

Since the 1950s, FAA controllers have used pieces of paper, known as flight progress strips, to control aircraft over non-radar oceanic areas. These paper strips, which contain aircraft identification, destination, and other information about planned flights, are delivered to controllers prior to aircrafts' entry into oceanic airspace. As an aircraft progresses through the airspace, a controller manually updates each plane's flight strip with the last reported position and other data. This updating of paper flight strips occurs as follows:

- Pilots report their positions at least once an hour to one of four ground-based radio stations via high-frequency voice radio. These radio stations are operated by Aeronautical Radio Incorporated, a private organization funded by airlines and the federal government.
- The communications operator at the radio station then creates a teletype message from the voice report and sends it to the appropriate FAA center.
- The teletype message is printed at the center and delivered to the controller.
- The controller, in turn, uses this information to manually update the flight progress strips.

In addition to not providing real-time information on aircrafts' locations, this process is cumbersome, time-consuming, and in a few rare cases results in inaccurate location information being provided to controllers due to human errors that occur during the exchange of data. Further, because high-frequency radio channels are sensitive to atmospheric conditions, communications can fade in and out.

System Limitations Prevent Efficient Use of Airspace

Because this manually-intensive process does not provide real-time data on aircraft locations, controllers maintain large distances between airplanes to ensure safe air travel. Specifically, controllers are required to maintain a distance ranging from approximately 60 to 160 miles between planes. By contrast, in areas over the continental United States, controllers are required to maintain about 3 to 5 miles of horizontal distance between controlled aircraft.

The current process also requires aircraft to adhere to rigid route structures that offer limited flexibility for change. Controllers are often not able to provide timely responses to pilot requests for more efficient routes due to the lengthy communications process and lack of real-time monitoring of aircraft movement. Other factors such as winds, airline schedules, and aircraft performance limitations can also inhibit optimal relies on the successful deployment of ODAPS. Because of the problems and delays in deploying a fully operational ODAPS, FAA needs to reassess this strategy.

Background

FAA's air traffic control mission is to promote the safe, orderly, and expeditious flow of civilian and military aircraft. To accomplish this mission, air traffic controllers direct aircraft departures and approaches; maintain safe distances between aircraft; and communicate weather information, instructions, and clearances to pilots and other personnel.

For the continental United States and its coasts, FAA has 20 domestic air route traffic control centers to control aircraft that is enroute between airports, and about 182 terminal radar approach control facilities for those in terminal airspace. At each of these facilities, controllers rely on radar to provide aircraft locations. These radar data, along with other appropriate information such as filed flight plans, are then processed by computers and displayed on video screens at controllers' workstations. The information may include airplanes' identity, position, altitude, speed, and direction.

The International Civil Aviation Organization—a United Nations agency—has delegated responsibility to the United States for controlling air traffic over significant areas of the Atlantic and Pacific oceans (see figure 1.) FAA primarily relies on two air route traffic control centers to handle this traffic—New York and Oakland, California. The New York Center has responsibility for approximately 3 million square miles of Atlantic non-radar airspace, an area equivalent to the continental United States. The Oakland Center is responsible for much of the Pacific non-radar airspace, an enormous segment covering over 9 percent of the earth's surface, or about 18 million square miles.