level of safety required by the Federal Aviation Act when these operators begin using airplanes designed to carry more than 10 persons. Accordingly, FAA developed certain special conditions for the type-certification of aircraft of the kind and for the use described above. These special conditions were set forth in a notice of proposed rulemaking issued in March 1967.

Air Agencies

In addition to airmen and aircraft, FAA certificates air agencies, which include (1) schools that teach flying or the skills required for repair and maintenance of aircraft and aircraft components, and (2) repair stations for the maintenance and repair of aircraft and aircraft components.

In both categories, certificated air agencies show sizable increases in numbers during the 1960's: Certificated pilot schools, numbering 895 in January 1960, increased by January 1967 to 1,364; of this total, 76 gave ground instruction only, the remainder giving combined flight and ground instruction (493) or flight only (795). Certificated mechanic schools increased between January 1, 1963, and June 6, 1967, from 68 to 80. Certificated repair stations numbered 722 on June 30, 1960, but had risen in number by June 30, 1967, to 1,638. Repair stations have ratings signifying the kind of work they are qualified to do. Of the 2,958 ratings held on June 30, 1967, the most numerous were airframe (20 percent), radio (20 percent), and accessory (17 percent).

SURVEILLANCE, INVESTIGATION, AND ENFORCEMENT ACTIVITIES

FAA monitors the operational safety of the civil aviation environment through a variety of surveillance, inspection, investigation, and enforcement activities. Some of the more notable occurrences in this general area during fiscal 1967 follow.

Surveillance

In the agency's efforts to help minimize preventable causes of accidents, especially mechanical failure or malfunctioning of aircraft, notable developments involved the following:

Maintenance Analysis Center (MAC).—Developed in concept in fiscal 1966, MAC was established in fiscal 1967 at FAA's Aeronautical Center, Oklahoma City. Its purpose is to provide a focal point and capability for the assembly, overall review, and diagnosis of data related to operational malfunctioning of aircraft; when the situation warrants, it issues warnings to alert interested members of the aviation community (including FAA inspectors) to potentially dangerous mechanical conditions in specified types of aircraft. To this end, MAC modernizes and automates FAA's information retrieval system applying to aircraft maintenance data; the system collects and collates the air carrier mechanical reliability report (MRR), the air carrier mechanical interruption summary (MIS), and the new general aviation maintenance irregularity report (MIR). To interpret the data thus assembled, MAC is staffed with aircraft maintenance specialists and technicians both trained and experienced in the techniques of failure-effect analysis, reliability engineering, continuous-maintenance practices, and statistical research.

Performance and Reliability Program (PAR).—Phase I of PAR began in June 1966. Still in operation at year's end, this phase is designed to monitor overall performance in the airline industry as represented by 15 participating airlines. From these airlines during fiscal 1967, FAA collected service experience and related information in the form of nine parameters (see the report for fiscal year 1966) representing 3½ million flying hours and 2½ million aircraft movements. The accumulated data are being studied by representatives of the airlines and FAA to appraise PAR's success thus far in bringing into focus areas where safety can be enhanced. Phase II, when implemented, is expected to add 15 more participating airlines. European interest has been expressed in developing a similar program.

Systemsworthiness Analysis Program (SWAP).—Implemented in try-out phase during fiscal 1967, SWAP is the agency's new approach to monitoring the air carriers' compliance with the rules and regulations governing operation and maintenance of their aircraft. When fully implemented, it will complement a system of routine inspections largely performed by cadres of inspectors domiciled at the carriers' main operations and maintenance bases. Teams of inspectors will work from bases strategically located within an inspection area, periodically performing comprehensive, in-depth inspections of the carriers' programs for keeping personnel and materiel up to standards. Additional inspections will be performed as necessary; for example, the PAR program may uncover trouble spots or regressive trends requiring attention of the SWAP teams. The Phase I implementation—which began on July 1, 1966, and was well received by the airlines during the year—demonstrated the effectiveness of the new approach. At year's end, full implementation (Phase II) was expected by October 1, 1967.

Improved Maintenance Standards.—FAA's programs for developing maintenance standards to be observed by operators of aircraft gave major attention during the year to standards for the coming generation of large turbine and supersonic transport aircraft. The objective is to assure that these aircraft, when placed in use, can be maintained in excellent operating condition. After type certification of the new models, maintenance review boards will use available information to establish for each model an initial maintenance program to be carried out by the U.S. operator (airline or other entity) until service experience provides a basis for the initial program's confirmation or modification.

Aircraft Reliability Control.—Continuing its development of reliability control methods for aircraft components, FAA in fiscal 1967 approved, as meeting the agency's standards, two air carrier programs covering aircraft

structures. In addition, a liaison committee consisting of FAA principal maintenance inspectors helped with administration of the Regional Operators Engine-Reliability Program (ROPER), an organization of local carriers formed to make their maintenance and reliability-control efforts more efficient through treating as a single fleet all transport aircraft operated by members.

Second Annual Maintenance-Reliability Symposium.—Growing out of the success of the first such symposium, in fiscal 1966, the second was held in November 1966; like the first, it convened in Washington with FAA as sponsor. Its subject was "Continued Reliability of Transport-Type Aircraft Structure," and attendance included representatives of foreign governments, domestic and foreign carriers, U.S. and foreign aircraft manufacturers, and repair stations and facilities. Planning was underway at year's end for a third similar symposium.

Airborne Integrated Data Systems (AIDS).—Under development in fiscal 1967 was a system of maintaining surveillance over air carrier performance by using flight-recorder data. The possibility of such an approach has been recognized for a number of years, but only recently has the agency begun development of the concept into a total system approach, including training in the use of the system for FAA inspectors and the system's use in FAA airplanes. The basic consideration is the capability of sophisticated flight recorders to measure and record a variety of data sufficient to permit fruitful comparison of actual aircraft flight with programed safe-flight "envelopes." Deviations in the actual flight pattern from the programed "envelope" indicate areas requiring special attention. Analyses of such deviations thus hold the promise of providing management with a valuable source of information on trends and problem areas in air carrier performance requiring corrective action.

Surveillance of Air-Taxi Operations.—The spectacular growth of scheduled air taxis has made it necessary for FAA to intensify its inspection and surveillance of the industry, at the same time reviewing current regulations in the light of the industry's changing needs. Toward the same end of operational safety, air-taxi organizations planned a series of air-taxi management and safety seminars to be conducted throughout the nation.

Airport Inspection

An airport safety-inspection program was begun on a test basis in fiscal 1967. By year's end, selected airports of various sizes and in all sections of the continental United States had been inspected by teams of specialists in the agency's major operational functions. These teams were able to alert airport managements to a number of unsafe or marginal conditions, some of which have already been corrected. The scope of the inspection was broad, including the following areas: fire suppression and rescue services, the bird-hazard situation, safety aspects of airport maintenance, runway improvements looking toward all-weather operations, refueling facilities, protection afforded passengers and the public, airport lighting and marking, medical facilities, existence (or not) of obstructions on or in the airport vicinity, and state of planning for emergencies, whether caused by natural disaster, catastrophic accident, or the Nation's foreign relations.

Usefulness and effectiveness of the approach used in this program are being evaluated as the program proceeds.

Flight Inspection of Navaids

Electronic air navigation facilities along the Nation's airways are regularly flight-inspected for proper performance by specially equipped FAA aircraft. Notable developments in fiscal 1967 involved—

- Further application of operations research techniques to determine necessary frequency of inspection: Past performance of a given facility provides a basis for calculating, through central computer processing, the probability that the facility is operating within allowable tolerances. Selective inspection of instrument landing systems, based on such calculations and begun in a previous year, became even more selective during fiscal 1967 as the result of refinements of method. As a further result of work done in fiscal 1967, similar selectivity of inspection was scheduled at year's end to begin in fiscal 1968 for precision approach radars (PAR's). Similar techniques, but without computer data, have been applied to airport surveillance radar (ASR) systems.
- SST altitudes: Planning was completed for a joint U.S. Air Force/Federal Aviation Administration program, beginning in fiscal 1968, to check adequacy of navaids at altitudes (40,000 to 70,000 feet) to be flown by supersonic transport (SST) aircraft.

Accident Investigation

Investigation of accidents and incidents is an important source of information helpful to FAA in improving safety requirements. (Incidents, embracing a range of malfunctions or mishaps within arbitrarily defined categories, are technically distinguished from and less serious than accidents.) Under the Department of Transportation Act, FAA participates with the National Transportation Safety Board in the investigation of aircraft accidents as it did under the Federal Aviation Act with the Civil Aeronautics Board; the NTSB on April 1, 1967, took over from the CAB responsibility for determining the probable cause of each civil aircraft accident.

Among FAA's significant activities in this area in fiscal 1967 were:

- Improvements in flight-data and voice recorders to increase amount of taped information available to investigators about movements and performance of an aircraft and actions of its crew prior to an accident.
- Continued support, jointly with the CAB, of the National Aircraft Accident Investigation School at FAA's Aeronautical Center, Oklahoma City. During fiscal 1967, 15 foreign nationals attended this school.

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- Continued coding of accident-investigation data, including medical data, for automatic data processing; the ADP system was scheduled at year's end to become operational during fiscal 1968.

Significant safety actions resulting from a series of unrelated yet tragic air carrier accidents in the spring of 1967 included:

- An FAR amendment permitting until December 1, 1967, substitution of one-engine-out landing in four-engine jets instead of a two-engines-out landing during pilot aircraft-type-rating and periodic checks (but requiring, for a pilot taking a type-rating check, prior certification to FAA by the pilot's instructor that the latter had seen the pilot make a satisfactory two-engines-out landing during flight training).
- Request by FAA and agreement by all operators of large four-engine jets that approach lanes over unpopulated areas must be used for conducting the final phase of two-engines-out training-flight landings when the speed is reduced below the two-engine minimum control speed.
- Formation of an FAA task force to explore, as a supplement to the agency's developing an electronic collision-avoidance system, procedural methods of minimizing the possibility of midair collisions.
- Special attention by FAA field inspectors to ground deicing procedures used by air carriers and commercial operators of large aircraft, with corrective action where necessary.

Enforcement

Safety rules and regulations would have little value if they were not enforced. Agency inspectors conduct appropriate investigations of all known or reported violations and take action as warranted. Emphasis is placed on educational and other methods of preventing recurrence of violations, but penalties are imposed where deemed necessary. Policy calls for the decision on the specific action required—whether remedial or punitive—to take place at the lowest workable level; this usually means the decision is made by the field inspector who observes or investigates the alleged violation.

Enforcement statistics for fiscal 1967, with the comparable figures for fiscal 1966, were as follows: Violations reported, 5,055 (4,342 in fiscal 1966); actions processed to completion, 3,962 (4,420); number of completed actions involving proceedings to suspend or revoke certificate, 1,500 (1,471); number of certificate-action cases appealed to the Civil Aeronautics Board or the National Transportation Safety Board (the CAB's successor on April 1, 1967, for hearing such appeals), 133, or 9 percent (150, or 10 percent [revised figures from those in the 1966 annual report]); number of cases settled by civil-penalty compromises or judgments rendered in U.S. District Courts, 1,002 (1,074); number of cases settled otherwise (the great majority by letters of reprimand or other administrative action), 2,960 (3,346); total of civil penalties collected (mostly through voluntary settlements between FAA and the airmen or operators concerned), $194,524 ($189,312); amount of preceding sum collected by Department of Justice, $17,907 ($13,526); number of violations involving military personnel reported to Department of Defense for disposition, 62 (86 [revised figure]); number of violations involving foreign-certificated airmen referred through Department of State to certificating nation, 18 (12) (both revised figures).

AVIATION SAFETY RESEARCH AND DEVELOPMENT

Improvements in aviation safety over the years have resulted in large part from focusing research and development on safety problems brought into prominence by aeronautical operations. Notable R and D activities of this sort conducted by FAA in fiscal 1967 follow.

Aircraft Safety Development

A vigorous program in aircraft safety development is essential in laying a sound technological foundation on which to build improved standards of safety. FAA's aircraft safety development program concentrates on the most pressing safety problems facing civil aviation. A description of some of the fiscal 1967 accomplishments in five research and development areas follows.

Airframe Program.—FAA continued to investigate the phenomenon of flash fires in aircraft. Conventional cabin interior furnishings and materials were subjected to full-scale fire tests, as were new and improved interior materials. A study of the fire-inhibiting characteristics of Freon 1301 was introduced into the program as part of the quest for effective ways of suppressing and controlling cabin and cargo compartment fires.

Attention was given to other areas in the airframe program as follows:

- A linear-shaped liquid explosive charge system capable of cutting a large hole in the cabin structure of an aircraft is being developed as a means of improving passenger evacuation during an emergency.
- FAA's runway friction studies facilitated the introduction of grooved runways in the United States. A runway at Washington National Airport was grooved during this reporting period (see chapter IV); runways at Kansas City Municipal Airport and John F. Kennedy International Airport have also been grooved. Meanwhile, FAA and the National Aeronautics and Space Administration are testing relative effectiveness of 18 groove patterns on taxiways at five airports.
- Improved fuel-containing bladder cells were designed and installed in typical aircraft tanks. Made of high-strength, light-weight, crash-resistant materials, the cells are scheduled for testing during the coming year to determine their ability to resist fuel spillage in a survivable aircraft crash.
- A computer technique was developed for analyzing the crash resistance of fuselage structures.

Propulsion Program.- Among the numerous avenues being explored for reducing the fire hazard in aircraft accidents, the use of thickened or gelled fuels is one of the more intriguing, although, as a practical matter, this poses many and complex problems. Such fuels have been under investigation by FAA for several years. During this reporting period, FAA used gelled fuels for the first time to operate a ground-based jet aircraft engine (J–47). This test, successfully concluded at FAA's National Aviation Facilities Experimental Center (NAFEC), was followed by the initiation of an expanded FAA-sponsored program at the Naval Air Propulsion Test Center. Fuel control, combustor compatibility, and other tests are included in this program.

In another development concerning currently used jet fuels, FAA is sponsoring a study comparing the relative fire hazards posed by different types of fuel during a crash. Construction has begun on a test chamber that will be used to conduct the tests.

At the request of the Air Force, FAA undertook as part of its engine-fire test program to simulate hot-surface ignition tests of a C–5A (jumbo jet aircraft being developed by the Air Force) engine installation. The tests, which were simulated on a JT3D turbofan engine installation, yielded results leading the manufacturer of the C–5A airframe to redesign the C–5A engine installation. A 3-year aircraft engine and nacelle fire-test program, which NAFEC is conducting under an Air Force contract, is expected to assist in the design of other advanced aircraft. These tests, like the tests of the C–5A installation, will be conducted under simulated conditions.

The hazard posed to aircraft by lightning strikes continued under investigation during the reporting period. Seventeen natural lightning strikes were triggered on a specially equipped research ship in an attempt to better understand the nature of lightning and to provide for improved protection against its hazards. In another experiment, laboratory lightning discharges were directed near an aircraft fuel-tank vent to determine if a lightning strike can ignite a flammable efflux under flight conditions. In yet another project, conditions in fuel-tank vent systems that may tend to promote the propogation of fire were analyzed. Finally, fuel-vapor conditions within aircraft fuel tanks were investigated. This investigation revealed that jet-fuel flammability envelopes established under conditions of equilibrium are enlarged when the effect of aircraft motion is introduced.

Equipment Program.—Among areas under investigation in the equipment program, the following items deserve special mention:

- FAA is continuing to evaluate all possible approaches to the solution of the problem of aircraft sabotage. A passive bomb-detection system under development by a contractor is being evaluated by FAA.
- An evaluation of flight data recorders has demonstrated the feasibility of recording a greater number of flight parameters as an aid to the investigation of aircraft accidents. Work aimed at improving capability of flight-recorder records to survive posterash fire was also begun.

- A test program was started to determine whether aircraft-engine ingestion of the proposed global meteorological experiment balloon would pose a hazard.

Flight Program.- Pilot disorientation resulting from unexpected weather conditions is one of the chief causes of in-flight accidents involving aircraft flown by pilots without an instrument rating. In attacking this problem, an FAA contractor has conclusively demonstrated that an experimental stability augmentation system for light aircraft can successfully counteract the tendency of non-instrument-rated general aviation pilots to lose control of their aircraft when deprived of visual references outside the aircraft. During the evaluation tests of the system, 26 non-instrument-rated pilots flew a cross-country course that included simulated IFR flying conditions. Those pilots using the stability augmentation system performed as well under IFR weather conditions as they did during VFR weather conditions; among those not using the stability augmentation system during bad weather, more than a third lost control of their aircraft at one time or another. At year's end, FAA was producing a motion picture describing the stability augmentation system and the results of the evaluation.

Other highlights of the flight program follow:

- Civil jet transports operating in and out of six major airports were photographed to determine the performance of these aircraft during takeoff and landing. Photographing operations have been completed at three of the airports, and the data, which will be used in establishing certification standards, were being reduced and analyzed at the close of the reporting period.
- The agency completed the last third of a three-helicopter test series in which the effects of altitude and weight on the height-velocity characteristics of single-rotor helicopters were established.
- An FAA-sponsored study conducted by that part of the Civil Aeronautics Board concerned with aircraft accident investigation (since April 1, 1967, a part of the National Transportation Safety Board) concluded that typical pilot errors in certain types of accidents were more influenced by some airplane designs than by others.
- The testing of air carrier pilots in the Navy's Johnsville (Pa.) centrifuge (a variable gravity simulator capable of simulating turbulent flight conditions) were completed at year's end. The pilots "flew" the centrifuge through "thunderstorms" in a simulated configuration duplicating the flight characteristics of the Boeing 720. Analysis of the data has begun, and, hopefully, the results will lead to a better understanding of "jet upset" and an improved technique for penetrating turbulence.

General Aviation Safety Development Program.—Because the number of general aviation accidents caused by aircraft stall and ensuing spin continue high, FAA has been giving this problem a great deal of attention. One effort is directed at improving the methods of warning pilots of light

aircraft of impending loss of airspeed. Various warning methods have been tested, and an order of merit for these methods is now being established. The information gathered from this project will be provided the general aviation community, and perhaps at some future date will be incorporated into the Federal Aviation Regulations.

In an effort to reduce the general aviation pilot's workload during poor weather, FAA has been testing a variety of cockpit instruments. These tests were completed during this reporting period, and a report is being prepared for distribution to the aviation community covering the results of the investigation. It is hoped that the report will speed up the introduction of improved instruments in general aviation aircraft and induce more general aviation pilots to secure an instrument rating.

In view of the fact that pilot error accounts for 85 percent of all general aviation accidents, FAA introduced a number of projects during this reporting period designed to improve pilot training. One project is devoted to sampling the private pilot population in order to determine the distribution pattern between local, cross-country, and other types of general aviation flights. Once these patterns have been determined, they will be used to reexamine the skill and knowledge required by the general aviation pilot for safe flight under different weather conditions. This, in turn, should lead to improved training curricula and more effective pilot certification testing methods. Another project is directed at developing a curriculum incorporating both training for an instrument rating and training for a private pilot's certificate -the object being, once again, to induce more general aviation pilots to obtain an instrument rating. Finally, in yet another project, the value of an angle-of-attack instrument for training student pilots to maintain better airspeed control is being examined.

Improved Flight-Inspection Equipment

Research and development efforts to improve flight inspection of air navigation facility performance included the following:

- Testing and evaluation of improved sensors for measuring strength and accuracy of signals emitted by navaids.
- Start of integration of advanced flight-inspection equipment known as SEAL (Signal Evaluation Airborne Laboratory).
- Successful testing of ILS (instrument landing system) positioning device (for glide slope and localizer). At year's end, additional tests were being conducted at a problem site.
- Completion of successful evaluation tests of the light-weight Portable Flight Inspection Package (PFIP), issuance of specifications to manufacturers, allocation of funds to purchase ten units for FAA and four for the Air Force, and issuance of invitations for bids from prospective manufacturers. Use of the PFIP will reduce cost of emergency and remote-area flight inspections by eliminating costly en route flight hours of large FAA aircraft. (See chapter IV for interest of foreign governments in the PFIP.)

Collision Avoidance

FAA has been working for some years to develop an effective collision-avoidance system—that is, equipment which, when carried aboard an aircraft in flight, can give the pilot timely warning of impending collision with another aircraft. Such equipment ranges from the relatively sophisticated to the relatively simple—from devices that can electronically assess a potential threat and command an appropriate maneuver for avoiding collision to devices that merely warn the pilot.

Of the techniques examined by FAA thus far, the cooperative time-frequency one shows the most potential. It is called cooperative because all aircraft protected by the system must be specially equipped with interdependent devices for exchanging data (identification and altitude). A common frequency reference for this exchange of data is made possible by the precise timekeeping ability of very stable oscillators. The precision of this common reference permits separate time slots that are small fractions of a second apart in a continuously repeated cycle to be assigned to aircraft for the exchange of the signals giving their identification and altitude. Thus it becomes possible to have in each aircraft in the system a device which, through measuring travel time of incoming signals from the other aircraft in the system and comparing time of signal receipt with the assigned reference points, can keep track of the distance of the other aircraft and, if collision becomes imminent, indicate evasive action the pilot should take.

In fiscal 1967, FAA:

- Participated in Government-industry conferences to develop national standards for system-component characteristics of time-frequency devices that may be operating in the future civil-military common systems of airborne collision prevention and air navigation and traffic control.
- Analyzed a contractor's preliminary report recommending time-frequency application to a collision-avoidance system.

The foregoing deals with the problem of preventing midair collision in general. A special form of this problem is concerned with assuring lateral separation between aircraft flying parallel routes over ocean areas. Toward finding a solution to this form of the problem, FAA in fiscal 1967:

- Investigated an over-ocean separation-assurance system.
- Awarded contracts for beacon range-altitude monitor and time-frequency range-altitude monitor.
- Completed DME (distance-measuring equipment) and operational tests.
- Began flight testing of beacon range equipment.
- Completed flight simulation using beacon, time-frequency, and DME information.

Airport Safety

FAA's R and D efforts to improve safety of aircraft operations on and in the vicinity of airports were concerned with the following problems or equipment during fiscal 1967 and achieved the indicated progress—

- Runway slush measuring system: Issued final report analyzing available techniques, concluding that application of any of them to civil airports is not feasible.
- Aircraft arresting systems: Achieved 90-percent completion of aircraft evaluation of a new pendant cable support system for hook-equipped aircraft at joint-use airports.
- Airport firefighting equipment and techniques: Completed evaluation of dry chemicals and foams to define adequate fire protection in terms of discharge rates, total quantities, and types of agents.
- Control of birds in and around airports: Completed an interim report on hazards to aircraft posed by migrating birds in the Mississippi flyway, and another on bird hazards at New York's John F. Kennedy International Airport. The Mississippi-flyway report notes routes, volume, species, and periods of greatest passage. The other report recommends several specific areas in the vicinity of the JFK International Airport where improvements are needed to correct bird-hazard conditions.

Aviation Weather

Encounters with the weather phenomenon known as clear air turbulence (CAT) have occurred mostly above 20,000 feet. For this reason its importance to aviation has greatly increased since the advent of jet transport aircraft, which routinely fly at higher altitudes than piston-powered aircraft. CAT poses a problem because encounters with it, though infrequent, have sometimes been violent enough to damage aircraft structurally and injure passengers; moreover, CAT's presence is usually not suspected until felt, since it is not betrayed by clouds or other visible or audible features.

