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# REPORT TO THE CONGRESS

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## Department Of Defense Use Of Flight Simulators-- Accomplishments, Problems, And Possible Savings

**BY THE COMPTROLLER GENERAL  
OF THE UNITED STATES**

PSAD-75-95

JUNE 24, 1975

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COMPTROLLER GENERAL OF THE UNITED STATES  
WASHINGTON, D.C. 20548

B-157905

(1) To the President of the Senate and the  
Speaker of the House of Representatives

We reported to the Congress in 1973 that greater use of flight simulators could lower costs and increase the quality of military pilot training (B-157905, Aug. 9, 1973). Since substantial cost savings and other potential benefits are involved, we followed up to assess the progress and problems of the Department of Defense in applying simulator technology to the management of flight and proficiency training.

This report describes how the Department of Defense is using flight simulators in its flight training programs and suggests improvements that would lead to increased training and safety benefits, cost savings, and conservation of fuel aircraft, and other resources.

Our review was made pursuant to the Budget and Accounting Act, 1921, (31 U.S.C. 53), and the Accounting and Auditing Act of 1950 (31 U.S.C. 67).

We are sending copies of this report to the Director, Office of Management and Budget; the Secretary of Defense; and the Secretaries of the Navy and the Air Force.

A handwritten signature in cursive script, appearing to read "James B. Atchafalua".

Comptroller General  
of the United States

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#### ABBREVIATIONS

AFLC	Air Force Logistics Command
CNO	Chief of Naval Operations
DOD	Department of Defense
FAA	Federal Aviation Administration
GAO	General Accounting Office
MAC	Military Airlift Command
NTEC	Naval Training Equipment Center
OSD	Office of the Secretary of Defense
SAC	Strategic Air Command

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D I G E S T

1, 2 GAO found that Air Force and Navy commands, operating large multiengine aircraft, have not used existing simulator equipment to its full potential because of various constraints and problems. These were primarily managerial and attitudinal, rather than technological.

Individual services have initiated programs to evaluate their training programs and simulator requirements. To support these efforts, funding requests have increased from \$88.5 million for fiscal year 1974 to \$283 million for fiscal year 1975. The fiscal year 1976 request is for \$247.5 million. (See pp. 24 and 25.)

Acquiring modern simulators offers no assurance that the desired cost savings and training benefits will be realized. Strong mandates and incentives are needed to insure that maximum effective use is made of simulators and that unnecessary flying is eliminated.

3 The Secretary of Defense should:

- Revise basic policies, regulations, and management procedures governing flight training and use of simulators to encourage their maximum effective use instead of flying. (See pp. 7 to 10.)
- Improve procedures and controls for maintaining simulators in an up-to-date and fully operable condition and insure they are used to their full potential. (See pp. 12 to 14 and 16 to 23.)
- Reevaluate the need for proficiency flying to maintain basic flying skills and consider potential substitution of simulator training for this purpose. (See pp. 14 and 15.)

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- Increase coordination between services and commands in developing and acquiring simulators. (See pp. 27 and 28.)
- Streamline procedures for funding simulator programs to improve their priority and insure coverage of all program elements. (See pp. 25 to 27.)
- Justify simulator acquisitions in terms of reduced flying, cost savings, and training benefits. (See pp. 25 to 27.)

The Department of Defense agreed that problems GAO identified have adversely affected utilization of simulators. The Department said it had recently started to correct many of the problems and would continue to seek further improvement. (See pp. 31 to 34.)

The Congress may wish to consider matters in this report in connection with the military departments' request for funding simulator development, acquisitions, and related support facilities.

Focus of this consideration should be to determine how acquisition of advanced simulators will affect flight training operations, manpower requirements, and aircraft acquisitions in terms of potential cost savings and reduced flying.

## CHAPTER 1

### INTRODUCTION

GAO previously reported to the Congress that the military services could lower costs and increase pilot proficiency by making greater use of flight simulators (B-157905, Aug. 9, 1973). The report cited the potential cost savings if flying were reduced and pointed out that increased use of simulators could help ease projected fuel shortages and enhance the safety and effectiveness of pilot training programs. This review was undertaken to (1) evaluate actions being taken by the military to increase its use of simulators and (2) identify any specific needed improvements in the management and use of existing equipment.

Several other recent studies of the military's use of flight simulators have arrived at conclusions similar to those in our current review. A July 1973 Office of Management and Budget staff study reported that substantial expansion of the Department of Defense (DOD) simulator programs was essential immediately to reverse the effects of rapidly escalating costs associated with aircraft procurement and operations. Subsequent to the completion of our fieldwork on this review, the Air Force Audit Agency issued a report entitled "Flight Simulator Utilization and Configuration Control." The report discussed conditions similar to those we found and concluded that these conditions prevented the Air Force from obtaining the maximum simulator training benefit at the least cost.