Toward solving the CAT problem, FAA in fiscal 1967:

- Continued its participation in the ad hoc National Committee on Clear Air Turbulence (seven Federal agencies and the National Science Foundation), which was established in November 1965 to determine operational needs for the detection and prediction of clear air turbulence and which prepared and published its final report in fiscal 1967. FAA is participating in the coordinated interagency planning resulting from the report.
- Continued work toward development of a CAT detector, with testing of an infrared radiometer that detected turbulence over the Canadian Rockies and the Sierra Nevada in California. The device had inadequate range but is worthy of further exploration.

Other FAA activities in the aviation-weather R and D area included work, as indicated below, toward the following objectives or on the following problems—

- Optimum parameters for weather display in the National Airspace System En Route Stage A air traffic control subsystem: Efforts directed mainly toward optimizing performance of weather outline generators and determining appropriate display characteristics on the basis of human-factors analysis.
- Elimination of radar clutter in display of weather data: Development of the engineering requirement and initiation of action to obtain bids for developing engineering specifications of a suitable device.
- Measuring and reporting runway visibility: Continuation of research, study, and experimentation with various techniques; the pulsed ruby laser showed high promise of providing an accurate, single-ended device for measuring low visibilities. Efforts continued also on the best way of measuring visibility readings given a pilot on final approach to achieve with the least number of such readings an adequate representation of what the pilot will encounter at touchdown.
- Convective-storm hazards: Continuation of research jointly with the Environmental Science Services Administration (ESSA), involving a series of thunderstorm penetrations and overflights to determine hazardous areas associated with convective storms; development of techniques for automatic measuring of convective-storm intensity so that the storm's location, direction, and velocity can be communicated to air route traffic control centers; conducting of exhaustive tests of representative types of airborne weather radar to establish safe rules for their use and better understanding of their capability.
- Improving terminal weather information: Preparation and publication of a test and evaluation plan concerning the Atlantic City mesonet (special-purpose network of meteorological observation stations), with plans for publishing in the first part of fiscal 1968 a technical report dealing with diagnostic studies and preliminary forecast verification, and preparing by the end of fiscal 1968 the final report on the utility of the mesonet approach.

Aeromedical Research

FAA conducts a vigorous aeromedical research program as part of its primary mission of promoting safety in the skies. During this reporting period, a number of the agency's investigations in accident and injury prevention appeared especially promising. Some of the more notable investigations follow.

- Passenger antismoke hoods: A polyimide device designed to protect a passenger's eyes and respiratory tract from postcrash smoke, noxious fumes, and heat was developed and tested. The device, which a passenger can slip over his head like a hood, provides breathable air for an additional 3 to 5 minutes during emergency evacuation.

- Universal evacuation simulator for advanced aircraft: A unit that can be employed in simulating evacuation procedures for supersonic transports, jumbo jets, and other advanced aircraft was designed by FAA, and the first steps were taken to install the unit at FAA's Aeronautical Center in Oklahoma City, Okla. The unit will be used to evaluate escape devices, do smoke and lighting studies, and test new emergency evacuation concepts.
- Impact survival: Studies of crushable energy-absorbing materials led to a new series of recommendations to aircraft designers for the construction of instrument panels and seats. The materials are designed to increase a passenger's chances of survival if he violently collides with a seat or instrument panel.
- Shoulder harness: A series of studies on shoulder harnesses led to an FAA notice to mechanics prescribing the proper method of installing these devices. It also led to the dissemination of a new advisory circular to pilots and a notice to general aviation district offices.
- Alcohol and flying: FAA's continuing study of the effects of alcohol on flying performance revealed in an earlier reporting period that the consumption of even one drink can impair a pilot's airmanship. As a follow-up, the agency published a notice of proposed rulemaking on the use of alcohol. After receiving comments from the aviation community, however, FAA has decided to substitute an aggressive educational program for the rule.
- Side-facing seats: Data collected during impact studies of side-facing seats revealed the need for proper torso restraint. These data were to be considered in a new crashworthiness rule being processed at year's end.
- Executive-jet decompressions: A study of the cabin decompressions of executive jets shed light on the proper window size for these jets.
- Cosmic radiation: The effects of small quantities of cosmic radiation on living things—a subject that has taken on particular importance with the impending arrival of such extremely high-flying aircraft as supersonic transports—got underway at FAA's Aeromedical Institute. Besides conducting their own investigations, scientists at the Institute are monitoring similar radiation studies at other institutions. A Committee on Radiation Biology Aspects of the SST, composed of prominent biophysicists and radiologists, was established by the FAA Administrator to help provide research guidance and make recommendations.
- Cockpit noise levels: The study of noise levels in the cockpits of general aviation aircraft and helicopters yielded information that will help pilots avoid permanent damage to their hearing.
- Cardiac rehabilitation: FAA has made significant progress in recent years in rehabilitating pilots with a history of heart disease. During this reporting period, two pilots who had suffered heart attacks and later participated in FAA's heart rehabilitation program were returned to flight status. Findings coming out of this program are being made available to medical groups throughout the country.

OTHER AVIATION SAFETY ACTIVITIES

Training of Aviation Safety Personnel

This area of agency effort was marked by the following developments:

- Nearly double the number of refresher clinics and revalidation courses conducted for flight instructors as compared with the number in fiscal 1966; 3,000 instructors attended.
- Start of a new jet training program at the FAA Academy, Oklahoma City, with two different models of popular general aviation jets (types used mainly by business corporations). The objective is to upgrade FAA inspectors' knowledge concerning jet aircraft safety problems.
- Establishment of an FAA-industry working group to explore ways and means of improving pilot training in emergency maneuvers and procedures. Because of the very high cost of training flight-time in such future aircraft as the jumbo jets and the SST, the development of improved flight simulators is especially important. Beginning its work in the last quarter of fiscal 1967, the group was aiming at completing its studies during the second quarter of fiscal 1968.

Improving Safety in General Aviation

The problem of safety in the general aviation segment of flying is especially challenging because of the growth of this segment, which for some years has been, and for the future is forecast to be, rapid. Notable among the agency's steps to meet this challenge during fiscal 1967 was the development of a program called Project 85. To be tested initially in two FAA regions—the Southwest and the Central—starting about January 1968, the program calls for a trained specialist to be stationed at each general aviation district office for an aggressive, full-time attack on the problem of preventing general aviation accidents.

A further effort toward the same end by the Central Region is a pilot's counseling program titled "This Is Your Life." The program aims at personal contact with and counseling of every pilot in the Central Region's jurisdiction whose actual flight performance indicates a high accident potential. Response of pilots so counseled (57 at year's end) has been excellent.

The year saw notable developments in Alaska also. In this State, where flying is the only means of transportation (other than on foot or by dogsled) between many points, the Centennial Year celebrations provided a special attraction for out-of-State general aviation pilots. FAA's Alaskan Region issued a booklet to inform visiting airmen concerning flight services available. Official State interest in aviation safety was shown during the year through sponsorship of pre-hunting season rallies in the three principal cities by Alaska's Department of Commerce, and by the Gover-

nor's proclaiming the week of February 8, 1967, as Flight and Ground Instructor Week.

Changes in Safety Rules and Regulations

As mentioned at the beginning of this chapter, changes in the interest of safety are made in the Federal Aviation Regulations when, as a result of experience or advances in technology or science, they become necessary or are deemed desirable. Certain fiscal 1967 changes and proposed changes were noted above (in the discussion concerning airman and aircraft certification and concerning accident investigation). Among the year's other notable changes may be mentioned the following:

Airline Transport Pilot Certificates and Associated Ratings.—Amendments to FAR Parts 61, 91, and 121, issued January 3, 1967, and effective by Part 61 for airline transport pilot certificates and associated ratings and by Part 121 for training and proficiency checks. Besides eliminating obsolete maneuvers, this amendment:

- Authorizes greater use of airplane simulators in flight checks.
- Allows waiver of certain maneuvers if the pilot being checked is employed by a Part 121 certificate holder and has successfully completed that certificate holder's training program.
- Authorizes retesting on maneuvers other than any maneuvers failed if such retesting is found to be necessary to determine the applicant's qualification.

Other *Aviation Mechanic Safety Awards.*—A coordinated effort begun in 1963 by FAA and certain private organizations, the aviation mechanic safety awards program recognizes the vital role the aviation mechanic plays in aviation operations by annually honoring State, regional, and national winners with awards for contributions to aviation safety. In fiscal 1967, the program completed its fourth successful year.

Aeromedical Standards.—As experience and aeromedical knowledge advance, medical standards applying to pilots must be constantly reviewed to keep them up to date. A notable review of this kind during the reporting period concerned cardiovascular disease in civil aviation. An FAA-sponsored public hearing on the subject, announced in December 1966 and held in February 1967, provided a forum for comment and discussion by interested members of the aviation community and the public at large. Many presentations were made by representatives of the aviation industry and of research groups. Subsequently, FAA subjected all presentations and comments to thorough review and analysis. At year's end, the agency was preparing a proposal to modify the existing standards as incorporated in the FAR's.

Aeromedical Education Activities.—Continuing its highly successful program of producing and distributing aeromedical education materials for both aviation medical examiners and general aviation pilots, FAA distributed during fiscal 1967 more than a million safety leaflets; other materials included films and exhibits.

Sport Parachutists.—Initial skydiving jumps have continued to produce an occasional accident, despite expenditure of considerable time and effort by individual parachute clubs and organizations in comprehensive educational programs. To help reduce the potential hazard of initial static-line jumps to a minimum, FAA issued a bulletin recommending such safety actions as:

- A general physical examination prior to initial jump.
- An organized program of initial training.

Deterrent to Anonymous Bomb Threats.—Progress toward deterring anonymous telephone calls that threaten the bombing of aircraft was made possible through certain research efforts of a private corporation in conjunction with information assembled by FAA on the frequency and location pattern of such calls.

SAFETY RECORD FOR THE YEAR

In its efforts to insure aviation safety, FAA works with other government organizations—Federal, State, and local—and with the aviation community in general. To carry out its statutory mission, however, FAA must not only cooperate; it must take the lead in these combined efforts. An index of the effectiveness of these efforts is [illegible] period of years. For its annual reports, FAA has been using the rates computed by the Civil Aeronautics Board, which until April 1, 1967, when the Department of Transportation Act became fully effective, had the statutory responsibility of determining the probable cause of every civil aircraft accident. Since the CAB computed these rates for calendar years only, the latest such figures available for this report are those for calendar 1966. Appendixes A and B show these latest CAB-computed rates for air carriers and for general aviation, respectively; to give perspective, the rates for both segments of aviation are also shown as far back as the middle of the 1950's.

The ideal, of course, is to have no accidents or fatalities at all in aviation. Achievement of that ideal on a sustained basis is not a realistic prospect in the near future. But from a practical point of view, the rates shown in the appended tables reflect well-functioning aviation-safety programs in both segments of civil aviation, whether the latest rates are compared with the rates for the preceding year or the preceding decade. For general aviation, there was no significant change from recent years. The air carriers, however, achieved in calendar 1966 the lowest rates they have had since 1954.

Chapter II

AIRSPACE CONTROL AND FACILITIES

Fiscal year 1967, like 5 previous years in the decade of the sixties, saw U.S. aviation attain new peaks of air traffic activity. These peaks were attained despite a labor strike that shut down most of the major airlines for 6 weeks. New highs were hit in all major measures of activity and by all aviation categories except military, illustrating the rapid growth rate being set by civil aviation. And from all indications the level of civil aviation activity in the future will head in the same direction—up—giving force to the necessity of implementing a modern airspace system with a greatly increased capacity.

Over the last 10 years, aircraft operations at FAA's airport traffic control towers (ATCT's) have registered an 81 percent increase; the same period saw the number of airport traffic control towers rise from 190 to 304—an increase of 60 percent. During this reporting period, the ATCT's reported handling 47.6 million aircraft operations, exceeding the fiscal 1966 count of 41.2 million by more than 15 percent. Approximately 22 percent (10.6 million) of this total were instrument flight rules (IFR) operations. Civil aviation accounted for most of the increase, and within this classification, general aviation was the fastest growing category. The three busiest airport towers during the reporting period were, in order of rank, Opa Locka (Opa Locka, Fla.), O'Hare International (Chicago, Ill.), and Van Nuys (Los Angeles, Calif.). Each of these towers registered more than 500,000 operations. Chicago's O'Hare, however, had by far the greatest number of instrument operations.

En route traffic also experienced a substantial increase. FAA's 28 air traffic control centers (ARTCC's), seven of which are outside the contiguous United States, reported handling 15,067,727 aircraft operating under instrument flight rules. This exceeded the fiscal 1966 count of 13,534,883 by 11 percent. Once again, it was civil aviation that accounted for the increase, with military aviation actually registering a slight decline. Moreover, while air carrier aircraft represented more than half of the total traffic and experienced a 14-percent rise, general aviation traffic grew twice as fast as air carrier traffic. The Chicago, New York, Cleveland, and Washington centers remained the four busiest in the country—the first three handling over a million aircraft each and together accounting for 23 percent of the total IFR traffic.

The future promises a continuation of this growth trend. Indeed, projected increases in aviation activity are being revised upward. By 1977, the IFR traffic handled by FAA's air route traffic control centers is expected

to double; the number of operations handled by airport traffic control towers is expected to triple. The large air transportation hubs ("large hub" is a metropolitan area with 1.0 percent or more of the total U.S. passenger traffic) will absorb a great deal of this increase. By 1980, aircraft operations at the 22 large hubs are expected to number 75 million—56 percent more than the total operations handled during this reporting period by all 304 FAA towers (including 59 combined station/towers).

AUTOMATING THE NATIONAL AIRSPACE SYSTEM

Aviation safety, like automobile safety, depends not only on a regulatory system and its enforcement, but also on the maintenance of adequate passageways of travel. The responsibility for managing aviation's highways—the nation's navigable airspace—belongs to FAA. Maintaining the safe and efficient utilization of this resource is a complex task requiring the linking of facilities, equipment, and people into a single system. It also requires—since aviation is an industry characterized by mushrooming growth—that the system be expandable and that it be able to evolve with advances in technology. FAA is meeting today's growing demands by steadily improving the various components of its air navigation and air traffic control system; it is facing up to the looming demands of the future by devising entirely new components, which, when knitted together and pressed into service, will compose an advanced system with considerably greater capabilities.

FAA's present air navigation and air traffic control system is essentially a manually operated system employing radar, general purpose computers, radio communications, and air traffic controllers. One of the chief deficiencies of the system is the handwritten data it requires. For example, only five ARTCC's (New York, Boston, Washington, Cleveland, and Indianapolis) have computers capable of processing flight data, calculating flight progress, checking for errors, and distributing flight data to control sectors. The remaining centers have equipment capable only of storing flight data and printing flight progress strips. Another deficiency of the system is the two-dimensional character of its radar display, which permits controllers to view only an aircraft's range and bearing. Such vital information as altitude and identity are obtained through voice contact with the pilot or from the flight plan. This forces the controller to perform a variety of tedious chores. In order to retain the correct identity of the moving aircraft target on his radar display, he must tag this aircraft target with a plastic marker (the so-called shrimpboat) containing the aircraft's identity and altitude and move the marker by hand along the display to correspond with the movement of the target. And he must make periodic references to flight progress strips alongside his radar display for supplementary flight information—thus diverting his attention from the scope in the process.

In contrast, FAA's presently planned Automated Air Traffic Control Subsystem, whose concept was set forth and recommended in Project

Beacon, a 1961 study requested by President Kennedy, will not only perform these chores automatically, but faster and more accurately than the controller. A computer complex with input and output devices will process and update flight data. Properly equipped aircraft will report their altitude, identity, and other flight data automatically at any given time. This information will be fed by the radars to a video digitizer, which will convert the data into digital messages—i.e., into language understood by a computer. After being sent over a telephone line to a central computer at a center or a tower, these processed messages will appear on a radar display next to the aircraft target they identify, in the form of alphanumeric symbols. With the alphanumeric tags, therefore, the radar display will be three-dimensional in effect and give the controller nearly all the vital flight information he requires.

The new system will be installed and implemented in stages so as to avoid a disruption in service. For example, the en route system is being developed in two separate stages and will be implemented in the same manner. Moreover, the first stage, NAS En Route Stage A, will itself be implemented in two phases. The first phase looks to the installation of computers and computer updating equipment at each ARTCC. This will automate flight data processing at the centers. In the second phase, the centers will be provided with the alphanumeric display system. Subsequent stages will provide the centers with such advanced functional capabilities as automatic prediction of potential traffic conflicts, long-range preplanning of traffic flow, control message generation, and others as they become technically and operationally feasible.

New York Interim Automation

Since the appearance of the Project Beacon report, FAA has conducted field appraisals of two automated air traffic control configurations—ARTS (advanced radar traffic control system) and SPAN (stored program alphanumerics). ARTS, which was concerned with traffic problems in terminal operations, went through an 18-month field appraisal at the Atlanta terminal facility. On completion of the field appraisal, in August 1966, the equipment was turned over to FAA's Southern Region for operational use in the Atlanta terminal. SPAN, which was concerned with air traffic control problems in the en route environment, underwent a field appraisal at the Indianapolis ARTCC.

In the first quarter of calendar 1966, the SPAN equipment was dismantled and transferred to the New York ARTCC to help relieve the traffic control problems in that center area. The objective, a stopgap measure, pending the implementing of the more capable NAS En Route Stage A configuration (see below), was to give the New York Center an alphanumeric display capability in the interim. By February 1967, the initial operating capability of this interim configuration had been installed, checked out, and put into limited used. Problems cropped up during the operational tests—some of which were still unresolved at year's end.

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It was also decided to provide the New York terminal environment with an interim automated capability. At the time this decision was made (December 1965), each of the major terminals in the New York complex (Kennedy International, La Guardia, and Newark) was independently responsible for the control of air traffic in its area of jurisdiction, but plans were underway to combine these independent operations in a common IFR room at Kennedy International. Accordingly, the automated capability was ticketed for installation at this integrated operation rather than at the individual towers. Based on the experience gained during the ARTS field appraisal, a configuration similar to ARTS was chosen for installation. The system was installed during fiscal 1967; it was expected to go into limited operation in July 1968.

NAS En Route Stage A

Meanwhile, FAA continued working on the more advanced NAS En Route Stage A and NAS terminal automation configurations, which will eventually comprise the automated portion of the National Airspace System. Assembly of the first field model of the NAS En Route Stage A was nearing completion by year's end at FAA's Jacksonville (Fla.) ARTCC. Testing of the major components has been in progress, and shakedown of the computer program was scheduled to begin in November 1967; the system is expected to go into limited operation by November 1968. Further implementation of En Route Stage A will proceed as rapidly as money and equipment become available. It is anticipated that all of the ARTCC's within the contiguous United States will be equipped with Stage A automated capabilities by the end of 1972.

FAA awarded three major equipment contracts during this reporting period for components of NAS En Route Stage A. A $22.4 million contract went for 177 digitizers. As these pieces of equipment become available, 111 will be installed at radar antenna installations feeding information to FAA ARTCC's; the remaining 66 will serve Defense Department installations. Another contract went for the purchase of computer display channels. Amounting to $44.8 million, the contract was the largest ever awarded by FAA for air traffic control equipment. The computer display channel comprises about a third of the equipment in an automated ARTCC and is the final link in the process of providing the controller with three-dimensional information on his radar display. The contract is expected to run for approximately 4 years. The third contract, which amounted to $17 million, went for the purchase of four additional IBM 9020 computers for the central computer complex—the core of the automated ATC system.

NAS Terminal Automation

Since the initiation of the NAS Air Traffic Control Subsystem modernization program, in July 1962, terminal automation has not gone forward at the same rate of progress as en route automation. This is primarily due to the complexity of the terminal problems.

During this reporting period, the gap between the two automation programs was closed somewhat. This was accomplished, for the most part, by depressing the level of effort on the TRACON (Terminal Radar Approach Control) high-density program, and spreading resources more evenly among all terminal programs. Nonetheless, progress was made in the high-density terminal program during the reporting period. Both a system description and an operational specification were completed for this configuration. In addition, the engineering and the software (i.e., computer programs, procedures, and the like) specifications were well underway at the close of the fiscal year. Progress was made in TRACON hardware, too, mainly by drawing on the experience of the ARTS program. FAA expects to request proposals from industry for this system early in fiscal 1968.

Progress was also made in the low-density terminal area program. In May 1967, FAA and the Department of Defense jointly awarded a $4.8 million contract for nine prototypes. This configuration will be used at both civil and military installations; indeed, DOD (Air Force and Navy) radar control facilities will use it exclusively. The system will initially employ only numerics, but an expanded version of the basic configuration, employing a full alphanumeric display, will ultimately be developed for terminal environments demanding a more capable system. The first basic unit was expected to be delivered to NAFEC for joint FAA-DOD testing near the end of fiscal 1968.

National Airspace System Training

The agency's long-range plans to automate the National Airspace System have necessitated the establishment of a continuing NAS technical training program to provide the people who will run the automated system with the necessary technical skills. The training program is primarily directed at employees engaged in air traffic control and facility maintenance; however, people who fall in neither of these categories but have a job-related need to understand the technical aspects of the new system will also receive training.

During this fiscal year, the training of data-systems coordinators for the New York common IFR room was completed. Also completed was the training of data-systems coordinators for NAS En Route Stage A at the Jacksonville ARTCC. As of June 30, 1967, some 1,200 agency personnel had completed or were taking some form of NAS training. The FAA Academy administered most of the courses; others were administered by contractors. By January 1968 the Academy staff will be able to provide this training without outside help.

Among additional NAS technical training activities worthy of note, the FAA Academy:

- Developed and published operational training handbooks for the New York common IFR room and the Jacksonville ARTCC.
- Developed and distributed to the various regions the schedule for training data-systems coordinators during fiscal 1968 and 1969.

- Completed the instruction materials for the flight data entry and printout course to be given initially in fiscal 1968.

IN-SERVICE IMPROVEMENTS IN AIR TRAFFIC CONTROL

While FAA is actively developing a sophisticated, highly automated air traffic control system, it is also making discrete improvements in the present traffic control system in order to keep pace with the air traffic demands of today. The existing ATC system, including all equipment and facilities, represents an investment of some $1.14 billion and requires approximately half a billion dollars annually to operate and maintain. During fiscal 1967, FAA obligated $96 million for new equipment and facilities (including equipment for the automated NAS). Of this sum, $12.3 million went for programs undertaken at the request of State or local governments and other Federal agencies. (Additionally, $1.2 million of reimbursable funds went for procuring equipment for the technical assistance program of the Agency for International Development.)

Compared in the table below are the number of major FAA-funded facilities commissioned for use in the air navigation and air traffic control system at the end of this reporting period with the number in use at the end of the previous reporting period.

NUMBER OF MAJOR AIR NAVIGATION FACILITIES OPERATED/FUNDED BY FAA AT END OF FISCAL YEARS 1966 AND 1967 [1]

Major Facility	Number	
	June 30, 1967	June 30, 1966
Approach light system with sequence flashing (ALSF)	234	223
Airport surveillance radar (ASR)	83	81
Instrument landing system (ILS)	265	257
Precision approach radar (PAR)	26	27
VOR (including TVOR)[2]	318	362
VORTAC	566	517
Flight service station (FSS)	333	333
International flight service station (IFSS)	12	12
Peripheral communication installation (RCAG)	375	361
Air route traffic control center (ARTCC)[3]	28	28
Airport traffic control tower (ATCT)	245	233
Combined station/tower (CS/T)	59	65
Long-range radar (LRR)	89	89
Military radar approach control facility (RAPCON or RATCC; figure includes center approach control)	36	36
Airport surface detection equipment (ASDE)[4]	8	4

[1] Figures shown include only facilities installed and/or maintained or operated with FAA funds; omitted are a small minority of military and/or non-Federal facilities that are part of the common civil-military air navigation and air traffic control system but not funded by FAA.
[2] Many of these facilities are being converted to VORTAC's.
[3] Figures include all centers outside as well as within the contiguous 48 States.
[4] Figures exclude San Francisco facility, which will be operated during the winter months only.

Airway Facilities Decommissioned.—Changing user needs and technological advances have regularly dictated the phasing out of obsolete facilities. Fiscal year 1967 was no different in this respect from other years, and the following facilities found to be either obsolete or no longer in the pattern of user needs were decommissioned:

- Four very high frequency omnidirectional radio ranges (VOR).
- One tactical air navigation aid (TACAN).
- One VORTAC (a combination of a VOR and a TACAN).
- Fifteen radio beacons.
- Five fan markers.
- Forty-one ILS compass locators (COMLO).
- Two low-frequency ranges.
- Two precision approach radars (PAR's).

Terminal Improvements

The reduction of congestion and delays at terminals continued to be one of the agency's principal objectives in air traffic control. To this end, FAA pushed forward with its air traffic control tower (ATCT) construction program, adopted a new design standard for ATCT's at medium-activity airports, and, among other things, launched a study evaluating the time-saving potential of standby terminal radar antennas.

Airport Traffic Control Towers.—FAA's current construction program, which began in fiscal 1963, includes 77 new or replacement control tower projects, which will cost the agency an estimated $44 million. Fifteen of these projects were completed during the reporting period, bringing the total tower projects completed to 34. Twenty towers are now under construction, nine have been deferred pending redesign, and fourteen have been rescheduled for construction in the future.

The mobile air traffic control tower program, which proved its worth last fiscal year after a fire destroyed the tower at the Lockheed Air Terminal in Burbank, California, also made progress. During the reporting period, five mobile air traffic control towers were constructed and commissioned. Designs were also completed for mobile VOR's and VORTAC's and mobile voice-communication facilities.

In another development, the agency adopted a new lower-cost design standard for control towers at medium-activity airports (100,000 takeoffs and landings of itinerant aircraft or 20,000 to 99,999 IFR operations). The new design standard retains the appearance of the tower concept adopted by FAA in 1962, featuring a free-standing 60- to 120-foot pentagonal concrete shaft topped by a control tower cab with 300 square feet of operating space. Money is saved in construction, however, through use of more conventional techniques and elimination of certain operational features. FAA estimates that the use of this design standard will save approximately $200,000 in construction costs at each new tower location. With 12 towers for medium-activity airports already programed and approved for construction through fiscal 1967, the savings on these towers alone will come to approximately $2.4 million. The first of these towers was due to be commissioned in April 1968 at White Plains, N.Y. Four

towers were scheduled for commissioning in calendar 1968, and construction will begin on nine towers in the very near future. Twenty-six additional towers are being planned for medium activity airports over the next 5 years.

Airport Surveillance Radars (ASR's).—Early in the fiscal year, FAA, acting jointly with the U.S. Navy, the U.S. Army, and the Agency for International Development (AID), awarded a $1.8 million contract for 24 airport surveillance radar display systems. Seventeen of the new display systems will replace obsolete equipment at Navy and Marine Air Stations; one system will be installed at Fort Rucker, Ala., an Army installation; two will go to Brazil under an AID agreement; and four will be employed by FAA at high-density terminal areas that require more than one display system. The new equipment has a number of advantages over the old system—larger and more easily interpreted radarscopes, more flexibility in various air traffic control applications, and greater adaptability to the forthcoming automated terminal area configuration.

In another contract, FAA ordered 88 "daylight" radar displays at a cost of $1.5 million. The conventional TV-type radarscopes now in use can be viewed in semi- or total-darkness; in bright daylight, however, only limited viewing is possible because of inadequate contrast, aggravated by reflection and glare. The new "daylight" displays are free of these limitations; they adequately present terminal surveillance radar data under virtually all lighting conditions in air traffic control cabs. This is made possible by the use of a new cathode-ray tube that gives off a brighter picture than a standard TV set and by a special filter mounted on the face of the tube to shield the display from sunlight and reflection. The new displays will greatly assist controllers in monitoring aircraft positions. They will also enhance the safe and efficient use of terminal airspace by presenting to the controller information permitting him to issue more precise traffic transmission to pilots. The "daylight" display, which was developed at NAFEC and evaluated at both the Atlanta and Chicago control towers was scheduled at year's end for installation at 85 of the busiest airports in the nation, beginning in April 1968.

Air Route Traffic Control Centers

Few discrete improvements were made in the air route traffic control centers (ARTCC's) during this reporting period; the agency's energies and resources were concentrated on the emerging automated NAS En Route Stage A. At the end of the fiscal year, there were still 28 ARTCC's, the same number as at the end of the previous year. Moreover, the character of the ARTCC system remained essentially the same save for the aforementioned developments at the New York Center. Boston, Cleveland, Indianapolis, Washington, and New York remained the only centers with computers capable of processing flight data.

One development worthy of note was the installation at the Cleveland Center of an IBM 9020 simplex computer system—the computer system

that will eventually form a major component of the automated NAS Stage A configuration. Cleveland is one of FAA's three giant centers. It is also one of the fastest growing: its total IFR traffic has more than doubled over the last 5 years. Controlling an area spread over 45,000 square miles, Cleveland ranks first among FAA centers in the number of IFR overflights handled. In terms of total IFR traffic, Cleveland ran only slightly behind Chicago and New York in fiscal 1967, handling a record 1,166,000 aircraft to New York's 1,182,000 and Chicago's 1,205,000. In fiscal 1966, its UNIVAC File II computer system had already proved incapable of keeping up with activity during peak traffic hours. This pushed additional work on the air traffic controllers, who were now forced to perform chores normally performed by the computer.

It was therefore decided to replace the overloaded UNIVAC with the speedier and higher-capacity IBM 9020. The new system can make up to 200,000 calculations a second. As presently configured, it has three times the capacity of the old system and is capable of processing 500 flight plans an hour. Moreover, it is a modular system: its capacity can be increased as its workload increases.

Installation of the system began in December 1966 and was followed by operational testing during periods of low traffic activity. At year's end, the system was expected to become operational in September 1967, giving Cleveland the most sophisticated flight data processing equipment now available—equipment that will be the brains of the forthcoming automated ATC system.

Flight Service Stations

As it has with its other systems, FAA has successfully striven to improve its flight service station (FSS) system. Specifically, it has sought to provide better service to the public by improving efficiency and adopting the most advanced equipment while maintaining a balance between necessary service and economy of operation.

On two occasions during the 1960's the FSS system has undergone a major reassessment. The first, conducted in 1964, brought forth a plan calling for a thorough revamping of the system. While this led to a series of improvements, the plan's fundamental concept, the extensive consolidation of existing flight service stations, was never implemented. It was judged at the time that such a step was premature. During this reporting period, FAA once again addressed itself to the question of improving the FSS system. At year's end, a tentative plan was under consideration; the chief unresolved question was whether the improved services envisioned by the plan would be worth the cost of implementing them.

While this question was being considered, a number of improvements recommended by the plan were tested. Among the more notable items:

- An *automatic call allotter* to insure that pilots calling for a weather briefing are answered in the order in which their calls are received at the flight service station is being tested at the Washington flight service station.

- A revised format for scheduled and transcribed weather broadcasts is receiving a 6-month test. The objective of the revised format is to streamline broadcasts in such a way as to conserve time, reduce workload, and relieve frequency congestion.
- A new frequency allocation plan which will reduce congestion on air-ground channels, particularly in large metropolitan areas, was developed and subsequently coordinated with the Federal Communications Commission.

Modernizing, realigning, and expanding Alaska's flight service stations, the plans for which were completed in fiscal 1966, continued apace. These efforts are of particular importance because Alaska, with its rugged topography, its remote areas, and its underdeveloped surface transportation, depends more than any other state on general aviation as a mode of transportation. Six Alaskan flight service stations were expanded to accommodate equipment and control circuits for remote communication outlets and single-frequency outlets. One part-time flight service station was commissioned at Dillingham, and an airport information desk (AID) was commissioned at Valdez. While this expansion was going on, three full-time flight service stations were converted to part-time flight stations. Both Barrow and Ketchikan are in line for badly needed part-time flight service stations. Barrow is also in line for other facilities. Air transportation is of singular importance to these communities. The only other mode of commercial transportation available to them is water-going vessels. Barrow, for example, is served by Government-owned vessels that can navigate in that region only during the month of August.

Hawaii was also ticketed for a new facility. The need for a part-time flight service station or a part-time combined station/tower (CS/T) at Kona Airport, on the island of Hawaii, became apparent during the reporting period. FAA's Pacific Region gave high priority to the activation of one or the other of these facilities; indeed, such was the increase in traffic at this airport that both Aloha and Hawaiian Airlines requested the establishment of a control tower, which was not warranted under existing traffic-density criteria. The space to house either an FSS or a CS/T will be provided by the State of Hawaii.

Changes in Air Traffic Regulations

As in the previous fiscal year, FAA made few major revisions in its air traffic regulations. Those amendments that were made were primarily designed to eliminate known deficiencies and make existing regulations more effective, rather than introduce radically new procedures. Among amendments put in force during the fiscal year were the following:

- Automatic altitude-reporting equipments were required to transmit altitude data that corresponds within 125 feet to the altitude the pilot uses and flies by. The same regulation also requires pilots to discontinue the automatic reporting of their altitude when requested to do so by air traffic control.

- More specific equipment requirements and functions were specified for the operation of unmanned free balloons in order to reduce the incidence of derelict balloons. In addition, balloons were required to contain radar reflective material so they may be tracked by primary radar in the event they go astray.
- The western boundary of the Alaskan Distant Early Warning Identification Zone was shifted to the 180-degree meridian of longitude. This step was taken in order to simplify flight planning and air traffic control procedures and to reduce communications for flights between Alaska and the Orient.
- Terms and conditions under which an aircraft with an inoperative transponder may operate in positive control airspace were broadened and clarified.
- Officially observed weather or pilot-observed weather was made the governing factor in determining whether flight operations can be conducted in accordance with visual flight rules or instrument flight rules at secondary airports within control zones.

Other Developments

At the close of the reporting period, amendments to regulations dealing with aircraft noise and its abatement were being actively considered. Whereas most existing noise-abatement regulations apply to large aircraft only, the regulations under consideration apply to all turbine-powered aircraft and large piston-powered aircraft (see chapter IV).

Satellite Communications.—FAA early recognized the potential usefulness of artificial satellites in air traffic control and has been exploring this potential with the National Aeronautics and Space Administration (NASA) for a number of years. Technological explorations such as these have been forced on the agency by the communications problems created by the increasing number and speed of air carrier aircraft flying international overwater and polar routes. Aircraft now flying such routes often lose radio contact with ground stations because of fading, static, and other interference caused by natural phenomena.

In December 1966, NASA launched the first of five satellites in its applications technology satellite program, the ATS I. This 775-pound spin-stabilized satellite, which is now hovering 22,300 miles above the Hawaiian Islands in a near-synchronous orbit, afforded FAA its first opportunity to evaluate a satellite as an air-ground-air relay for long-distance very-high-frequency (VHF) radio voice communications. The ATS I has acquitted itself well in the testing conducted thus far. Voice messages of excellent clarity originating either from the ground or from flying aircraft were relayed by the satellite. Both FAA and air carrier aircraft took part in the experiments.

Continuous-Power Program.—Prior to the massive November 1965 power failure in the Northeast, FAA generally relied on dual commercial power sources as a means of insuring a continuous power supply for many of its

air traffic control facilities. The massive blackout of that fall, however, demonstrated to FAA that it could no longer rely on commercial suppliers for adequate standby power sources. The agency thus found it necessary to respond with a nationwide program to equip all critical FAA facilities with standby engine generators capable of functioning if normal power sources should fail.

In fiscal 1966, FAA selected 50 airports to be equipped with standby engine generators. The airports were selected on the basis of geography and aviation activity. Control towers, airport surveillance radars, approach light systems, instrument landing systems, and other key airport facilities are included in the program. To date only two airports have been equipped with an emergency power source for all such key facilities. Steps have already been taken, however, toward equipping most of the remaining 48 installations.

During this reporting period, FAA began planning a similar program for the air route traffic control centers. Over the past 3 years, the centers suffered more than 1,300 power failures lasting long enough to impair the operational use of critical equipment. Such outages can be a great deal more serious today than they were in the past because of the growing demands of positive air traffic control, and will no doubt be potentially more serious in the future because of the increasing reliance on automation. FAA recognizes, therefore, that systems as critical to air route traffic control operations as voice communications (both radio and interphone), radar display and associated equipment, computers, and selected area and console lighting must not be rendered inoperative for even short periods during the loss of primary power. FAA's current plans call for the implementation of adequate auxiliary power sources and uninterruptible power units at all centers scheduled to receive NAS En Route Stage A equipment.

Automatic Broadcasting of Weather Information.—FAA continued to implement its plan to consolidate its transcribed weather broadcast service (TWEB) facilities. At the close of the reporting period, 77 TWEB outlets (transmitters) were operating from 64 flight service stations. This has resulted in lower operating and maintenance costs.

Among FAA's other efforts in automatic weather broadcasting the following fiscal 1967 developments are worth noting:

- FAA tested a "quadrantal" pilot automatic telephone weather answering service (PATWAS) in Kansas City, Mo. This form of mass briefing provides more detailed weather information in a sectorized area and along the airways in a sector. Each of the four quadrants (sectors) surrounding Kansas City offers the pilot weather information pertaining to his particular area(s) of interest.
- FAA's automatic terminal information service (ATIS) was made available at 31 additional airports, bringing the total number of airports offering this service to 56. ATIS is now being projected for 29 additional airports.

Miscellaneous Developments.—Fiscal year 1967 also witnessed a number of other developments aimed at improving the air traffic control system. Among these:

- Approximately 2,000 square miles of previously reserved special-use airspace was made available to civil aviation, bringing the total airspace returned to public use since 1958 to 64,000 square miles.
- Two new operational manuals, "Terminal Air Traffic Control" and "En Route Air Traffic Control," were completed. Work is continuing on an operational manual for flight service specialists and administrative manuals for supervisory personnel.
- The Flight Service Stations Procedure Committee was established to provide representative groups of working-level flight service specialists with an opportunity to participate in the development of national flight assistance and communication procedures.
- A program was launched to determine the feasibility of reducing the present air traffic control radar separation minimum between aircraft. Both NAFEC and the Jacksonville ARTCC are conducting tests to determine the accuracy of airport surveillance radar. As the program progresses and the test parameters are validated, the tests will be expanded to include other radar systems. This program is part of FAA's continuing effort to increase system capability and to decrease traffic delays. The test period is expected to extend into calendar 1969.
- A 2-year test and evaluation of the Airman's Information Manual was completed. All segments of the aviation industry and the military services participated in the evaluation, and appropriate revisions were made to the manual after coordination of the test results.
- A new method of flight inspecting instrument landing systems was successfully tested. The new method provides extremely accurate performance checks during both IFR and VFR conditions without the need of measuring the position of an aircraft from the ground by optical theodolite.
- A technique was developed for measuring the ceiling and visibility at airport terminals. The U.S. Weather Bureau is now using this technique at eight airports.
- Production specifications were completed for (1) a long-range VHF/UHF air-ground troposcatter system, (2) UHF antennas for ground ATC communication stations, (3) five-channel voice recorders for control towers, (4) radio channel controls, and (5) low-power transceivers.

Chapter III

NATIONAL DEFENSE

A civil agency controlling use of the national airspace, as FAA does, inevitably has a large community of interest with the Department of Defense. This community of interest centers in the FAA-operated national system of air traffic control and navigation facilities; constituting a civil-military common system, these facilities are designed to serve military- as well as civil-aviation needs, except for military needs peculiar to warfare. Outstanding among other defense-related FAA responsibilities are national emergency plans and preparedness programs pertaining to the Nation's civil airports, civil-aviation operational facilities, and civil aircraft other than air carrier aircraft.

To insure adequate consideration of military needs in FAA's operations, members of the Armed Forces are part of FAA's regular staffing, as provided for in the Federal Aviation Act (section 302(c), "Military Participation"). Only commissioned officers have been assigned under this provision, but it is broad enough to include enlisted personnel too, should there be a need for their services. (Under section 302(k), "Cooperation with Other Agencies," both officers and enlisted men of the Armed Forces have on occasion been lent to FAA—not assigned as part of the agency's regular staffing—to complete short-term projects; e.g., the transfer of the flight inspection of Air Force navaids from the Air Force to FAA.) Reaching a high of 133 in 1959, the number of officers assigned to FAA at any one time has most of the time been under, but close to, 100. Recently it has decreased rather sharply, following a joint DOD-FAA review of the need for military participation in FAA. This review, completed in January 1966, produced a recommendation that the number of military positions assigned be reduced to 50. By June 30, 1966, the number had dropped to 70, and by June 30, 1967, the end of the current reporting period, it was down to 52. This last number represents a ratio of one Armed Forces officer for every 830 civilian FAA employees.

SPECIAL MILITARY SUPPORT SERVICES

Central Altitude Reservation Facility

Military aircraft use the FAA-operated civil-military common system of air traffic control and navigation in the same way as civil aircraft when this will serve their purpose. When one of the Armed Forces needs airspace for special operational purposes, such as maneuvers, FAA assigns the space for the time needed. Military requests for such reservations of

airspace are handled by FAA's Central Altitude Reservation Facility (CARF), which was created in July 1956 at Kansas City, Mo., and moved in September 1963 to Washington, D.C.

During fiscal 1967, CARF processed 10,843 military altitude reservations in support of military-command aircrew proficiency training and numerous national defense exercises; these involved the Strategic Air Command (SAC), the North American Air Defense Command (NORAD), the Tactical Air Command (TAC), the Air Defense Command (ADC), and participating Army and Navy air-defense components. Additionally, specialized air traffic control services were provided for overseas deployment of air combat and support units from SAC, TAC, ADC, and the Military Airlift Command (MAC) to Southeast Asian and European bases. These operations involved limited occupancy of the airspace controlled by FAA's 28 air route traffic control centers (21 in the contiguous United States plus seven others) and the airspace controlled by 18 foreign centers on occasions numbering in the thousands. The processing of these missions involved the plotting of 232,219 air navigation fixes to establish the various flight routes.

The following sections give details on some of the principal activities included in the comprehensive statistics above, and also on some activities outside CARF's area of jurisdiction, notably the area west of Guam.

Southeast Asia Support Activities

General.—As during the previous year, FAA support services were provided in fiscal 1967 to an increasing volume of both military and civil aviation related to the military operations in Southeast Asia; regulatory services were also performed for the civil aviation involved. On Guam, the FAA center/radar approach control facility (CERAP) played a significant role in Vietnam operations for the second consecutive year. The CERAP's launch and recovery of SAC bomber missions directed at enemy targets in Southeast Asia increased steadily during the year; sorties, varying from 3 to 30 per mission, reached in May 1967 a total of 10,000. The FAA-operated Wake Island airport was one of the busiest on the Military Airlift Command's circuit. Traffic volume at this airport, having increased about 47 percent in fiscal 1966 over the previous year (average monthly operations up from 1,952 to 2,863), expanded another 20 percent in fiscal 1967 (average monthly operations up to 3,431). At Anchorage, FAA's air route traffic control center recorded some 42,000 oceanic overs, surpassing the preceding year's total by about 55 percent. The higher volume of jet traffic transiting the North Pacific and this traffic's use of minimum-time random routes resulted in heavy congestion and inefficient use of airspace, severely taxing the capabilities of the air traffic control system. To alleviate this condition, the U.S. and Japanese air traffic control agencies jointly developed, and in May 1967 implemented, a scheme to provide more order. At year's end, United States-Japanese efforts were continuing, in cooperation with the air carriers involved, to make further improvements in the North Pacific jet-traffic flow.

Southeast Asia Airlift.—The year's outstanding phenomenon involving FAA in the Southeast Asia support activities was the transpacific airlift performed by civil air carriers under contract to the military. Starting in January 1966 with five airlines, this airlift had mushroomed to include 20 by the beginning of fiscal 1967. These civil carriers airlifted more passengers and cargo across the Pacific in the month of December 1966 alone than was achieved by U.S. civil and military air transport combined in their best year of transpacific operations supporting the United Nations action in Korea in the early 1950's. According to statistics currently available to the U.S. Air Force's Military Airlift Command, the Korean airlift's largest single year in terms of passengers and cargo tons moved by both civil and military aircraft across the Pacific (U.S. west coast to Japan in most cases) was the first year of the operations, fiscal 1951; 92,000 passengers were transported, and 30,600 tons of cargo. The December 1966 figures for the civil air carriers of the Southeast Asia airlift were 99,980 passengers and 37,400 tons of cargo. For the entire year in fiscal 1967, the civil air carriers of the Southeast Asia airlift transported 996,709 passengers and 117,680 tons of cargo.

Overall responsibility for monitoring the special conditions and problems affecting the civil airlift operation has been assigned to FAA's Pacific Region. This region coordinates with the other FAA regions having regulatory control over any of the 20 air carriers operating under Military Airlift Command contract. To carry out its responsibilities better, the Pacific Region took several significant administrative steps in fiscal 1967: It assigned an air carrier maintenance specialist to Travis Air Force Base, Calif.; established (June 1, 1967) an FAA office at the Tan Son Nhut Air Base, Saigon, staffed by an FAA Representative; and created the position of airlift coordinator at its own headquarters. The region has a senior air traffic control specialist on assignment to the U.S. Air Force Command in Vietnam.

Other Southeast Asia Support Activities.—Other activities in this category in fiscal 1967 included—

- Provision of air traffic control facilities and equipment to U.S. military forces: Under reimbursable agreements completed in fiscal 1967, FAA is to provide the U.S. Army with 22 completely equipped airport traffic control towers (ATCT's), and the U.S. Air Force with 10 air traffic control consoles and 15 mobile ATCT's. Value of the materiel involved totals $4.6 million. Besides providing the Army towers, FAA will install and check them out and train personnel to operate and maintain them. Scheduling at year's end called for some of the facilities and equipment involved in the agreements to be in operation by April 1968, and all by December 1968.
- Further advisory assistance to the U.S. Air Force with its SEAMARF (Southeast Asia Military Altitude Reservation Facility), which went into full operation during fiscal 1967. In fiscal 1966, FAA had assisted with establishment of this militarily staffed facility at Clark

Air Base, in the Philippines, to coordinate military altitude reservations with foreign- and U.S.-operated agencies west of Guam.

- Continuation of experienced FAA air traffic control specialists on assignment as expert consultants and advisers to military air-command headquarters in Hawaii, Japan, Okinawa, the Philippines, Taiwan, South Korea, and Thailand (as well as Vietnam, mentioned earlier).

FAA-ADC Integration Program

On the home front, one of the more notable forms of FAA support to the military continued to be the handling of interceptor aircraft of the Air Defense Command, U.S. Air Force, within FAA's air traffic control system during certain flight phases of training missions flown by such aircraft. Begun in 1964, this FAA service includes the exercise of air traffic control over the interceptor aircraft from start of mission to arrival at a point in designated airspace previously assigned by FAA to ADC for conducting the purely military training phase. Control of the aircraft is then assumed by an ADC facility and retained while the aircraft practice such operations as tactical maneuvering and weapons-system applications. After completion of this militarily controlled phase in reserved airspace, the interceptor aircraft are handed off by the ADC facility to FAA's air traffic control system for return to base.

NATIONAL COMMUNICATIONS SYSTEM

FAA and DOD are two of five Federal agencies with major communications networks that are putting their facilities together to make a National Communications System; the other three agencies are the State Department, the National Aeronautics and Space Administration, and the General Services Administration. As conceived and launched toward realization several years ago, the NCS is intended to organize and use in the most efficient and economical way, for both military and civil purposes, the communications resources of the Federal Government. By presidential direction, the Secretary of Defense is the Executive Agent, NCS, and the Secretary has designated the Director of the Defense Communications Agency as the Manager, NCS.

Progress during fiscal 1967 within the NCS concept included, notably:

- Progress in the program, approved in fiscal 1966, to consolidate at Kansas City all Aeronautical Fixed Telecommunications Network (AFTN) switching now being done separately at New York, Miami, San Juan, and Balboa. AFTN messages contain flight-movement and -control data and meteorological information. In fiscal 1967, equipment specifications were developed and a contract was awarded for a solid-state computerized store and forward teletypewriter switching system for the above purpose. At year's end this AFTN switching center was expected to be in operation by early 1969. A similar computerized weather message switching center, to be co-located with the AFTN center, is expected to be in operation about a year and a half later. It will modernize the operation of all FAA meteorological networks in the contiguous United States.

- Completion of Phase I and near-completion of Phase II of the three-phase project to provide communications support in Hawaii to NASA's Apollo program: Previously chosen as the best sites for this purpose had been the locations of FAA's HF (high-frequency) transmitter and receiver facilities—on the islands of Oahu (at Ewa) and Molokai, respectively. An agreement between FAA, NASA, and the Air Force Western Test Range calls for AFWTR to procure and deliver the necessary new equipment, FAA to install and operate it, and NASA to reimburse the Air Force and FAA for all expenditures incurred on NASA's behalf. At year's end, equipment installed included 10 transmitters, 25 receivers, and 21 antennas, and support had been provided to space and missile program operations, including Gemini 12 (in November 1966). The final phase of equipment procurement and installation—involving 9 additional transmitters, 17 receivers, and 5 antennas—was expected to be completed in 1968. Installed equipment was maintained by FAA during fiscal 1967 on a reimbursable basis; in fiscal 1968, such maintenance will cease to be reimbursable.
- Start of a project to consolidate FAA and Government of American Samoa (GAS) communications equipment. Under an FAA-GAS agreement executed in fiscal 1967, GAS transmitter and receiver equipment being maintained apart from FAA equipment of the same kind established on Tutuila in 1964 will be co-located with the latter. Involved in FAA's part of the project in fiscal 1967 were final project engineering, shop fabrication of specialized equipment, rehabilitation of electronic equipment, and initial phases of construction required to accommodate the additional equipment. At year's end, the project was expected to be completed in fiscal 1968.
- A new teletypewriter circuit between Anchorage and Honolulu, which was implemented in January 1967 to help meet the rising communications demands resulting from the increase in air traffic between the Western Hemisphere and Southeast Asia. These demands were further served by establishment of a direct Anchorage-Tokyo high-frequency radio interphone circuit, which began operating in May 1967.
- Completion of the project, begun in fiscal 1966, to consolidate all FAA HF receiving services into the Defense Communications Agency (U.S. Navy component) remote receiver site at Salinas, P.R.

FAA DEFENSE READINESS

General

FAA and DOD continued during fiscal 1967 to develop the detailed agreements necessary to implement their memorandum of understanding which, having been drawn as a first major step toward carrying out Executive Order 11161, had taken effect April 13, 1966. (Issued July 7, 1964,

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Executive Order 11161 directs, and contains guidelines for, FAA-DOD planning of a coordinated response to a war emergency or a lesser national emergency.) DOD has designated the North American Air Defense Command (NORAD) as its executive agent to work with FAA on plans covering the continental United States (including Alaska). Similarly, FAA's Pacific Region is developing plans with the Pacific Command; and FAA's Europe, Africa, and Middle East Region, with the U.S. European Command. The resulting plans will spell out relationships designed to insure that, under national-emergency conditions, FAA's functions will be performed in such a way as to satisfy essential national defense requirements; in accordance with the guidelines of Executive Order 11161, the plans are premised on the probability that in case of war the President would make FAA an adjunct of the Department of Defense.

Plans to replace the emergency relocation site of FAA's Washington headquarters, which had made considerable progress, had to be suspended as a result of FAA's incorporation, on April 1, 1967, into the Department of Transportation. The question of a new relocation site had arisen because of certain deficiencies in the existing site; the question has now been made part of a study of total Departmental relocation-site needs.

The existing Washington headquarters relocation site and the relocation sites for the principal field headquarters are stocked for emergency use, task forces have been designated to operate these sites under emergency conditions, and operating procedures have been provided for the task forces. Plans and procedures exist governing operation and maintenance of FAA aircraft under emergency conditions, including airlift of the Administrator and key FAA officials. An internal security program has been instituted to guard against the unauthorized interception of classified defense information via teletype communications.

Exercises

During fiscal 1967, FAA participated in the national military exercise called HIGH HEELS and in the Office of Civil Defense exercise called CEDEX. Relocation was carried out by portions of the Washington and regional headquarters and the area offices. The agency's part in these exercises permitted testing of emergency notification procedures and emergency plans for operating at relocation sites, evaluation of emergency communications capabilities at the relocation sites, and practice in damage assessment and reporting procedures.

At FAA air route traffic control centers, airport traffic control towers, and flight service stations, frequent local and regional exercises provided practice in implementing emergency plans and agreements with DOD facilities. In accordance with FAA-DOD agreements, the new plan for security control of air traffic and air navigation aids (SCATANA) was tested at least every 60 days. (SCATANA superseded SCATER, or security control of air traffic and electromagnetic radiation on April 1, 1966.)

CIVIL AVIATION DEFENSE PLANNING

General

Executive Order 11003, dated February 16, 1962, assigns to FAA certain responsibilities in the area of civil aviation defense planning. The Nation's civil airports, civil aviation operating facilities and services, and general aviation aircraft (i.e., non-air-carrier aircraft) are embraced in these responsibilities, along with national emergency plans and preparedness programs applying to these civil aviation components.

Substantial progress was made during fiscal 1967 in planning war mobilization or other emergency use of the State and Regional Defense Airlift (SARDA), a general aviation organization. Under the broad policy guidance of FAA's Advisory Circular 00–7 (SARDA), 52 States and territories had submitted by year's end draft emergency resource-management plans called for by the Office of Emergency Planning's comprehensive program for State and local emergency management of resources, and FAA had approved 35 of these draft plans as meeting the basic criteria of the advisory circular. For the remainder of the plans, FAA provided (through OEP) comments and recommendations designed to make them acceptable.

In the area of airport emergency planning, gains continued to be made during the year in the program to assist, and to obtain the cooperation of, civil airport managers in establishing disaster-control plans and improving defense-readiness postures. Though there are local exceptions, the larger and busier airports have, on the whole, responded better than the smaller ones.

The safe haven airport program was marked during the period by exhaustive review and revision of the criteria for selection of safe haven airports; this action was required in the light of new targeting and vulnerability studies recently developed by the Office of Emergency Planning. The safe haven airport program is designed to assist in the dispersal of the Nation's civil air fleet if an enemy should attack the country, the objective being maximum survival of that fleet.

Several publications have been produced by the agency to assist civil aviation in improving its overall readiness for emergencies. These include: A handbook for air carriers giving detailed instructions on planning and implementing emergency aircraft maintenance programs; manuals for airport personnel containing emergency operating information on nuclear accidents and incidents and on radiological recovery of airports; and an advisory circular on radiological decontamination of aircraft. An FAA handbook was developed covering the agency's responsibility for the war air service program (WASP), air carrier portion.

Metro Air Support '66

The year was marked by a very successful demonstration of aviation's ability to provide air access and logistic support to a city center in time of emergency, particularly in case of disrupted or paralyzed surface trans-

portation. This was an exercise called Metro Air Support '66, staged in November 1966 in New York City. The first major operation of its kind, it involved more than 200 airplanes and helicopters. A number of airlines cooperated by flying supplies from distant points to airports in the vicinity of the city, but the key operation involved the airlift of supplies from the fringes of the city to its center—an operation accomplished by helicopters and STOL (short takeoff and landing) aircraft. FAA officials participated importantly in planning the exercise.

Besides providing a general test of the city's ability to respond to an emergency, Metro Air Support '66 had as a central objective to encourage development of waterfront locations for STOL-aircraft ground facilities. Headquarters for the exercise was Pier 26, a 900-foot-long concrete pier on the Hudson River in Manhattan. Other sites used by the helicopters and STOL aircraft in delivering emergency supplies to the city were certain other piers, East River Park, South Street, and Governors Island. Inbound airlift takeoff points included, besides satellite airports in the metropolitan area, such places as Brooklyn's 69th Street ferry slip and Rikers Island (in the East River). Airlifted items included food, clothing, blankets, medical supplies, emergency hospital equipment, a portable control tower, a Red Cross mobile canteen, a Salvation Army mobile kitchen, and various others. The success of the demonstration amply proved the practicality of this emergency mode of supplementing or temporarily replacing other modes of transportation.

OTHER FAA-DOD COOPERATION

Numerous forms of FAA-DOD cooperation exist besides those already mentioned in this or an earlier chapter; in fact, important FAA-DOD working agreements being carried out during fiscal 1967 numbered more than a hundred. Among this total are agreements providing for FAA technical assistance services to foreign governments, which are covered in Chapter IV. Certain notable instances of FAA-DOD cooperation not covered elsewhere follow.

Joint FAA-DOD Use of Long-Range Radars (LRR's)

Since 1957, joint civil-military use of long-range radars—for air traffic control on the one hand, for air defense on the other—has been saving money for the U.S. taxpayer. At the end of fiscal year 1961, there were 15 such radars being jointly used by FAA and the Department of Defense. This number had risen by the beginning of fiscal year 1967, the current reporting period, to 58 (21 FAA and 37 military). An additional 6 were added in fiscal 1967, raising the total in joint use at year's end to 64 (19 FAA and 45 military).

Action on questions relating to FAA-DOD long-range-radar operations is coordinated through the Joint Radar Planning Group (JRPG). As fiscal 1967 opened, planning called for FAA-DOD joint-use radars to reach an eventual figure of 84, or 20 beyond the fiscal 1967 yearend total:

DOD, however, has announced a radar reduction program that will reduce FAA-DOD joint use of long-range radars. The JPRG prepared during the year the *United States Interagency Ground Inspection Manual*, which incorporates standardized technical-performance criteria for long-range radars in joint FAA-DOD use.

Joint Use of Terminal Radar Facilities

The long-range radars that FAA uses jointly with DOD serve, so far as FAA is concerned, air route traffic control centers—that is, they are used by FAA in controlling aircraft that are en route between airports. Under a somewhat different kind of joint-use arrangement, FAA and DOD also avoid costly duplication of facilities at certain locations involving 33 DOD-owned terminal radar facilities. These facilities, serving both civil and military aircraft in landings and takeoffs, consist of 26 U.S. Air Force radar approach control facilities (RAPCON's) and 7 U.S. Navy radar air traffic control centers (RATCC's). The arrangement applying to these facilities differs from that applying to the joint-use LRR's in that the terminal facilities serve only an air traffic function and are operated by FAA whereas the LRR's provide two separate radar displays: one for FAA air traffic controllers and the other for DOD air-defense personnel. What is common to the two arrangements is that both save the U.S. Government money by eliminating duplication of equipment.

Fiscal 1967 saw completion of a terminal-facility project jointly funded by FAA and the USAF—a combined airport traffic control tower and radar approach control facility at Elmendorf Air Force Base, Alaska (near Anchorage). Constructed under terms of an FAA-USAF agreement signed November 6, 1964, this combined facility was commissioned on June 28, 1967.

Air Force Undergraduate Pilot Training Program

In 1964, the U.S. Air Force requested FAA to provide for the USAF Training Command's undergraduate pilot training program positive separation control as well as area positive control; FAA had already been providing the latter for some years. The additional service, it was agreed, would be provided in five phases, with implementation dependent on FAA's acquisition of the necessary equipment and personnel.

At the end of fiscal 1967, implementation of Phase I was complete—i.e., provision of both area positive control and positive separation control for high-speed (supersonic) high-altitude T–38 jets at each of the 10 training bases involved in the agreement. Implementation of three other phases—involving T–38's en route to or returning from ancillary high-altitude training areas (Phase II), en route to or returning from low-altitude training areas (Phase III), and operating in the low-altitude training areas (Phase IV)—had been partially completed (about 85 percent for Phase II, and about 30 and 20 percent, respectively, for Phases III and IV). Phase V implementation had not begun at year's end because

the aircraft involved—subsonic T–37 trainers—had not been equipped with transponders; further delay of this phase for some 2 years was anticipated.

Assistance to the U.S. Army on Kwajalein

The complex research projects conducted at the Kwajalein Test Site require special, in addition to normal, air traffic control services for participating aircraft. FAA performs these services under reimbursable agreement with the U.S. Army. A special service rendered is radar assistance to range operations in the handling of mission aircraft during missile reentries.

Assistance to the U.S. Air Force in Alaska

An agreement executed by FAA and the military in April 1967 provides for military use of the very-high-frequency air-ground communications system serving Control Route 1310 between Anchorage and Seattle. Air Force airlift aircraft flying the Seattle-Anchorage route are thus enabled to communicate with their base operations office at Elmendorf Air Force Base in Alaska—through telephone patch via the Anchorage international flight service station.

Flight Information Coordination

FAA and DOD continued in fiscal 1967 their efforts toward combining the military system of notices to airmen (NOTAM's) and the agency's own similar civil system into a single national NOTAM system.

The development of common civil-military aeronautical charts continued also to be an important form of FAA-DOD cooperation, the objective being elimination of Government chart duplication, with resultant monetary savings.

Chapter IV

FOSTERING DOMESTIC AND INTERNATIONAL CIVIL AVIATION

In addition to being responsible for aviation safety, FAA has the job of encouraging and fostering the development of civil aeronautics and air commerce in the United States and abroad. Of course, FAA indirectly serves this additional mission simply by performing its primary mission of aviation safety. But the agency does undertake programs directly related to the development of civil aviation. It helps finance airport construction; it undertakes aircraft development projects; it informs and educates the American public in aviation matters; and it plays an active role in international aviation activities.

DOMESTIC AVIATION ACTIVITIES

Airport Development

National Airport Plan.—The Federal Airport Act of 1946, which established the Federal-aid airport program, also established a requirement for a National Airport Plan (NAP). Updated annually, the NAP projects 5 years into the future and identifies airport construction and improvement projects considered necessary by the FAA Administrator in meeting the foreseeable needs of civil aviation. The fiscal 1967 edition of the NAP, covering fiscal years 1968 through 1972, identifies more than 4,000 existing and proposed civil landing sites in the United States, Puerto Rico, and the Virgin Islands requiring new or improved facilities over the next 5 years. The total cost of developing these facilities is estimated at $1.5 billion.

Federal-Aid Airport Program.—While the National Airport Plan identifies civil airport needs, the Federal-aid airport program (FAAP) provides some of the money to meet those needs. In fiscal year 1967, Congress allotted $71 million to FAAP. FAA, in turn, entered into 303 grant agreements with local agencies at a cost of $63.9 million in Federal funds. These agreements call for FAA to pay a specified percentage of allowable project costs, usually 50 percent. The remaining costs are borne by the local sponsoring agencies. The highest priority was given to projects looking to the development of safety facilities. Improvements enabling airports to accommodate late-model jet aircraft were also high on the priority list.

The following table gives the yearend status of active or remaining FAAP projects for which funds were authorized during this and prior reporting periods:

Status of Federal-Aid Airport Program

	Active Projects As of June 30, 1967	*Federal Funds Allocated*
Unobligated allocations	255	$ 62,775,492
Obligated (construction not started)	174	33,768,292
Obligated (construction started)	693	206,466,231
Construction completed (final payment pending)	474	120,585,574
Total	1,596	$423,595,589

FAA also financed airport development projects jointly with other Federal agencies. In the economically depressed Appalachian Mountain region, FAAP funds and funds coming under the Appalachian Regional Development Act, which are administered by the Economic Development Administration, went into six airport development projects. In addition, funds coming under another EDA-administered act, the Public Works and Economic Development Act of 1965, supplemented FAAP funds going to three airport development projects.

Surplus Airport Program.—The Surplus Property Act authorizes Federal agencies to transfer to local communities, without monetary compensation to the Government, any surplus Federal property, either real or personal, that in the estimation of the FAA Administrator is suitable for use as a public airport.

The Defense Department, naturally enough, is the Federal agency most likely to possess surplus property of this kind, and, in fiscal year 1967, several major defense installations that were no longer performing military missions, but were deemed by the FAA Administrator as suitable sites for civil aviation activities, were conveyed to local authorities. Among these properties were Schilling Air Force Base, Salina, Kans.; Larson Air Force Base, Moses Lake, Wash.; Olmstead Air Force Base, Middletown, Pa. These three properties alone represented a Federal investment of $100 million. In addition, airport operating and maintenance equipment valued at approximately $6 million was turned over to owners of public airports.

Airport Planning

Fiscal year 1967 saw the goals and objectives of FAA's airport planning function drastically revised. Hitherto, airport planning did not extend beyond the scope of the 5-year National Airport Plan, which deals only with those individual airport projects eligible for financial assistance under FAAP. During this reporting period, the groundwork was laid for planning further into the future and taking into account a broader and more complete range of factors that would properly place any given airport within a national system of airports.

The following highlights illustrate the new trend in FAA's airport planning:

- Aviation demand was forecast through 1980 at the 22 large hubs of aviation activity (a metropolitan area with 1.0 percent or more of the total U.S. passenger traffic is classified a large hub by FAA). Forecasts were translated into future facility requirements for complete airport complexes—air-passenger terminals, aircargo terminals, apron space, aircraft parking, automobile parking, and so forth. These forecasts, which were enthusiastically received by all segments of the aviation industry, will help communities to determine their future facility requirements early and will foster comprehensive metropolitan planning in time for effective action.
- Guidance was provided FAA field elements on advising the public of the expected impact on community airport needs by the introduction of new types of aircraft. This guidance will help determine where and when these aircraft will come into service and the kind of airport development they will require.
- Procedures were established for coordinating with FAA the airport-improvement plans of the aviation industry. This step assures that these efforts of the aviation industry will be coordinated nationally.
- Coordination procedures concerning technical assistance projects and ground access to airports in highway planning programs were established with the Department of Housing and Urban Development, the Economic Development Administration, and the Bureau of Public Roads.

Airport Design and Construction

The introduction of new types of air carrier aircraft, the proliferation of executive or business aircraft, the need to improve safety on the runway—all this has meant that the standards FAA sets for airports in the national aviation system must undergo constant review and change. The agency's task in establishing such standards is made considerably easier by manufacturers' furnishing FAA with preliminary data on new aircraft. This data is analyzed and subsequently reflected in revisions to airport design and construction standards. During the reporting period, FAA made the following revisions in airport design and construction standards:

- A new parameter was included in the design of runway lengths to enhance the safety of jet operations where runways are frequently wet or slippery.
- A single set of standards was issued for airports used exclusively by aircraft weighing 12,500 pounds (gross) or less.
- New dimensional standards were developed for airports intended for use by business jets and other large business aircraft.
- A taxiway width of 60 feet was established as the standard for two-engine and three-engine jets. (This compares with the 75-foot standard for four-engine jets.)

- A new runway design standard providing for a variable transverse pavement thickness was adopted. The new standard, while calling for thicker pavement in the center traffic area of the runway, permits reduced thickness outside this heavy-traffic area. The thicker pavement of the critical area at the runway end will be extended to accommodate jet aircraft, which accelerate slower than propeller-driven aircraft. The new standard reduces pavement costs without reducing safety.
- A medium-intensity runway-lighting system was adopted as the recommended standard for all airports except those which can justify the higher cost of a high-intensity system.
- A new 2,000-candlepower runway-centerline light was approved for installation at airports to permit operations under low-visibility conditions.

All-Weather Landing

One of the most notable developments in aviation since World War II has been the reduced interference of bad weather at airports with the regularity of airline schedules. Indeed, FAA and the air carrier industry can now see the day when, at the very least, weather conditions inhibiting a pilot's vision will no longer prevent the landing of air carrier aircraft.

Prior to fiscal 1966, air carrier aircraft could not land at most major airports if weather conditions were below Category I minimums—i.e., a minimum decision height of 200 feet above the ground and a horizontal visibility of 2,400 feet along the runway. But, in the last half of fiscal 1966, with the development and installation of both ground-based and aircraft-borne landing equipment, four U.S. air carriers and three major U.S. airports were qualified for the first step of Category II operations, under which landings may be made with a 150-foot decision height and a horizontal visibility of 1,600 feet. The final step of Category II will permit landing with a minimum decision height of only 100 feet and horizontal visibility of 1,200 feet. Daylight landings during a runway visual range of 1,200 feet will soon be possible as a result of recently developed 2,000-candlepower centerline lights, which were adopted by FAA in February 1967. And looking further into the future, FAA is actively working towards the day when aircraft will be able to land with a prevailing visibility of zero—the final step for Category III operations.

During this reporting period, two more major U.S. air carriers (bringing the grand total to six) were approved by the FAA for the first step of Category II operations. (One of these carriers has approval to use an automatic landing system during regular service for Category II operations.) At year's end it was expected that some of these carriers would be approved by the end of calendar 1967 for the second step of Category II operations.

Two more airports were also approved for Category II operations during the reporting period, making a total of five. In addition, FAA has scheduled 18 more airports for Category II equipment—three of which should

be certified for Category II operations by the end of calendar 1967. Of the five airports now certified for Category II operations, Dulles International (serving Washington, D.C.) became the first to be equipped with an approach lighting system that conforms with international standards. This system, which features red light bars on both sides of the runway centerline and eliminates strobe flashers on the inner 1,000 feet, was developed and tested at FAA's National Aviation Facilities Experimental Center (NAFEC), Atlantic City, N. J.

Work on FAA's all-weather Category III instrument landing system, still in the development and testing stage at NAFEC, also went forward during the reporting period. A development model of the ground-based ILS system was installed at NAFEC, and system testing is due to begin in fiscal 1968. Meanwhile, a single-channel airborne system was installed in an FAA jet transport, and a reliability analysis of Category III ground and airborne systems was completed. The results of the analysis were published in a number of reports, which presented criteria on component reliability, system configuration, redundancy level, mean time between failure, etc. At year's end, a 4-month evaluation of the total ILS system was scheduled to begin in November 1967.

FAA Administration of Airports

The FAA operates and maintains a number of federally owned airports. These include two large metropolitan airports—Washington National and Dulles International—which serve the Washington Metropolitan Area. In addition, the agency operates the Wake Island Airport and the airport at the National Aviation Facilities Experimental Center, which also serves as the municipal airport for Atlantic City, N. J. It also operates a number of airports in Alaska, principally for support of FAA operations, and a small intermediate airport at Hanksville, Utah, used for emergency landings. Following are some notable developments concerning the two National Capital airports.

National Capital Airports.—Fiscal year 1967 was the busiest year in the history of Washington National Airport and Dulles International Airport. Passengers handled at both airports numbered 9.8 million, an increase of 11 percent over the previous year. Aircraft operations increased 4 percent. This growth took place despite a 6-week strike against five major air carriers serving the Washington area.

By far the greater part of this air traffic was absorbed by Washington National Airport. Aircraft operations here continued at a heavy volume throughout the year, but stayed within tolerable limits as a result of the air carriers' voluntarily restricting themselves to 40 scheduled operations an hour. (Allowances are made for extra sections of scheduled flights.) General aviation users also observed voluntary restrictions. Nevertheless, Washington National was handling a disproportionate share of the area's air traffic and passengers; in consequence, at the end of the fiscal year, the Civil Aeronautics Board (CAB) announced it would investigate means of

balancing the use of Washington National, Dulles International, and Baltimore's Friendship International.

Inadequate automobile parking facilities remained a critical public-service problem at Washington National. Parking lots were regularly filled by 8:30 a.m. During peak periods of activity, the lots were literally swamped—and this in spite of the fact that these facilities were expanded during the year. In order to relieve this situation, plans were developed for privately financed construction of a multideck parking facility; the National Capital Planning Commission, however, deferred action on the proposal pending approval of a new master plan for the airport. Consequently, the multideck parking proposal was dropped for the present.

Congestion in Washington National's terminal building was relieved somewhat by the construction of "hold" rooms and other passenger facilities. These improvements were undertaken by 11 of the 13 air carriers serving the airport, at a cost of more than $12 million.

The Government itself invested little in improvements at Washington National, holding such spending to a minimum pending the completion of FAA's plans to modernize the airport. The first stage of the modernization study, conducted by an FAA contractor, was presented to FAA during this reporting period. Four concepts of modernization were selected for further study and refinement.

Among the improvements the Government did undertake at the airport, two are worth mentioning. One was the completion of a four-lane viaduct connecting the airport with the Jefferson Davis Highway (U.S. Route 1). This viaduct, which cost FAA $3.7 million, improves the airport's accessibility by automobile. The other improvement, the grooving of the airport's main (north-south, instrument) runway, adopts a technique found to be highly successful by the British in reducing the tendency of landing aircraft to aquaplane on wet surfaces.

Dulles International had no similar problems, although activity at this location continued to grow at a rapid rate. Aircraft operations increased 12 percent, to 194,000; the number of passengers handled increased 18.8 percent, to 1.3 million.

The fiscal year saw an increase in the number of airline diversions to Dulles as the airport began to come into its own as a diversion airport. This increase was due in part to Dulles' ability to keep its runways and its excellent access road clear of snow and ice. During the heavy snowfall of February, for example, Dulles was virtually the only major airport in the Northeast to remain open. On the basis of this performance, Dulles is expected to become the major diversion airport for flight operations in the Northeast.

Dulles' advanced concept and design make it uniquely equipped to accommodate the larger aircraft of the future. This fact was brought into sharp focus during the year when the Boeing Company began coordinating its plans for introducing the 425-passenger Boeing 747 with airport operators in the United States. Dulles' 11,500-foot parallel runways and other facilities make it better equipped than any other airport in the nation to handle the 747, the supersonic transport, and other jets of the jumbo category. This no doubt accounted partially for the fact that interest in the Dulles airport concept ran high throughout the year, with the airport playing host to many airport designers and operators from around the world.

A number of other notable developments occurred at Dulles during the year:

- Local-service airline operations were introduced when Piedmont Airlines inaugurated service at the airport in November.
- Two additional mobile-lounge docks were constructed to accommodate the substantial increase in international flights at the airport.
- Twelve thousand square feet of aircraft parking were added in the general aviation area.
- Arrangements were well advanced by the end of the year for the construction of a motel at the airport.
- Toll charges for telephone calls between the airport and any point in the Washington Metropolitan Area were abolished—an added service to the public.

The two airports did comparatively well financially during the year. Their combined income of $10.7 million exceeded direct operating expenses by $3 million—an increase of $2.5 million over the previous year. But, when interest and depreciation are included (mainly writeoffs against Dulles), the airports had a net loss of $4.7 million, which was, however, 29 percent less than the net loss sustained in fiscal 1966. On the brighter side, all present projections indicate that the Dulles investment (plus interest and depreciation) will be paid off in 30 years, as planned—or sooner.

As the year ended, legislation was pending before the Congress which would transform the Bureau of National Capital Airports from an FAA bureau into a Government corporation operating under an Advisory Board responsible to the Secretary of Transportation. Passage of this legislation would give the Bureau much greater flexibility in conducting its operations and strengthen its role in community relations in the metropolitan area.

U.S. Supersonic Transport Program

During this reporting period, the commercial supersonic transport (SST) development program completed the competitive design and study phase (Phase II) and entered the prototype development phase (Phase III). The decision to proceed with prototype development, which was based on the recommendation of the President's Advisory Committee on Supersonic Transport, was announced by President Johnson on April 29, 1967. (President Johnson gave the formal go-ahead to the Secretary of Transportation on May 1.)

The decision to proceed with Phase III was preceded by the selection of the winning Phase II-C designs, which were announced by FAA Administrator McKee on December 31, 1966. In the airframe competition, the Boeing Company variable-sweep-wing design was selected over the Lock-

heed Corporation double-delta-wing design; in the engine competition, the General Electric afterburning turbojet was selected over the Pratt & Whitney duct-burning turbofan. The selections were based on an intensive 2-month evaluation conducted by a 240-man team of aeronautical experts from the Defense Department, NASA, the Civil Aeronautics Board, and FAA. In addition, 10 U.S. and 18 foreign airlines independently evaluated the proposals and submitted individual recommendations.

In February 1967, FAA asked the 12 U.S. air carriers holding SST delivery positions to help with the financing of the prototype program by contributing one million dollars for each delivery position held. By late April, 10 air carriers, holding a total of 52 delivery positions, had responded favorably to the request. The $52 million airline contribution, which will be used in fiscal 1968 in lieu of Government funds, is in the form of risk capital and not recoverable in the event of program failure. Contributions in no way affect previously established delivery positions; those carriers contributing and those not contributing still retain their original slots on the FAA reservation schedule. Under the Government contract royalty arrangement, however, the contributing airlines stand to recover up to $1.5 million for each $1 million invested if the program is a financial success.

Among other developments, it was announced in June that the Boeing Company had agreed to assume full responsibility for allocating SST delivery positions to purchasers. Taking over this function from FAA, Boeing will honor assignments already made, which involved 113 positions and 26 airlines at year's end. Announcement of this change, which was issued in June, was accompanied by the additional information that Boeing will require a deposit of $750,000 for each new delivery position. (FAA had required a deposit of only $200,000.) Moreover, the $750,000 deposit will be in the form of risk capital and will be used by Boeing in lieu of Government funds to help finance the prototype program. The airlines will eventually recover their deposit through a royalty plan on SST sales (provided, of course, the program does not fail), but the deposit will bear no interest.

The Government estimated the total cost of the prototype program at $1.275 billion, including $193 million in overruns and $132 million in "nonallowable" manufacturer expenses. Under the terms of the Phase III contracts, the Government will contribute 90 percent of all normal "allowable" costs (the manufacturers, 10 percent) and 75 percent of "allowable" overruns (the manufacturers, 25 percent). The manufacturers must bear all "nonallowable" costs, which include selling expenses, expenditures for new and peculiar facilities, and interest on borrowed money. Using this formula, the Government's Phase III share works out to approximately $1.005 billion, which will be furnished to the manufacturers in appropriate increments over a 4-year period; however, this figure will be reduced by an amount equal to the amount contributed by the airlines and, indeed, was already reduced at year's end by the $52 million previously mentioned. Further airline contributions will reduce the Government's share even more, which, in the light of the increasing demands made on the Federal budget by the Vietnam war, will be of no small significance. Barring overruns in excess of $193 million, the manufacturers' contribution works out to $271 million. This contribution, plus what the airlines have already contributed, brings the private sector's share of total expenses to approximately 25 percent.

Under a formula in the Phase III contracts, the Government will recoup its entire SST investment with the sale of about 300 SST's. It will do even better if FAA economic studies are borne out. These studies indicate that at least 500 transports will be sold by 1990 even if sonic boom limits the aircraft's operations to overwater and sparsely populated land areas; in such an event, the Government stands to recover its investment plus a profit of between 4 and 6 percent per year compounded quarterly (or a total net return of 100 percent). If sonic boom does not prevent normal overland operations, the program could, according to the studies, run as high as 1,200 aircraft, with a total net return of 300 percent. Whether restrictions on overland operations will be necessary is beyond prediction now, although the calculated sonic-boom characteristics of the SST are very good for an aircraft of its size and weight.

At year's end, the Boeing design called for a titanium-constructed aircraft measuring 306 feet from nose to tail tip (since extended to 318 feet) and 180 feet 4 inches from wing tip to wing tip (since shortened to 174 feet 2 inches). The prototype will have a gross weight of 675,000 pounds. During subsonic cruise, its sweep wings will be at a 42-degree angle and during supersonic cruise at 72-degree angle. According to present estimates, each copy of this aircraft will cost the airlines $40 million—$21.4 million for the airframe, $5.5 million for the four engines, $13.1 million for Government royalty payments and the manufacturers' interest and mark-up. This is about four times the cost of the most expensive air carrier aircraft now flying. But the SST will carry about 280 passengers a distance of 4,000 statute miles at a cruising speed of Mach 2.7 (1,800 m.p.h.). These figures mean that the SST will be capable of transporting more people to and from Europe in one year that six ocean liners of the Queen Mary class.

Subsonic Aircraft Development

Throughout the decade of the sixties, FAA has been cooperating with the military services in developing aircraft that are capable of meeting both military and civil needs. The benefits civil aviation can reap from such a program are considerable: (1) The commercial utility of aircraft designed primarily for military use is substantially increased, (2) the cost of acquiring and the complexity of operating surplus military aircraft are reduced, and (3) fuller advantage can be taken of military research in the field of flight characteristics.

The most notable military aircraft development projects in which FAA is currently participating are:

- The advanced aerial fire support system (AAFSS), a new high-speed

compound helicopter under development by the U.S. Army. This vehicle's acceptance by the Army is contingent on FAA certification, which will permit the vehicle's further development as a high-speed (200-knot) transport or utility helicopter.

- A 3-year Air Force research study conducted by the Cornell Aeronautical Laboratory to update the military specification for fixed-wing-aircraft handling characteristics. The data ultimately gathered by the military may prove useful to the agency for updating flight-characteristics criteria for civil fixed-wing aircraft.
- A U.S. Army research study to update the military specification for rotary-wing-aircraft handling characteristics. FAA expects to use the new specifications as the basis for establishing flight-characteristics criteria for civil helicopters and compound helicopters.

The role of future air vehicles, particularly V/STOL (vertical or short takeoff and landing) aircraft, in providing convenient short-haul transportation to close-in or city-center terminals has been of continuing interest to the FAA. It has also been a subject of continuing investigation. During this reporting period, an FAA-sponsored study undertaken by the McDonnell Aircraft Corporation and the Stanford Research Institute revealed that V/STOL aircraft can play a major role in meeting the future needs for short-haul transportation. The study examined the feasibility of introducing V/STOL aircraft during the 1970's in a densely populated, heavily traveled California corridor stretching 500 miles over Sacramento, San Francisco, Los Angeles, and San Diego. According to SRI's forecasts, this corridor will have a total travel market of 180 million passengers by 1980. V/STOL aircraft, the study found, because of their ability to reduce the time spent traveling between the airport and the center of the city, would capture a substantial part of this market—40 percent of the short-haul passengers. Additionally, the study found that a V/STOL transportation system could be economically viable whether operating independently or as a complementary system.

FAA is also cooperating with the Department of Agriculture in investigating the safety and utility of agricultural aircraft. The U.S. agricultural fleet has gone through—and is still going through—a period of rapid expansion, and aircraft manufacturers and operators alike have come to the realization that safer and more economical agricultural operations are needed. The FAA-Agriculture investigation has revealed thus far that the performance of agricultural operations can be made significantly more efficient by improving the design of aircraft spraying and dusting equipment.

Noise Abatement

Ever since the introduction of turbojet aircraft into commercial service, in 1958, noise has posed a growing problem to communities in the proximity of major metropolitan airports. The problem has grown in magnitude of late, not only because of the increasing volume of jet air carrier traffic in the large aviation hubs but also because of the introduction of

short- and medium-range two- and three-engine jets capable of serving communities that were hitherto not being served by jet air carrier aircraft. Jet noise became serious enough for a panel of the Office of Science and Technology (OST) to recommend to the President in March 1966, after a special study, that appropriate solutions be sought by the Federal Government. The OST study, combined with a call by the President for a concerted attack on aircraft noise, led, in late fiscal 1966, to the establishment of the interagency aircraft noise abatement program—a program in which FAA plays a large part.

The various projects of Federal agencies participating in the noise-abatement program can be conveniently classified under three distinct categories: (1) Developing quieter engines, (2) revising aircraft operating procedures, and (3) promoting land uses around airports compatible with airport operations.

The roar of the exhaust jet and the whine of the compressor or fan are the main sources of gas turbine engine noise, and both of these sources are currently under attack. In one FAA-sponsored study, the General Electric Company is testing choked inlet guide vanes as a way of muffling compressor whine; it is also testing, under the same contract, the use of acoustically treated guide vanes or struts to absorb whine. In another FAA-sponsored study, G.E. is developing a scale-model Freon compressor as a tool for investigating compressor acoustics. Its feasibility already established, the model is being made available to any approved research group working in the area of compressor noise. In yet another study—this one conducted by the Boeing Company under an FAA contract—the effect of compressor blades on sound generation was examined and an equation was formulated that reasonably predicts sound levels for a free-running flat-blade rotor.

The National Aeronautics and Space Administration is undertaking complementary projects in engine-noise-suppression research and development. At its Lewis Research Center, in Cleveland, Ohio, NASA was preparing at year's end to launch, early in fiscal 1968, what is known as the quiet-engine project. Research conducted over a period of years has revealed that each of the elements of a jet engine can be altered in design to permit a substantial reduction in noise. The objective of the quiet-engine project, which is due to run into fiscal 1972 and cost $50 million, is to employ all known noise control techniques in a 20,000-pound-thrust demonstrator engine. When installed in a new sound-absorbing nacelle (which is also being developed by NASA), the "quiet engine" is expected to be 20 PNdB (perceived noise decibels) quieter than present jet engines.

FAA is not now empowered to promulgate noise standards as criteria for aircraft certification; such certification is based solely on considerations of safety. But, if the quietest possible aircraft operations are to be achieved in the shortest possible time, FAA will need authority to establish noise certification standards. An administration-sponsored bill giving the Secretary of Transportation authority to prescribe standards for both engine noise and sonic boom and make these standards part of the overall aircraft

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certification criteria was pending before the Congress at the end of the reporting period.

FAA does have the authority, under section 307(c) of the Federal Aviation Act, to prescribe flight procedures that abate aircraft noise. Under this authority, the agency has for many years required special takeoff and landing procedures, and it continues to press forward in this area, seeking improvements through the study and implementation of new procedures.

During the last half of the fiscal year, FAA developed and implemented a new noise-abatement procedure for jets serving Washington National Airport. A two-segment takeoff profile, the new procedure calls for rapid climb to a specified altitude and then a reduced-thrust climb until the aircraft is 10 miles from the airport. Results following the procedure's introduction have been encouraging.

Corroboration that the new measure was effective was provided by a study of aircraft-overflight recordings. Made by members of FAA's Office of Aviation Medicine, these recordings included approximately 3,000 overflights of various types of aircraft (piston, turboprop, and turbojet). Results of the study showed that departing and arriving turbojet aircraft observing the prescribed noise-abatement procedures were no louder and perhaps less noisy than piston-driven aircraft. Plans were afoot at year's end to implement the same procedure on a voluntary basis at other noise-sensitive airports.

While no new landing procedures were introduced during the year, FAA and NASA worked out and tested a two-segment procedure calling for air carrier aircraft to approach an airport along a steeper glide slope than they use today. Aircraft would maintain this slope until they reached a distance of approximately 3 miles from the end of the runway, at which point they would assume a normal approach angle. Even steeper approaches than the one just described have been receiving some attention, especially at NASA. There is little likelihood, however, that such approaches will be acceptable for aircraft presently in service. Safe approaches at such steep angles will require either a direct lift control system or an advanced automatic landing system. But aircraft scheduled for introduction at or soon after the turn of the decade (such as the Boeing 747 and the supersonic transport) may have direct lift control systems as part of their original equipment.

Quieter engines and revised aircraft operating procedures can be put to maximum use, and still a large amount of aircraft noise will remain. Compatible land use is that phase of the interagency aircraft noise abatement program that deals with this residual noise. The objective of this phase of the program is to stimulate land development around airports in directions that either anticipate or mitigate community aircraft noise problems by providing guidelines for planning, zoning, and other local action. More than 50 programs (both remedial and preventive) have been identified as capable of exerting influence to achieve land-use patterns compatible with airport operations. Illustrating the importance the National Administration attaches to the objectives of this program was a March 22, 1967, Presidential memorandum directing all Federal agencies to take explicit account of aircraft noise whenever it has relevance to one of their programs. "We must do all in our power to assure that the environment in which we live is not overburdened with any form of pollutant," the President wrote, "including excessive noise."

Accordingly, FAA and the Department of Housing and Urban Development (HUD) developed detailed procedures to assure that the question of compatible land use is properly considered in projects falling under HUD's urban planning assistance program (sec. 701 of the National Housing Act of 1964). These procedures assure that HUD will approve no funds for a 701 project until it is satisfied that the acquisition of airport-adjacent land for noise-compatible use and zoning has been given due consideration.

Finally, the agency is continuing to document aircraft noise levels around all major airports in the country. These data will be analyzed along with land-use data being collected by HUD. The analysis should help determine existing needs for corrective action. It should also help develop guidelines for compatible land use.

Information and Education Programs

Information Programs.—"A democracy works best when the people have all the information that the security of the nation permits." It is in the spirit of these words, recently expressed by President Johnson, that the FAA public information program is conducted. And it is conducted for the benefit not only of easily differentiated groups—legislators and other government officials, airline and aircraft manufacturing executives, pilots and the flying public—but also for the benefit of all interested citizens, most of whom have no direct connection with aviation.

A mainstay of FAA's information program is the press release, and the agency's Washington headquarters issued no fewer than 142 releases to the news media during the reporting period. The agency continued publishing *FAA Aviation News*, a monthly magazine intended primarily for general aviation pilots. The magazine is sold by subscription and has tripled its circulation over the last 2 fiscal years.

The role of the motion picture as an information tool is not to be overlooked. During this reporting period, FAA produced and released for distribution six short films. One of these, *It Pays to Stay Open*, is narrated by Danny Kaye and illustrates how communities can benefit economically by keeping their airports illuminated for round-the-clock operations. Another film, *Path to Safety*, featuring Cliff Robertson, points up some of the common mistakes made by general aviation pilots at or near airports and prescribes correctives. The serious effects of alcohol and drugs on general aviation pilots are illustrated in *Charlie*. A fourth film, *Chemical Safety in Agricultural Spraying*, is designed to warn pilots of the dangers of insecticides applied in flight. The other two films were produced for an audience of engineers and aircraft designers. FAA also produced four short films that were used as part of the agency's exhibit

at the 1967 Paris Air Show. In unusually active use during fiscal 1967 was an FAA film released late in fiscal 1966: *Wake Turbulence*. By year's end, it had been shown to nearly 100,000 pilots and air traffic controllers.

In an effort to make the American public more aware of the importance of civil aviation, FAA launched a three-pronged public information program called Project Urgent. Under this program, the agency made nationwide distribution of (1) short television films describing the FAA, (2) radio tapes explaining various facets of civil aviation, and (3) large colored posters emphasizing aviation safety. The films and tapes will be played over the air waves as public service announcements; the posters will be displayed in major air terminals. A complementary effort launched a program designed to keep local communities informed of the social and economic benefits they can reap from civil aviation.

FAA also has the responsibility of keeping its own employees as well informed as possible. To this end, the agency converted its monthly magazine, *FAA Horizons*, into a fortnightly newspaper—a format judged to be more conducive to the publication's objectives. The agency's weekly newsletter, *Intercom*, continued to be published as before, as was the *Tech-Info Bulletin*, a technical periodical attuned to the interests of important management officials.

Airports are built to serve a functional need, but this does not mean that their design must ignore esthetic values. It was primarily to get across the idea that airports can be made to appeal to the eye that FAA inaugurated its airport beautification awards program. Any U.S. airport is eligible for one of the awards, which honor both public agencies and private organizations that have protected, restored, or enhanced airport beauty. The first award was presented by Mrs. Lyndon B. Johnson to the Phoenix, Ariz., Sky Harbor Municipal Airport.

The agency sponsored other award programs to highlight significant achievements in civil aviation—among them the FAA mechanic safety awards program and the Air Force aero club awards program. During this reporting period, the FAA Administrator presented no fewer than 22 awards to members of the aviation community for achievements ranging from acts of heroism to significant contributions to air safety.

Aviation Education.—FAA maintains an active aviation education program throughout the United States. During this reporting period, FAA employees were available at more than 1,500 locations for conducting tours of FAA facilities, speaking to students and teachers, and providing educational and teaching materials for grade levels ranging from kindergarten to college. By participating in aviation workshops, FAA employees provided training to an estimated 10,000 teachers, who will eventually influence more than 250,000 students.

Prominent among the materials available for the first time in fiscal 1967 were two motion pictures: *Aviation—Where Career Opportunities Are Bright* and *Flight to Grandmother's*. The first film attempts to inform high school students, teachers, and guidance counselors of the wide variety of jobs in aviation and of the training opportunities available at vocational and technical schools. The second unfolds the adventures of a boy and girl going to their grandmother's by air. The children take a helicopter ride, tour the airport, ride an airliner, and wind up their trip with an air-taxi flight to grandmother's farm. Both films are available from the film library at the FAA Aeronautical Center, Oklahoma City.

FAA has long published and distributed training and education handbooks as part of its safety program. Notable among publications of this kind issued during fiscal 1967 were:

- An Instrument Flying Handbook (FAA Advisory Circular No. 61–27), containing the basic information required by a pilot to acquire an FAA instrument rating.
- A handbook on Cold Weather Operation of Aircraft (FAA Advisory Circular No. 91–13), detailing how to maintain and operate an aircraft in cold weather.
- A handbook on Doppler Navigation Aids (FAA Advisory Circular No. 121–10), containing the basic information required for securing operational approval of a Doppler cockpit navigation system.
- A handbook on Inertial Navigation Systems (FAA Advisory Circular No. 121–11), containing the basic information required for securing operational approval of an inertial cockpit navigation system.
- A handbook on United States Standards for Terminal Instrument Procedures, which groups all applicable existing instrument approach criteria within a single volume. Criteria for Category II operations will soon be included in a revised version of the handbook.

General Aviation Growth

General aviation (nonairline and nonmilitary aviation) was once again the fastest growing segment of civil aviation—and from all indications it will continue to be so for some time to come. As compared with figures for fiscal 1966, the number of general aviation aircraft handled by FAA's air route traffic control centers in fiscal 1967 increased by 31 percent; in contrast, the number of air carrier aircraft handled increased by 14 percent. Similarly, the number of general aviation takeoffs and landings handled by FAA airport traffic control towers increased by 20 percent while air carrier takeoffs and landings increased by only 5 percent. (It should be noted that air carriers were hobbled part of the fiscal year by a lengthy labor strike.) Further illustrating the remarkable expansion of general aviation was the dramatic increase in the number of pilot briefings and flight condition messages, the great majority of which are received by general aviation pilots. No fewer than 7.3 million briefings and flight condition messages were given by FAA flight service stations, an increase of 30 percent over the 5.6 million given the previous fiscal year. And this growth trend is expected to continue. According to the latest FAA forecasts, the general aviation fleet, which now runs to 155,132 registered aircraft, is expected to nearly double during the next 10 years.

The air taxi business is the fastest growing component of general avia-

tion. Usually employing aircraft weighing less than 12,500 pounds at takeoff, air-taxi operators perform such functions as carrying mail, freight, and commuters, linking up passengers with scheduled air carriers, and even transporting passengers long distances. One of the more notable developments within the air-taxi industry in recent years has been the extraordinary growth experienced by scheduled air taxis. In January 1964, there were only 12 such scheduled operations in the United States; by November 1966, the number had risen to 116—an increase of 900 percent in less than 3 years. The number of aircraft utilized in these operations has also increased at an extraordinary rate—from 72 in January 1964 to 510 in November 1966, or a rise of 600 percent.

The growing importance of the air taxi as a mode of transportation was further highlighted by the announcement during this reporting period by nearly every major manufacturer of general aviation aircraft of an intention to produce lightweight 10- to 19-passenger twin-engine aircraft especially designed for air-taxi operations. In November 1966, one such manufacturer had received more than 100 orders for his newly designed air-taxi aircraft.

INTERNATIONAL AVIATION ACTIVITIES

Civil aviation is global in character, and FAA's activities, perforce, extend beyond the confines of the United States. The United States belongs to, and FAA participates in the activities of, a number of international organizations devoted to aviation. The agency extends assistance and training to foreign countries. And it takes part in a miscellany of other activities of an international character.

Participation in International Organizations and Meetings

The International Civil Aviation Organization (ICAO) provides the United States with its principal forum for presenting its view on international air transportation and air navigation policies. During this reporting period, FAA representatives served on delegations to 13 ICAO conferences and assumed a principal role in preparing and coordinating the official U.S. position for these meetings. The agency also began preparing the U.S. position for 12 ICAO meetings scheduled for the next fiscal year. Additionally, as a member of the Interagency Group on International Aviation (FAA chairs the Group), FAA assisted in formulating the U.S. position for 20 international meetings.

Among the ICAO meetings attended by FAA, the following bear special mention:

- Two meetings of the North Atlantic Systems Planning Group held in Paris during November and December 1966 and April 1967. A data collection and analysis program was developed at these meetings to supply a basis for determining a safe lateral separation standard for jet aircraft flying the North Atlantic. (See "North Atlantic Systems Planning" below for details.)

- Fourth Caribbean Regional Air Navigation Meeting held in Mexico City during November and December 1966, at which the needs of general aviation were considered for the first time in an ICAO forum.
- Communications/Operations Divisional Meeting and All-Weather Operations Panel Meeting held in Montreal during October and November 1966 and April 1967, respectively. FAA helped advance at these meetings the objective of an all-weather aircraft operating capability through the development of an intermediate step in the relaxation of specific weather minimums for landing at airports.
- Conference on Charges for Airports and Air Route Navigation Facilities held in Montreal during March and April 1967. This conference dealt with the controversial subject of user charges, which ICAO had previously considered in 1956 and 1958. User charges for international general aviation were considered at this meeting for the first time.

The agency also took part in a number of international meetings outside of ICAO, including:

- Four meetings with the United Kingdom-France Type Certification Board, at which intensive comparisons were made between the proposed U.S. airworthiness standards for supersonic transports and Anglo-French standards. These standards will ultimately apply to the forthcoming Anglo-French Concorde and the American SST (the Boeing 2707).
- A bilateral meeting between FAA officials and the United Kingdom Board of Trade held in London in February 1967. This was part of a continuing series of annual meetings that seek Anglo-American agreement on a variety of aviation problems.
- A Meeting on the Reduction of Noise and Disturbance Caused by Civil Aircraft, held in London in November 1966. Under U.K. auspices and attended by representatives of many nations, the conference laid the groundwork for developing international noise standards and permitted the exchange of views on the possible application of such standards to the noise certification of aircraft.

North Atlantic Systems Planning

The United States has long recognized, as have other ICAO members, that air navigation over international waters, no less than air navigation over land, requires adequate aeronautical services. Accordingly, as a result of U.S. proposals to the ICAO Special North Atlantic Meeting, held in Montreal, Canada, during February and March 1965, the ICAO Council established the ICAO North Atlantic Systems Planning Group (consisting of Canada, France, Ireland, the Netherlands, the United Kingdom, and the United States) and gave it the responsibility for continuously studying and evaluating the North Atlantic System in the light of changing traffic characteristics and technological advances. The chief operational problem receiving the attention of the six planning-group nations during this reporting period was the lateral separation of turbojet aircraft.

On January 13, 1966, in compliance with recommendations adopted at the Special North Atlantic Meeting, the lateral separation between turbojet aircraft operating in the North Atlantic region was reduced from a minimum of 120 nautical miles to a minimum of 90 nautical miles. No sooner was this action taken than the pilots of the airlines operating in the region took exception to it. The pilots contended there was insufficient evidence that all aircraft operating in the region could navigate with adequate safety under the new minimums. In February 1966, this protest resulted in the pilots' being granted permission to request and receive a 120-mile separation when flying below 29,000 feet. (The 90-mile standard still prevailed at 29,000 feet and above.) Two months later, in April, responding to a request by the Air Line Pilots Association (ALPA), FAA held public hearings on the subject. The burden of the testimony presented by ALPA witnesses was that the decision to reduce the lateral separation minimum was inadequately supported by technical data.

Meanwhile, it was becoming apparent that with the advent of the summer tourist season the prevailing dual separation standard would place an intolerable workload on the air traffic control facilities of Canada and the United Kingdom. A series of informal discussions between representatives of Canada, the United Kingdom, and the United States led to the three nations' return to the 120-mile separation standard on June 12, 1966. At the same time, the three nations issued a statement announcing their intention "to invite the cooperation of . . . other States and of the national and international organizations concerned [to conduct an] immediate study of navigational accuracy over the North Atlantic."

At two Paris conclaves—one held in the fall of 1966, the other the following spring—representatives of the six planning-group countries, together with representatives from Portugal and three international organizations (the International Air Transport Association, the International Federation of Air Line Pilots Associations, and the International Airline Navigators Council), met under ICAO's auspices and worked out a program of data collection and analysis designed to measure the navigational capability of turbojet aircraft flying the North Atlantic.

The data collection program was scheduled to begin on July 1, 1967, with all participating nations accepting assignments in data collection and analysis. During this exercise, NATO Loran "A" Chains "Charlie" and "Delta" will operate full-time, and daily radar observations from sites at Gander, Newfoundland, and Kilkee, Ireland, will be automatically recorded. In addition, three specially equipped U.S. Coast Guard vessels will make similar radar observations from selected mid-ocean points. Something in the neighborhood of five to six thousand flights will be monitored.

The data will be sent to FAA's National Aviation Facilities Experimental Center, in Atlantic City, N.J., where they will be processed and compared with flight-plan data collected from the oceanic air traffic control centers. The data will then be sent on to the United Kingdom's Royal Aircraft Establishment for final analysis and preparation of a report. The program is expected to run for approximately 9 months and should lead to a safe and universally acceptable standard for lateral separation over the North Atlantic.

Foreign Assistance and Training

FAA's activities in the area of foreign assistance and training continued to be sponsored primarily by the State Department's Agency for International Development (AID) and the Defense Department's military assistance program. Moreover, the character of these activities remained substantially the same—providing advice and technical assistance to foreign governments and groups in matters pertaining to civil aviation.

FAA had a total of $9.3 million available from all sources during the fiscal year for foreign assistance operations. Some of these resources went to maintain 20 technical assistance groups in 22 foreign countries (including satellite offices of regional groups). Thirteen of these groups were sponsored by AID, six by the U.S. Air Force, and one by the U.S. Army. Five new groups were established—Iran (U.S. Air Force), Turkey (U.S. Air Force), Ryukyu Islands (U.S. Army), and Jordan (one for U.S. Air Force and one for AID)—and three groups were discontinued—United Arab Republic (AID), Turkey (AID), and the Republic of China (U.S. Air Force). With the increase in the number of assistance groups came an increase in the number of FAA's authorized overseas positions—from 97 to 113. The Far East had the greatest increase. The group in Thailand jumped from three positions to 11; the Vietnam group, from 20 to 34. The five new groups accounted for 14 new positions. In all, 39 positions were created while 23 positions were abolished.

One of the factors contributing to the growth of FAA's Civil Aviation Assistance Group in Vietnam, which is supported by AID, was the increased volume of aircraft operations at Saigon's Tan Son Nhut Airport. The immensity of this volume is illustrated by the number of aircraft operations in May 1967: at 115,000, they were 25,000 more than the combined total at the three major airports in the New York City area. And no letup is in prospect. Indeed, prospects at year's end were that FAA's personnel strength in Vietnam might double in the near future.

FAA's assistance to the U.S. Air Force also increased. Under a new FAA-USAF agreement, FAA agreed to assist the Air Force in implementing joint military-civil support projects required by the military assistance program. Accordingly, a new type of field group, the Federal Aviation Specialist Group, was established to provide this kind of assistance. Two such groups were established to implement communication projects in Jordan and Iran. The group in Jordan, however, was evacuated in June 1967, when the Middle East crisis broke out. The Jordanian project was in a "hold" status at the close of the reporting period. Over the next two years, FAA is expected to provide the Air Force with two additional air traffic control systems: one in Iran and one in Taiwan.

The problem of providing Latin America with sufficient air navigation and communication services—a subject which began to receive much-needed attention with the launching of the President's International Coop-

eration Year in 1965—was of special concern to FAA during the reporting period. Among other studies, the agency undertook to compare the implementation of new navigation services in Latin American countries with the applicable ICAO regional air navigation plans. The comparison revealed a gap between existing aeronautical services and the services called for by the ICAO plans. At the end of the reporting period, FAA was studying various means of finding the necessary financing to close this gap.

FAA's training of foreign nationals in specialized aviation skills continued on a sizable scale. During the fiscal year, FAA trained 242 foreign nationals, 175 of which were sponsored by AID, 18 by ICAO, and 49 by foreign governments.

Flight Inspection in Foreign Countries

FAA flight inspection of ground-based air navigation facilities (navaids) extends into many foreign countries. This service is performed not only on U.S.-owned facilities, but also on foreign-owned facilities—in which case it is done on a cost-reimbursable basis. During this reporting period, 19 reimbursable agreements with foreign countries were reviewed and, where necessary, renegotiated to provide for full cost recovery in accordance with recent U.S. budgetary policy.

While the agency flight-inspects navaids in foreign countries, it also seeks to encourage and assist these countries in developing their own flight-inspection capability. FAA culminated its efforts in this area during this fiscal year by perfecting and readying for production a unique portable flight inspection package. (See Chapter I.) Capable of being installed in nonspecialized aircraft, the two-unit package enables such aircraft to substitute for the more sophisticated special-purpose aircraft under certain conditions, thereby permitting marked economy. A number of countries are planning to use the U.S.-manufactured package, with resultant savings in FAA overseas expenditures.

Among other notable developments during this reporting period were negotiations involving:

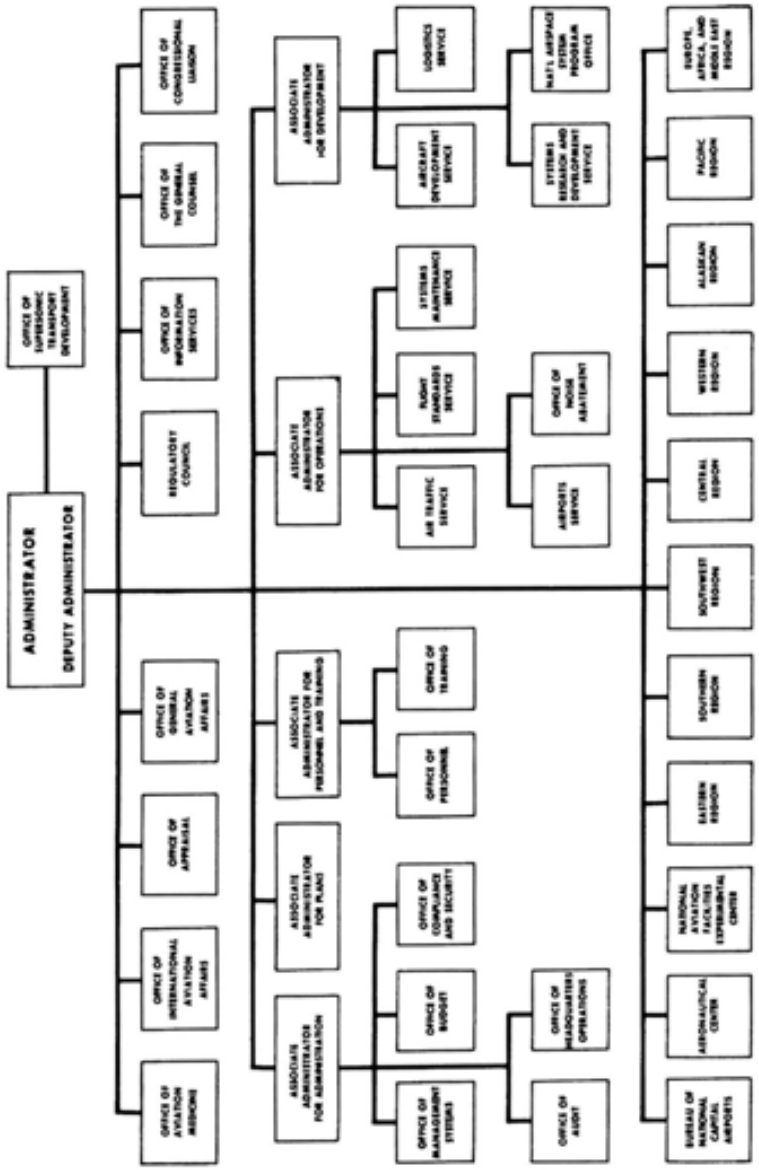
- The pending transfer to Canada of the flight inspection of U.S. military navaids in that country.
- The early development of a flight-inspection capability by Iceland through the loan of U.S. flight-inspection equipment and the training of Icelandic personnel at the FAA Academy.
- The final phasing out of U.S. flight inspection of a large number of navaids in Japan. The last navaids were turned over to the Japanese for inspection in April 1967, following on-the-job training of Japanese personnel.

Other International Activities

The events described below round out FAA's participation in activities of an international character:

- In March 1967, Soviet fighters intercepted a number of U.S. air carrier aircraft in the area of the Komandorskie and Kurile Islands. The USSR lodged a protest with the State Department, alleging that these aircraft violated Soviet airspace. A special FAA team, after investigating the navigation practices in the North Pacific and finding relatively poor ground-based navigation aids along the route, recommended that the buffer zone between the flight-plan tracks and the northern boundary of the Anchorage and Tokyo Flight Information Regions be widened. Acting on this recommendation, FAA issued new operating specifications to all U.S. air carriers flying the North Pacific route. Air carrier aircraft using an approved Doppler navigation system were required to maintain a 50-mile buffer; those using conventional navigation methods, an 80-mile buffer.
- A large number of airlines gave their adherence to last year's interim agreement raising the Warsaw Convention airline liability from $16,600 to $75,000. The interim agreement is terminable on 12-month notice, however, and the United States actively sought in fiscal 1967 to work out a permanent solution. FAA participated in this work as a member of the working group that prepared the U.S. position for a special ICAO panel.
- FAA gave a great deal of attention to the problem of facilitating the movement of aircraft, passengers, baggage, and cargo between countries through the streamlining of border-crossing formalities. This problem has taken on increased urgency with the impending introduction of such high-capacity aircraft as the Boeing 747 and the supersonic transport, and FAA, through the National Facilitation Committee, is pressing for the adoption of comprehensive plans of facilitation. The Facilitation Division of ICAO will meet in fiscal 1968 to seek solutions.
- FAA's suggestion to build the major U.S. theme for the Paris Air Show around the 40th anniversary of Lindbergh's transatlantic flight was adopted by the Interagency Exhibits Committee. The American show included an operational replica of Lindbergh's "Spirit of Saint Louis," which, after a short flight, was mounted as a static display at the gateway to the U.S. pavilion. FAA's exhibit at the air show, which was held in June, was acclaimed for its originality of design and its effectiveness in telling FAA's story.
- FAA and the Canadian Department of Transportation agreed, at a meeting in June 1967, to the details for implementing the 1963 Canadian-United States air traffic control agreement. This agreement permits the two countries to delegate to each other the control of specified portions of their airspace. The agreement is expected to be fully implemented by December 1967.

FEDERAL AVIATION ADMINISTRATION



Chapter V

ADMINISTRATION

The creation of the Department of Transportation was by far the outstanding administrative development of fiscal 1967. Besides making FAA a component of the new Department, the Department of Transportation Act opened the door to administrative and procedural changes of prime importance to the Federal role in transportation, including aviation as well as the other modes.

Administrative developments of internal origin were also important in FAA's fiscal 1967 activities. A new, overall management system was articulated. Significant strides were made in the area of financial management, particularly in developing a new accounting system. Personnel and training programs moved forward. The agency's cost reduction and occupational health programs made notable progress. Details on these and other administrative developments follow.

MANAGEMENT

Systems Approach to Management

The most significant event in the area of management during this reporting period was the preparation of a description of a unified system for FAA program and resource management. Like the system concept employed in the development of sophisticated weapons, the new management system is directed at the totality of an enterprise. Its objective is to integrate all existing FAA management systems into one central system. The system description was ready for publication in an FAA handbook at year's end.

The system approach in management (as distinguished from the overall integration of individual systems referred to above) is nothing new to FAA, especially in the area of financial management. A cost-accounting system and cost-based budgeting have been under development in the agency for some time; a Planning-Programing-Budgeting System (PPBS) was adopted by the agency in fiscal 1966; cost-benefit analyses were employed in managing the development and area planning phases of the National Airspace System.

While these and other FAA management systems had a certain relationship to each other, they were nevertheless separate systems designed to solve separate problems. Lacking the unity and cohesion of a single system, they could not address themselves to the totality of the agency's problems.

By July 1966, the proliferation of these systems in FAA caused two things to become apparent to FAA's Working Group for Financial Management Improvement and other elements in FAA: (1) Several unintegrated systems would by themselves not do; (2) a systems approach to management transcended the purely financial realm—the area in which FAA had thus far employed the approach—and could be usefully employed not only in deciding on ways and means, but also—and perhaps more importantly—in establishing agency goals. What was needed, it was concluded at the time, was a single unified system capable of pulling the separate systems together and gearing each of them to the others.

The aim of the new system is simple enough—to help each FAA manager recognize when the need exists to make a decision and then to provide him with the facts he requires to make it. The day of the intuitive decision may not be over, but the time has come when a manager can rely less and less on his staff's ability to gather all the relevant information required in making a decision. FAA has grown so large and so complex that it is no longer possible for a manager, no matter how gifted and experienced, to cover all the data, range over all the variables, and note all the interrelationships without something better than a catch-as-catch-can method. Sheer size alone dictates that there be an organized framework for presenting information to a manager in a systematic way.

A manager requires information to plan (i.e., to consider what needs to be done) and to program (i.e., to consider when to do it and how). He needs timely access to reliable budgetary data, which will tell him, among other things, whether he can commit the agency to expend the resources he requires. In addition, he will be unable to function effectively unless he receives continuing information about the activities with which he is concerned. But an uncontrolled flood of information would be about as helpful as no information. This means that the information fed to the manager about activities within his scope of interest must focus his attention on essentials. Finally, a manager needs to know not only what is being done within his area of operation, but also how well it is being done. Judging quality of performance is therefore a vital part of any management system, and a manager must be provided with a standard of quality against which he can compare actual performance. He must also be provided with a standard of productivity.

The FAA management system description envisages meeting both the internal needs of managers and the external requirements imposed on FAA by other Federal agencies through the operation of two categories of specialized subordinate systems—management support systems and program management systems. The first category encompasses a number of specialized systems devised to focus either on specific portions of the managerial process or on specific subject matter. Included are such subordinate systems as PPBS (which provides a common framework for deciding what should be done, when it should be done, and how much should be invested in resources), the accounting system (which reports on the application of resources in terms of dollars), the manpower-management system (which identifies and satisfies manpower needs in terms of numbers, skills, and levels), and the materiel-management system (which is concerned with identifying, acquiring, storing, distributing, and controlling the disposition of property). The second category, program management systems, provides an orderly means of determining needs, analyzing operations, and making comparisons along program lines.

The unified system provides for common system elements to go along with the two classes of subordinate systems. Users will require a unified bank of information from which they can draw. If such a bank is to function effectively, all depositors (data originators) and borrowers (data users) must deal in common terms.

Implementing the unified system is, of course, a long-term proposition, stretching over many years. During fiscal 1967, an order of priorities was established for implementing the various subordinate systems. Top priority has been given to revising FAA's basic accounting system (see below). The new accounting system will provide a bridge from costs to obligations, which is a prerequisite to cost-based budgeting—the next item on the list of priorities. Program management systems will not be developed until basic summary-level accounting and cost-based budgeting are functioning.

Meanwhile, agency managers and executives are being reoriented in such current systems concepts as the quantitative definition of mission, cost-benefit analyses of alternatives, the use of standards for cost-based budgeting, and other concepts. By year's end, nearly 300 key managers and executives had been briefed on these systems. Finally, in another step designed to familiarize key officials with these concepts, the agency's regular resident training courses for managers and executives were revised to give added emphasis to the systems approach to management.

Financial Management

Financial management is, of course, an integral part of FAA's total systems approach to management. What follows, therefore, is a review of the fiscal 1967 progress achieved in the separate subordinate systems that will ultimately make up the overall integrated system discussed in the previous section.

Accounting.—FAA concentrated most of its financial management activities during this reporting period in working toward full approval for its modernized accounting system from the Comptroller General. During the previous reporting period, FAA had submitted to the General Accounting Office (GAO) three segments setting forth the description and plan of the new accounting system; these were formally approved by the Comptroller General in January 1967.

A work plan for developing the remaining segments of the accounting system has been agreed on by FAA and the GAO site audit staff. By the end of the reporting period, no fewer than 19 segments of the new system had been submitted to GAO for informal review.

To conform with the concepts approved by the Comptroller General, FAA revised and reissued its handbook "Concepts and Standards for FAA Integrated Financial Management System." In addition, a major effort was undertaken to systematically organize and update accounting directives. Fifty-eight circulars and directives have thus far been canceled or recodified; the updating will continue through the next fiscal year.

Future plans call for developing and installing a revised allotment-accounting system consistent with agency policy on levels of accounting and reporting of obligations. The cost-accounting system will be expanded to (1) meet cost management needs, (2) support PPBS, and (3) provide bases for developing an internal cost-based budget. All property-accounting systems will be reviewed for adequacy of property control and, where necessary, will be revised to conform with management needs and the newly approved accounting principles and concepts.

Planning-Programing-Budgeting System.—Efforts to integrate PPBS into the agency's management procedures continued. In this connection, two FAA registers were developed and issued during the reporting period. One of these, a register of requirements, forms the basis for research and development and project planning for the National Airspace System. The register will be updated continuously to reflect aviation requirements, system requirements for in-service improvement, and requirements arising from advances in the state of the art. The other issuance, a register identifying all agency PPBS analyses, was the first of its kind in FAA. It, too, will be updated continuously and will include such information as titles of the analyses, a statement of purpose, and an identification of the office of primary responsibility.

Among other accomplishments in this area, the agency—

- Employed the PPBS program structure for the first time in developing a multiyear program and financial plan (covering the period from fiscal 1969 through 1973).
- Developed and published a program management handbook incorporating the concepts and procedures for implementing cost-based operating budgets and reporting for all FAA aircraft operations.

Plans for fiscal 1968 and beyond include the following goals:

- Revise PPBS program categories, program memoranda, and procedures to make them compatible with a Department of Transportation PPBS for preparing multiyear financial plans for transportation.
- Begin developing (in fiscal 1968) the concepts and procedures for presenting appropriation estimates on a cost basis.

Property Accountability and Control.—The major developments in property management during this reporting period have already been reflected in the events covered in the last two sections—e.g., the review of property-accounting systems. But a few additional developments, largely in the form of future plans, should be noted:

- The structures and methods for (1) the operating materiel inventory system, (2) the regional segment of the project materiel management system, (3) the real-property accountability system, and (4) other in-place property accountability systems will be clarified or expanded during fiscal 1968 as an outgrowth of a survey of property accountability begun in April 1967.
- Portions of the project materiel management system are scheduled to be redesigned by July 1, 1968.
- All property and materiel directives will be codified into one logistics manual. This work will be largely completed in fiscal 1968.

Audit.—Audit is a vital cog in the scheme of any financial management system: it is the means by which management is provided with an independent and objective review of how effectively financial and resource-management responsibilities are being carried out. Accordingly, as one further step in achieving an effective financial management system, the agency issued an FAA order in January 1967 prescribing a new approach to internal audit. The order, which established 42 auditable areas within FAA, was predicated on the principle that internal audits are as important as audits bearing on FAA's external activities (FAAP, air carrier, and contract audits). To put it another way, internal audits were no longer to be considered as a peripheral activity, to be engaged in only after the staffing and resource requirements of other audits had been fully satisfied.

The agency has determined that the new internal audit program can be conducted over a 4-year cycle by sampling only half of the regions or centers and the Washington headquarters during each audit. The results of each such audit, besides going to the FAA Administrator and to the officials whose functions had been audited, will be disseminated to all field directors to permit follow-up on potential problems. Four audits under the new program were in progress at year's end.

FAA auditors continued to provide many of the agency's elements with advisory assistance. Final audits were performed on 426 FAAP projects involving $217 million in sponsors' costs. Costs amounting to $6.3 million were questioned by the audits—all of which must be reviewed and either sustained or rejected by the regional grant review committees. During fiscal 1967, the regional grant review committees reviewed questioned costs amounting to $2.7 million and sustained FAA auditors in their questioning of $1.9 million.

Rounding out the agency's audit activities during the fiscal year were:

- The issuance of 59 audit reports making suggestions for improving efficiency and economy.
- The issuance of 62 reports evaluating the financial fitness of air carriers and other commercial operators.
- The auditing by FAA and the Defense Contract Audit Agency of 98 FAA contracts with private industry, involving $152 million in Federal funds.
- The identification of $1.4 million in potential agencywide savings.

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Cost Reduction

For the third consecutive year since President Johnson inaugurated the Government-wide cost-reduction program, in fiscal 1965, FAA achieved significant economies in operating and administrative costs. As a matter of fact, the agency exceeded its original cost-reduction goal by a considerable margin; but those increases in productivity and efficiency that were in excess of the original goal were due in large measure to workload increases of unexpected size. This was particularly true in the area of air traffic services. Here the rapidity of civil aviation's growth made it clear early in fiscal 1967 that safety in the air could be impaired if, through circumstance rather than design, the air traffic control work force continued to be called on to absorb unanticipated increments in workload. Accordingly, the ranks of air traffic control personnel were bolstered; they rose—though not so fast as the demand for services—from 17,866, or 41 percent of the total FAA work force, at the end of fiscal 1966, to 18,643, or 42.1 percent of the total work force, at the end of fiscal 1967. And at year's end, FAA was actively seeking to bolster their ranks even more. Nevertheless, the productivity of the individual air traffic controller will no doubt continue to rise as planned efficiencies, including automation, are gradually introduced into the system.

FAA was particularly successful in using its engineering talents to cut costs. One notable example involved the conversion of a dual-cavity invar-steel filter used with a model AN/GRN–9A tactical air navigation (TACAN) transponder into two single-cavity filters. The aluminum spectrum-control filters furnished by the manufacturer for transponder models AN/GRN–9B and AN/GRN–9C had a high failure rate, resulting not only in frequent equipment shutdown, but also in high maintenance and reconditioning costs. The solution, as originally conceived in fiscal 1966, was to buy new filters at a cost of $628,000. This idea was scrapped, however, in favor of oonverting the dual-cavity filters into two highly reliable single-cavity filters and using them to replace the unreliable filters used with the AN/GRN–9B and AN/GRN–9C models. The conversion is expected to extend into fiscal 1968 and will produce enough single-cavity filters to render the procurement of new filters unnecessary. During this reporting period, $385,000 in cost avoidance was realized; by the time the program runs its course, an additional $293,000 is expected to be saved.

FAA is also taking full advantage of modern technological advances to cut operating costs. To cite one example, the agency is replacing vacuum-tube rectifiers with solid-state rectifiers (semiconductor crystals) in its far-flung use of electronic equipment. The engineering studies and field tests for this program were conducted in fiscal 1966; replacement began this reporting period and is expected to be completed in fiscal 1968. Although crystal diodes are more expensive than electron tubes, they require less servicing, they have a longer life, they are less susceptible to accidental damage, and (because they dissipate little or no energy in the form of heat) they are almost infinitely more efficient. The net result is that they

are much more economical to use. The replacement program netted $266,800 in savings during this reporting period; it is expected to net still more in fiscal 1968.

Another source of cost avoidance has been Alaska's flight service station system, which is presently going through a modernization program. The objective of this program is to reduce the number of manned facilities while providing at the same time better and more far-reaching service, particularly in remote areas. Thus far, this program has yielded only $56,700 in savings (all of it this fiscal year); but, by fiscal 1970, when it is fully implemented, it is expected to yield a net annual saving of $265,000. (Actually, the annual saving to FAA will come to $575,000, but a rise in the U.S. Weather Bureau's annual costs will offset this to the extent of $310,000.)

Other actions contributing to FAA's cost-reduction program may be mentioned:

- The consolidation of flight inspection services in the Far East and the reorganization of the Pacific Region's Air Traffic Division netted a combined saving of approximately $290,000.
- FAA's study to determine the optimum operating hours at nonapproach control towers, which was begun in fiscal 1966, was expanded during this reporting period to include all types of control towers. Operating hours were reduced at eight towers in fiscal 1966 and at nine towers in fiscal 1967. The total savings realized in fiscal 1967 were $63,800. Current planning calls for reducing the operating hours at 18 additional towers during fiscal 1968.
- The continuing program to eliminate nonessential air traffic control and navigation facilities had realized savings of $1.3 million at year's end. A fiscal 1967 study on "Facility Essentiality and Colocation" is expected to give added impetus to this program in fiscal 1968.

Personnel Administration and Training

Fiscal year 1967 saw FAA reverse a 3-year downward trend in its personnel strength. At year's end, the number of agency employees stood at 44,328, or 771 more than the total on June 30, 1966 (but still 2,104 short of the agency's peak yearend personnel strength, registered in fiscal 1963). Current forecasts indicate that the agency's personnel strength will continue slightly upward during the next 5 years.

FAA continued its efforts to enhance the quality and competence of its employees by expanding old and introducing new programs to take better advantage of the agency's manpower resources. Among the more notable developments were those in the areas of manpower planning, career planning, and management training.

Personnel Administration.—FAA's heavy technical orientation leaves the agency more exposed to the effects of rapid technological change than most Federal agencies. Among these effects is the necessity of keeping the skills of the agency's work force in step with advancing technology. During

this reporting period, FAA inaugurated an integrated manpower planning program to identify future skill and skill-level requirements and plan for their orderly development. The program has been structured to be consistent with the agency's PPB system, annual fiscal programs, and the cycle of budget estimates.

The program calls for FAA managers to (1) identify and project skill requirements as much as 6 years into the future; (2) evaluate the skill characteristics of their current work force in relation to prospective needs; (3) identify actual or potential skill imbalances; (4) plan and make on a timely basis the required adjustments in work-force skills. All of this, it goes without saying, must be accomplished with minimal, if any, adverse effect on the agency's mission and its existing work force. FAA's announced intention in fiscal 1967 to complete the automation of its manpower and personnel data system by 1970 is in line with these objectives.

FAA's career planning program, which is one more facet of the larger manpower planning effort, is designed to inform supervisors and other employees alike of career progression paths and the particular skills the various FAA career fields require. To this end, FAA revised and improved its Flight Standards Service Career Planning Handbook, which covers approximately 5,000 FAA employees. The agency also had in draft at year's end a career-planning handbook for maintenance and airway facilities, which covers an additional 9,000 employees. In addition, work was well underway on similar career-planning guides for engineers and administrators. Finally, an agencywide program was launched to provide FAA employees having basic flight experience with an opportunity to pursue careers as general aviation operations inspectors.

The equal-employment opportunity (EEO) program continued to make progress during the fiscal year. The year's more notable achievements in the internal EEO program included:

- Reducing significantly the number of official complaints of discrimination by agency employees.
- Raising minority-group employment by nearly a full percentage point, from 6.2 percent of the total agency work force to 7.1.
- Designating an agency housing officer to determine the relationship between equal housing opportunities and the successful recruitment of minority-group employees.
- Conducting seminars on "Organizational Bias" in 10 major cities for the benefit of 350 regional and area managers.
- Setting up a minority-group statistics reporting system to measure progress made by the EEO program.
- Establishing a program to extend recognition to employees making significant contributions in the area of EEO.

The year's more notable achievements in the external EEO program included:

- Developing a plan of action to facilitate advance compliance with the EEO program by FAAP contractors and sponsors. The plan envisages personal visits with airport contractors and sponsors for educational discussions.
- Establishing basic FAA policy and guidelines for conducting preaward and post-award reviews of contractors and subcontractors subject to Federal EEO regulations. On the order of 37 percent of all FAA contracts are expected to be reviewed under these guidelines.
- Withholding approval of a number of contracts until the prospective contractors or subcontractors have submitted an acceptable program for complying with EEO regulations.
- Incorporating in the Federal Aviation Procurement Manual EEO requirements pertinent to procurement activities.
- Producing a film entitled "What About Billy Wilson?" designed to motivate minority-group students to prepare for and seek FAA employment.

In the area of personnel recognition and awards, agency participation in the Government-wide economy champion campaign was especially successful, with FAA receiving due recognition for its efforts from the Civil Service Commission (CSC). Six agency employees were designated economy champions during the course of the year; two of these received special recognition for their achievements at a public ceremony held by the CSC. Moreover, FAA played a major role in DOT's chalking up the highest dollar benefit among civilian agencies in this campaign. Of the $2.8 million in cost benefits realized by the Department, more than 98 percent was attributable to the performance and ideas of FAA employees.

FAA's efforts in the President's Mission Safety-70 program were also marked with notable success. The agency received the President's Safety Award for the best safety performance by any Federal agency of its size during calendar 1966. By the end of the reporting period, FAA was well on its way to attaining, perhaps even bettering, the Mission Safety-70 goal of reducing personal injuries (and their related costs) 30 percent by 1970.

Other achievements in personnel administration during fiscal 1967 follow:

- Development of a new-employee orientation package containing in a single folder all the information relating to personnel procedures that a new employee should have at his disposal when taking up his duties. The package describes the FAA personnel system and the employee's rights, privileges, and responsibilities.
- Grant of recognition to 65 employee organizations, bringing the total number recognized to 232. Exclusive recognitions rose from 90, at the end of fiscal 1966, to 146. Union members now make up approximately 25 percent of FAA's work force.
- Provision of additional services and amenities for FAA employees and their families living outside of the contiguous 48 States. This included: Bolstering housing, commissary privileges, and community facilities in Alaska; improving school transportation in Puerto Rico; instituting a free summer-school program on Wake; acquiring addi-

tional housing and securing commissary and base-exchange privileges on Guam.

- Negotiation of Civil Service Commission approval of special salary rates for FAA jet air carrier operations inspectors in an effort to slow down the steady loss of these employees to private industry. The new rates appear to be working effectively. In fiscal 1966, when the old rates were in force, FAA lost 20 jet air carrier inspectors; in fiscal 1967, only two were lost.
- Participation in a number of programs for disadvantaged youths. In such work, FAA: provided nearly 1,000 jobs during the summer of 1966 as part of the Youth Opportunity Campaign; completed a 14-week Neighborhood Youth Corps experimental course designed to assist out-of-school enrollees to achieve a GS–1 level of proficiency; worked with 327 youths during the fiscal 1967 Back-to-School Drive.
- Inauguration of a special on-the-job training program to increase the number of native Alaskans on the FAA Alaskan work force. Besides providing jobs and valuable technical skills for these people, the program will help reduce the high turnover, moving, and turnabout-leave costs now being absorbed by the Alaskan Region.

Management Training.—FAA's management training program is one of the more important factors underlying the agency's ability to do its job properly. In this area during the reporting period the agency—

- Prepared and distributed a new edition of the FAA Training Handbook. This edition consolidates FAA training policies and procedures and presents a new section on on-the-job training.
- Developed and tested at the FAA Academy a personal effectiveness development course for Flight Standards personnel, whose effectiveness in dealing with the public is essential to the proper discharge of their duties.
- Conducted a new compliance and security investigative training course for the benefit of compliance and security personnel at the Western, Alaskan, and Pacific Regions. The course seeks to improve the reporting and investigative skills of these personnel.
- Established agencywide the FAA management intern program, which was previously limited to FAA's Washington headquarters. The objective of the program is to recruit recent college graduates for training as future FAA managers.
- Prepared a new FAA management training handbook—"Personnel Management for Managers"—and simultaneously developed a new management training course based on the handbook.
- Inaugurated the MITTS (management improvement through team study) program, a supervisory training program open to all FAA employees. The program consists of an FAA Academy-administered correspondence course followed by workshop sessions.
- Reconstructed the management institute and executive school management training programs to reflect the newly emerging fiscal and systems-oriented management concepts being adopted by FAA.

OTHER ADMINISTRATIVE DEVELOPMENTS

Procurement

FAA's efforts to improve its procurement of goods and services were concentrated during fiscal 1967 on assuring that such procurement activities are carried out in a uniformly efficient and economical manner. To this end, the agency developed and published the Federal Aviation Procurement Manual, which codifies all agencywide regulations, orders, and procedures relating to procurement. The FAA Academy developed in turn a national procurement training program based on the new 2,300-page manual. This training program consists of a series of courses designed to provide FAA personnel engaged in procurement activities with the skills needed to carry out their duties effectively. Included in the curriculum are courses in contract placement and administration, small purchase transactions, pricing techniques, and personal-property administration.

In another development, the Washington procurement office gave special emphasis to devising a more efficient and more comprehensive property control system. The office also looked to the strengthening of contract administration by introducing new techniques, by establishing a production unit in the area of quality and reliability, and by increasing the emphasis placed on contract administration by quality and reliability personnel in the plants of FAA contractors.

Because some elements of the Department of Transportation—the Office of the Secretary among them—have no procurement capability of their own, FAA's Procurement Operations Division was assigned the task of procuring for these organizations. Processing for the 403 procurement actions involved a total of $1.2 million.

Legislative and Legal Activities

Legislation.—From the standpoint of FAA, the statute establishing a Department of Transportation (Public Law 670) was the most significant item of legislation enacted during this reporting period by the 89th Congress. Among other things, this legislation created within the new Department a Federal Aviation Administration, headed by a Federal Aviation Administrator. The act transferred to and vested in the Secretary of Transportation all the functions, powers, and duties of the Federal Aviation Agency and, in turn, transferred those duties of the Secretary pertaining to aviation safety to the Federal Aviation Administrator. FAA, then, was changed from an independent agency to a.. operating administration under a department headed by a secretary with Cabinet status.

Two pieces of legislation recommended to the Congress by FAA were also enacted into law during fiscal 1967. One of these, an amendment to the Federal Airport Act, extended the Federal-aid airport program for an additional 3 years, from fiscal 1968 to fiscal 1970, inclusive. The act authorized the Congress to appropriate up to $75 million for each of these years for grants-in-aid to airports. The other item of legislation was a

private law compensating three FAA employees for losses incurred in 1963 when their new duty assignments were abruptly canceled.

Litigation.—Since FAA has the task of maintaining safety in the skies, it often finds itself named a defendant in a damage suit arising out of an aircraft accident. The principal issue in such cases is usually whether the responsibility for an air accident lies with FAA's operation of the air traffic control system or with the pilot's operation of the aircraft. Ninety-five new damage suits were filed against the agency in fiscal 1967—down from 125 suits in fiscal 1966. This represented a decrease of approximately 25 percent. The agency closed 178 cases during the reporting period, or more than three times the number closed during the previous period. The total damages claimed against the agency in all aircraft accident cases at year's end stood at approximately $207 million.

In June 1967, the District Court of the United States for the Eastern District of New York handed down a significant decision *(American Airlines, Inc., et al.,* v. *Town of Hempstead)* dealing with the power of local governments to regulate air commerce. The Hempstead (N.Y.) City Council, seeking to regulate the level of aircraft noise over the town, had passed an ordinance having the effect of denying to interstate air carriers the landing approaches to and takeoff paths from John F. Kennedy International Airport. The court declared the ordinance invalid, holding (among other things) that State or local legislation denying access to navigable airspace was a trespass on the Federal power to regulate interstate commerce.

Occupational Health Program

FAA continued to pursue medical and health-fitness programs aimed at promoting employee efficiency. These programs include preventive-medicine procedures, the detection of environmental health hazards, general and specialized examinations of particular categories of employees, and emergency medical care.

Fiscal 1967 was the first full year of operation of the air traffic control health program. This program was established to provide the agency with psychophysical data vital in establishing policies for selecting, employing, and retiring air traffic controllers, who work under severe pressure during peak traffic hours. This reporting period saw an independent group of physicians and psychologists carefully evaluate the program (including the psychological testing procedures), recommend its continuation, and offer a number of suggestions for improving its effectiveness.

As was to be expected in the initial stages of a program of this kind, an unusually high number of medical problems were detected; by the same token, a sharp drop in such problems is to be expected in succeeding years. Altogether, 12,275 examinations were conducted during the reporting period, and approximately 800 waivers were granted.

The medical clinic in FAA's Washington headquarters building performed its usual yeoman service, giving physical examinations to agency executives, airmen, controllers, firemen, policemen, and employees with

suspected medical problems that might be affecting their job performance. The clinic also offered emergency medical care and such preventive medical procedures as polio and influenza immunization. The clinic's staff gave 2,507 physical examinations, handled 14,615 clinical visits, and conducted nearly 50,000 laboratory procedures during the year.

With the creation of the Department of Transportation, the medical clinic has undertaken to extend to DOT personnel working in the Washington headquarters building and elsewhere in the area the services provided FAA personnel. At year's end, a first-aid station was being established at the nearby Donohoe Building to care for DOT employees in that building. This station was expected to go into operation within a few weeks after the start of the new fiscal year.

Other developments in the employee occupational health program follow:

- Intensive studies of noise, radiation, sanitation, pollution, and other environmental health and safety problems were conducted by FAA's Aeromedical Services Division.
- A special survey team was established by the FAA Administrator to investigate working conditions at FAA field facilities, particularly the environmental surroundings of air traffic controllers.
- Studies of air traffic controller age and performance levels, factors which affect job placement and retirement programs, continued during the reporting period.
- The agency continued to arrange for medical specialists from Honolulu to make periodic visits to Wake Island to assist the two permanent general practitioners on the island.

Administrative Standards and Support

One of FAA's standing objectives is to provide maximum administrative support at minimum cost. By doing this the agency can apply a greater proportion of its manpower and dollars directly to aviation safety and other public-service missions. Some of the ways FAA has furthered this objective have already been mentioned. Other examples follow.

Automatic data processing (ADP) is a valuable administrative and record-keeping tool, not only because it is faster and more efficient than any manual process but also because it is cheaper in the long run. During this reporting period, the agency took a major step in expanding its ADP capabilities at its Washington headquarters by replacing its IBM 1401 with a new IBM 360/30. Besides being faster and more versatile than the 1401, the 360 is modular, and thus expandable in capacity with the agency's needs.

FAA sought to advance its reference and record-keeping capabilities in a number of other ways. Specifications were developed for converting its library information-retrieval system from a Termatrex (card system) to an ADP system. In addition, an information-retrieval capability was established between the NAS documentation effort at NAFEC and the agency's headquarters system. Finally, reference collections of all FAA General Counsel opinions were made available at all area offices.

In the area of records and paperwork management, the agency succeeded in eliminating one hundred thousand public applications yearly by making the student pilot certificate issuable by the aviation medical examiner with the appropriate medical certificate; formerly, it had to be obtained separately at another office. Five million punched cards—the equivalent of 70 file cabinets—were scheduled for disposal in the field. At the Washington headquarters, files occupying space equivalent to 3,035 cabinets were retired during a cleanout campaign. And to insure that records will be managed efficiently in the future, 56 new employees were indoctrinated in file operations and records management. A National Archives and Records Service audit of FAA's paperwork management program revealed that the program, though having its share of defects, rated in excellence second only to the U.S. Air Force's in the Federal Government.

As part of the effort to assure the most efficient and economical use of available space, FAA's services and regions are planning to colocate administrative space with air traffic facilities wherever feasible. An inventory of FAA administrative space revealed that the agency occupies 4.5 million square feet possessing a rental value of approximately $18 million. Twenty-two percent of the total space was found to be substandard, but most of this is already covered by new construction programs.

Support to DOT.—FAA contributed a substantial portion of the administrative support required to establish the Department of Transportation as a functioning organization. And because of its close proximity to the Office of the Secretary (OST), FAA continued to assist the new Department after its establishment on April 1, 1967. Some of the support services provided are noted below:

- Helped staff the Interagency Task Force and the various working groups created under the task force charged with planning for and implementing DOT's establishment. FAA officials served as chairmen of six of these working groups.
- Helped staff an interim OST personnel office charged with developing position descriptions, screening job applicants, and performing other personnel services required by other elements of the new Department.
- Provided OST and other DOT elements with motor transportation, mail, communications, printing, clerical, security, library, and other administrative support services.
- Obtained suitable office space for OST and other DOT elements. The entire eighth floor of the Washington headquarters building was made available to OST, and a lease was secured for the Donohoe Building, at 6th and D Streets SW., to accommodate portions of the Federal Railroad and Federal Highway Administrations and those portions of OST that could not be accommodated on the eighth floor of the headquarters building.

Federal Executive Organizations

FAA's participation in the activities of Federal executive organizations remained one of the more notable examples of FAA field executives working in concert with field executives of other Federal agencies. During this reporting period, FAA officials were members of nine Federal Executive Boards (FEB's), Federal Executive Associations (FEA's), or lesser local organizations. Some of these officials held positions of leadership in these organizations. FAA regional directors chaired the New York City and Los Angeles FEB's. In Honolulu, the director of FAA's Pacific Region was president of the Federal Executive Association; when this organization became a Federal Executive Board during fiscal 1967, he became chairman. The Kansas City (Mo.) FEB elected an FAA regional director as its chairman for fiscal 1968. In addition, an FAA regional director served as the vice chairman of the Atlanta FEB, and the Anchorage FEA had an FAA regional director as its president. Finally, FAA officials in Forth Worth, Oklahoma City, and Atlantic City were active members of local Federal organizations in those cities.

Illustrating the kind of cooperative tasks Federal executive organizations can undertake were the activities of the FAA-chaired Alaskan Interagency Committee on Housing Rental Rates, which functions under the auspices of the Anchorage Federal Executive Association. Composed of representatives of all Federal agencies renting living quarters to Government employees in Alaska, the Committee seeks, among other things, to establish comparability in Federal rental rates in Alaska, where the ownership and operation of housing present special problems. During this reporting period, the Committee concentrated most of its energies on sponsoring a study to establish a new Government rent structure. The study, which was conducted by a private consulting firm, revealed that Government housing was renting at a considerably lower rate than comparable privately owned housing. At year's end, informal discussions were being conducted with the Bureau of the Budget in an effort to develop a common course of action and to arrive at a rate equitable to both Government and Government employee.

Aviation War Risk Insurance

On April 1, 1967, the aviation war risk insurance program—authorized by Title XIII of the Federal Aviation Act of 1958, as amended—was transferred, pursuant to the Department of Transportation Act, from the Department of Commerce to the Department of Transportation. Subsequently, it was delegated by the Secretary of Transportation to the Federal Aviation Administrator.

Under this authority, the Federal Aviation Administration has maintained a standby insurance binder program which would make available aviation war risk insurance upon an outbreak of war.

In addition, at the request of the Department of Defense, aviation war risk insurance is being provided U.S. civil air carriers under contract to

the Military Airlift Command (MAC) for airlift services, including overseas destinations in areas where warlike actions may be encountered.

Active insurance policies were effective covering a total of 468 aircraft currently engaged in military civil contract operations or which are committed to the Department of Defense in the event of an emergency. Maximum contingent hull liability under these policies amounted to approximately $2 billion. Insurance binders also were effective covering 48 aircraft. Applications for insurance coverage of additional aircraft were being processed.

Revenue for the fiscal year 1967 was $18,000, and administrative expenses, of which $6,000 was charged to the "Operations" appropriation, totaled $22,000. Retained earnings at the beginning of the year were $47,000; at the end of the year, $49,000.

APPENDIX A

U.S. AIR CARRIERS—ACCIDENTS, FATALITIES, AND RATES: CALENDAR YEARS 1955–66

Year	Number of Accidents[1]		Aircraft-miles flown (000)[2]	Accident rate per 1 million miles flown[3]		Fatalities[4]				Passengers carried[5]	Passenger-miles flown (000)[2]	Passenger fatality rate per 100 million passenger-miles[6]
	Total	Fatal		Total accidents	Fatal accidents	Total	Passengers	Crew	Others			
1955	93	17	862,787	0.107	0.019	227	185	37	5	42,232,555	26,547,895	0.70
1956	103	9	993,055	.104	.009	174	156	18	0	46,352,843	29,465,957	.53
1957	112	13	1,089,727	.102	.011	97	72	20	5	49,655,519	33,001,466	.22
1958	91	14	1,084,652	.084	.013	160	128	29	3	49,529,396	33,650,121	.38
1959	101	18	1,155,520	.087	.016	340	271	61	8	56,897,612	39,395,165	.69
1960	90	[7] 17	1,130,069	.079	.012	465	400	52	13	58,944,499	42,692,503	.94
1961	84	11	1,104,042	.076	.010	311	275	35	1	59,390,148	43,244,587	.64
1962	70	10	1,170,374	.059	.008	285	242	40	3	63,371,782	47,642,497	.51
1963	77	13	1,231,312	.063	.011	264	223	41	0	[8] 71,437,828	54,237,143	.41
1964	79	13	1,336,867	.058	.009	194	161	32	1	82,436,762	62,524,506	.26
1965	83	9	1,536,395	.054	.006	261	226	35	0	95,722,520	74,285,572	.30
1966[9]	78	8	1,768,451	.044	.005	272	137	27	108	110,988,467	87,275,073	.16

[1] Total accidents for all U.S. certificated route air carriers and supplemental carriers; data include accidents caused by sabotage.
[2] Data are for U.S. certificated route air carrier scheduled domestic and international passenger services; and supplemental carriers.
[3] Accident rates exclude accidents due to sabotage. (Nov. 1, 1955—39 passengers, 5 crew; July 25, 1957—1 passenger; Jan. 6, 1960—29 passengers, 5 crew; May 22, 1962—37 passengers, 8 crew; May 7, 1964—41 passengers, 3 crew.)
[4] Fatalities and passenger fatality rates exclude fatalities involved in sabotage accidents mentioned in footnote 3.
[5] Includes 3 midair collisions nonfatal to air carrier occupants which are excluded in computation of fatal accident rates.
[6] Data are for U.S. certificated route air carrier scheduled domestic and international passenger service. Data for supplemental carriers are not available.
[7] Preliminary.

Source: National Transportation Safety Board.

APPENDIX B

GENERAL AVIATION—ACCIDENTS, FATALITIES, AND RATES: CALENDAR YEARS 1955–66

Year	Hours flown (000)[1]	Total accidents [2]	Rate [3]	Fatal accidents [2]	Rate [3]	Total fatalities [2]	Rate [3]
1955	9,500	3,343	35.1	384	4.0	619	6.5
1956	10,200	3,474	34.0	356	3.4	669	6.6
1957	10,938	4,200	38.4	438	4.0	800	7.3
1958	12,579	4,584	36.4	384	3.1	717	5.7
1959	12,903	4,576	35.5	450	3.5	823	6.4
1960	13,121	4,793	36.5	429	3.3	787	6.0
1961	13,602	4,625	34.0	426	3.1	761	5.6
1962	14,500	4,840	33.4	430	3.0	857	5.9
1963	15,106	4,690	31.0	482	3.2	893	5.9
1964	15,738	5,070	32.2	504	3.2	1,056	6.7
1965	16,733	5,196	31.1	538	3.2	1,029	6.1
1966	21,023	5,425	25.8	538	2.6	1,069	5.1

[1] Estimated hours flown 1958–61 and 1963 are based on inspection report (FAA Form 2350) and have been revised by a correction factor drawn from the 1962 survey of aircraft use in general aviation. The 1962 figures are taken directly from the survey of that year.
[2] 1957–66 CAB data. 1966 data are preliminary.
[3] Rates are per 100,000 hours flown

AIRCRAFT MODELS CERTIFICATED, FISCAL YEAR 1967

Category	Make	Model	Make	Model
TRANSPORT	Boeing	707-337C -340C -341C -355C -365C -385C -387B 727-21C -25C -29 -29C -30C -31C -61 -62C -64 -82	Boeing	727-90C -92C -108C -109 -191
			Douglas	DC-8-61 -61F -62 -63 DC-9-15F -31 -32
			Fairchild Hiller	FH-227B
			Hamburger Flugzeugbau	HFB 320 Hansa
			Lockheed	282-44A-05 (C-130B)
			North American	NA-265-60
			Piaggio	PD-808
HELICOPTER	Bell	206A	Sikorsky	S-61A, S-61D, S-61V
	Fairchild Hiller	FH-1100		HRS-3/H-19B, H-19D, H-19G
	Hughes	269A-2 369A, 369H		
BALLOON	Semco	30-AL		

APPENDIX C

AIRCRAFT MODELS CERTIFICATED, FISCAL YEAR 1967—Continued

Category	Make	Model	Make	Model
BUSINESS AND GENERAL (Except Helicopters)	Aero Commander	B–1A	C. Itoh	N–62
		680V	Lockheed	1329–23E (JetStar)
	Alon	A–2A	Maule	M–4–220, M–4–220C, M–4–220S, M–4–220T
	Beagle	B.206 Series I		
	Beech	A65		
		56TC	Mitsubishi	MU–2B–10
	Bellanca	17–30	Mooney	M20F
	Cessna	172I		M22
		182	Navion	H
		TP206B, TU206B, U206B	Pilatus	PC–6/B–H2, PC–6/B1–H2, PC–6/C–H2
		210G, T210G		
		310L	Piper	PA–25–260 (Part 3)
		320E, 320F		PA–25–260 (Part 8)
		T337B		PA–28R–180
		401		PA–31
		402		PA–32S–300
		411A	Short Brothers & Harland	SC7
		421	Swearingen	SA–26T
	Champion	7KCAB	Ted Smith	Aerostar 360
	Helton	Lark 95	Weatherly	201
	Intermountain (IMCO)	A–9B	Wing	D–1
GLIDER	Societe C.A.R.M.A.M	M–200 Foehn	Schleicher	AS–K13
	Entwicklungsgemeinschaft Flug- und Fahrzeugwerke AG.	Phoebus A1, B1	Schweizer	SGS 2–33
		HBV "Diamant"	Szybowcowy Zaklad Doswiadczalny.	SZD–24–4A "Foka–4"

APPENDIX D

FEDERAL AVIATION ADMINISTRATION REPORT OF FUND STATUS ON JUNE 30, 1967

(Thousands of dollars)[1]

FY 1967 Appropriation	Carryover of uncommitted balances from FY 1966	FY 1967 appropriation	Reimbursements earned FY 1967	Total available resources	Obligations incurred FY 1967	Uncommitted balances	
						Returned to U.S. Treasury	For carryover into FY 1968
Research and Development	22,989	28,500	769	52,258	35,466	----------	16,792
Operations	----------	575,319	13,580	588,899	586,303	2,596	----------
Facilities and Equipment	186,456	28,000	12,877	228,333	97,530	----------	130,803
Operations and Maintenance, Washington National Airport	----------	3,821	227	4,048	3,971	77	----------
Operations and Maintenance, Dulles International Airport	----------	4,705	163	4,868	4,798	70	----------
Construction, Washington National Airport	3,978	----------	----------	3,978	495	----------	3,483
Construction, Dulles International Airport	3,817	----------	----------	3,817	676	----------	3,141
Grants-in-Aid for Airports	65,173	71,000	----------	136,173	61,389	----------	74,784
Civil Supersonic Aircraft Development	53,069	280,000	----------	333,069	189,827	----------	143,242
Aviation War Risk Insurance Revolving Fund [2]	----------	41	8	49	----------	----------	49
Totals	335,482	991,386	28,624	1,355,493	980,456	2,743	372,294

[1] Fiscal Year 1967 appropriations only.
[2] Transferred from Department of Commerce effective 4/1/67.

APPENDIX E

FEDERAL AVIATION ADMINISTRATION STATEMENT OF FINANCIAL CONDITION

(Thousands of dollars)

Assets	June 30 1967	June 30 1966	Liabilities and equity	June 30 1967	June 30 1966
Cash			Liabilities		
Funds with U.S. Treasury	$ 725,680	$ 619,512	Current		
Trust and Deposit Funds	31,580	28,852	Accounts Payable and Accrued Liabilities		
	$ 757,260	$ 648,364	Federal Agencies	$ 8,322	$ 5,489
Accounts Receivable			Other	89,746	40,674
Federal Agencies	$ 19,196	$ 15,472		$ 98,068	$ 46,163
Other	[1] 22,538	2,744			
	$ 41,734	$ 18,216	Other		
Inventories			Trust and deposit fund liabilities	$ 31,590	$ 30,577
Stock and Stores	$ 106,412	$ 117,038	Employee's accumulated leave	44,553	43,837
Work-in-process	7,852	551	Allocation from other agencies	1,778	743
Other special materiel	17,855	17,793	Assets on loan to FAA	6,460	6,654
	$ 132,119	$ 135,382	Deferred credits	129	9
Fixed Assets (net)				$ 84,510	$ 81,820
Land	$ 21,278	$ 12,355			
Buildings, structures and facilities	431,579	434,051	Total Liabilities	$ 182,578	$ 127,983
Equipment	606,252	592,916			
	$1,059,109	$1,039,322	Equity		
Work in progress	182,628	[2] 137,457	Unexpended appropriations	$ 744,946	$ 635,274
	$1,241,737	$1,176,779	Capitalization of assets	1,235,939	1,216,078
Other Assets	613	594	Total Equity	$1,990,885	$1,851,352
Total Assets	$2,173,463	$1,979,335	Total Liabilities and equity	$2,173,463	$1,979,335

[1] Includes advances of $18,156 to contractors for manufacture of equipment.

[2] Includes advances of $8,630 to contractors for manufacture of equipment.

Appendix F

GLOSSARY OF FEDERAL AVIATION TERMS

Aeronautical Center (AC).—FAA's center at Oklahoma City, Okla., for training personnel and the modification and maintenance of aircraft.

Airman.—A pilot, mechanic, or other licensed aviation technician.

Air navigation facility.—Any structure, equipment, or device used in air navigation or air traffic control. By definition in the Federal Aviation Act of 1958, the term also includes landing areas.

Air route surveillance radar (ARSR).—A long-range radar (approximately 150-mile radius) used by air route traffic control centers to control air traffic between terminals.

Air route traffic control center (ARTCC).—An operating facility, commonly called a center, which provides air traffic control service to airplanes operating under instrument flight rules (see *IFR*) within controlled airspace, principally during the enroute phase of flight.

Air traffic control (ATC).—A service provided for the purpose of keeping aircraft flying under instrument flight rules (see *IFR*) safely separated while operating in controlled airspace—taking off and climbing, en route, and when approaching and landing at air terminals. In general, aircraft flying under instrument flight rules are monitored by air traffic controllers using radar and direct radio communications between pilots and controllers.

Air traffic control radar beacon systems (ATCRBS).—The form of secondary radar used in the common system for air traffic control. It consists of ground-based interrogators and airborne transponders coded to provide identification and positional information.

Airport surface detection equipment (ASDE).—Radar that shows the movement of aircraft and other vehicles on the ground at an airport: a valuable tool for the ground control of airport traffic at night and during low visibility.

Airport surveillance radar (ASR).—A short-range radar system that maintains constant surveillance over aircraft at the lower levels of flight, normally within a 30-mile radius of an airport. The altitude coverage ranges from 10,000 to 30,000 feet.

Airways.—Designated paths through the airspace in two layers—a lower structure extending generally from 1,000 feet above the surface to 18,000 feet, and a jet route system from 18,000 to 45,000 feet. Airspace above 45,000 feet is reserved for point-to-point operations on a random routing basis. (This designation of the airway structure became effective on September 17, 1964.)

Combined station/tower (CS/T).—A control tower equipped to provide aircraft in flight with the services usually performed by a flight service station.

Continental control area.—All airspace at and above 14,500 feet mean sea level (MSL) over the 48 States, excluding prohibited and restricted areas. VFR traffic is not permitted in this area when visibility is less than 5 miles.

Control tower.—A facility for controlling traffic in the vicinity of and on an airport.

Federal Aviation Regulations (FAR's).—Mandatory requirements and standards issued by FAA to govern civil aviation activities. The FAR's cover such subjects as airworthiness certification of aircraft; certification of airmen; operation of aircraft in all phases of flight; airspace and traffic control management; maintenance and repair of aircraft and their components; and the operation of schools teaching flying, the maintenance and repair of aircraft, or other airman skills. The FAR's are a streamlined codification of the former Civil Air Regulations, Special Civil Air Regulations, Civil aeronautics manuals, and the Regulations of the Administrator, which was completed in fiscal 1965.

Flight information region (FIR).—An airspace of defined dimensions within which flight-information and alerting services are provided. These services cover such matters as navaids, collision hazards, and weather.

Flight service station (FSS).—A facility having the prime responsibility for preflight pilot briefing, en route communications with VFR flights, assisting lost VFR aircraft, originating Notices to Airmen, broadcasting aviation weather information, accepting and closing flight plans, monitoring radio navigation aids, participating with search and rescue units in locating missing VFR aircraft, and operating the national weather teletypewriter systems. In addition, at selected locations, FSS's take weather observations, issue airport advisories, administer airman written examinations, and advise appropriate customs and immigration officials of transborder flights.

Ground-controlled approach (GCA).—The radar system developed to give direction, distance, and elevation along a fixed approach path to an airport. The ground controller at the radarscope communicates instructions to the pilot to direct the aircraft along the approach path.

IFR.—Abbreviation indicating a flight is under instrument flight rules. IFR flight prevails when weather conditions fall below the minimum ceiling (1,000 feet) and visibility (3 miles) prescribed for flight under visual flight rules (VFR). In order to fly IFR, a pilot must pass an instrument flight test and receive a special instrument rating from FAA. When operating under IFR, a pilot is required to report his position to an air traffic control center from designated fixed locations throughout the flight.

Instrument landing system (ILS).—A facility consisting of four ground radio transmitting stations, at and in the vicinity of an airport, which radiate direction and position signals to approaching aircraft. The signals are received on an instrument in the aircraft and alert the pilot to any deviation from the safe approach path to the correct touchdown point on the runway. The signals can be fed directly to the autopilot for automatically controlled approaches.

International Civil Aviation Organization (ICAO).—A specialized agency of the United Nations system whose objectives are to develop the principles and techniques of international air navigation and foster planning and development of international air transport.

MSL.—Abbreviation for mean sea level, the base commonly used in measuring altitudes.

National Aviation Facilities Experimental Center (NAFEC).—FAA's experimental center at Atlantic City, N.J., where research and experimental testing are conducted and aviation equipment and procedures are evaluated.

Oceanic control area (OCA).—An area for which the United States, through agreement with other nations of the International Civil Aviation Organization (ICAO), exercises control over all aircraft.

Peripheral communication installations.—Air-ground facilities by which the pilot and air traffic controller talk directly. These facilities provide coverage to the periphery of the designated control area.

Positive control.—A service in designated controlled airspace, whereby air traffic controllers provide positive separation by radar and/or radio to all aircraft, regardless of weather conditions.

Precision approach radar (PAR).—Radar used by traffic controllers in a ground-controlled approach to "talk" a pilot on final approach down a prescribed path leading to the runway.

Prohibited area.—Airspace where flight is prohibited—as, for example, over the White House.

Radar.—An electronic device that locates an aircraft by transmitting pulses of radio energy toward it and timing the echo's return. Reflected on the cathode-ray tube of a radar console, the echo, called a blip, furnishes the controller with the actual position of the aircraft. The term "radar" is derived from the words "radio detection and ranging."

Primary radar is distinguished from *radar beacon*, or *secondary radar*. —Primary radar involves the use of an echo of radio energy, as just described. The radar beacon, dispensing with the echo, makes use of a radio transmitter/receiver (interrogator) on the ground and a radio receiver/transmitter (transponder) aboard the aircraft. When radio pulses transmitted by the interrogator are received by the transponder, they trigger transmission of a reply in the form of a distinctive signal. This signal from the transponder, rather than an echo, is received at the site of the interrogator and identifies the aircraft.

Radar approach control (RAPCON—U.S. Air Force) and

Radar approach control center (RATCC—U.S. Navy).—Military radar stations that control arriving and/or departing IFR traffic at Air Force and Navy bases. At certain locations RAPCON's and RATCC's are operated by FAA personnel.

Radar handoff.—Transference of radar identification and control (or advisory jurisdiction) over an aircraft from one controller to another without interrupting surveillance.

Radio range.—A radio facility which defines navigational courses, providing a track type of guidance.

Restricted area.—An area in which there is a hazard, generally invisible, to flight or navigation, such as aerial gunnery, artillery fire, or the launching of guided missiles. Permission must be obtained before a flight may enter such an area when it is in use. Restricted areas are noted on navigation charts.

SAGE.—A ground air-defense system in which reporting devices feed into an electronic computer that digests, memorizes, and displays the air situation shown by the reports and then, when decision for action is fed into it, translates the decision into orders to the various air defense combat units. The name is derived from the words "semiautomatic ground environment."

Separation.—Spacing of aircraft for safe and orderly movement while taking off, in flight, or landing. Standards are applied to separate aircraft vertically, laterally, and longitudinally.

Side-lobe suppression (SLS).—Technique to suppress the replies from transponders which are being interrogated by the side lobes rather than the main beam of radiofrequency energy. In effect, it reduces the problem of false targets appearing on the control scope.

TACAN.—A military navigation aid that provides distance and direction information to appropriately equipped aircraft. The term is derived from the words "tactical air navigation."

VFR.—Abbreviation used to designate flight under visual flight rules. VFR is also known as the "see and be seen" category of flight. The other category is IFR (instrument flight rules).

VOR (very high frequency omnidirectional radio range).—A ground radio station that provides 360 courses radiating like the spokes of a wheel. With the proper airborne receiver, a pilot can fly any selected course to or from the station.

VORTAC.—A combination of the civil VOR and the military TACAN. It is an electronic navigational system that gives the pilot his direction and distance from the VORTAC ground site, thus providing track guidance and position location at all times. VORTAC ground components may be used by both civil and military aircraft.

V/STOL (vertical/short takeoff and landing).—A term categorizing aircraft capable of very steep climbs and descents and of using very short runways or small areas for takeoffs and landings.

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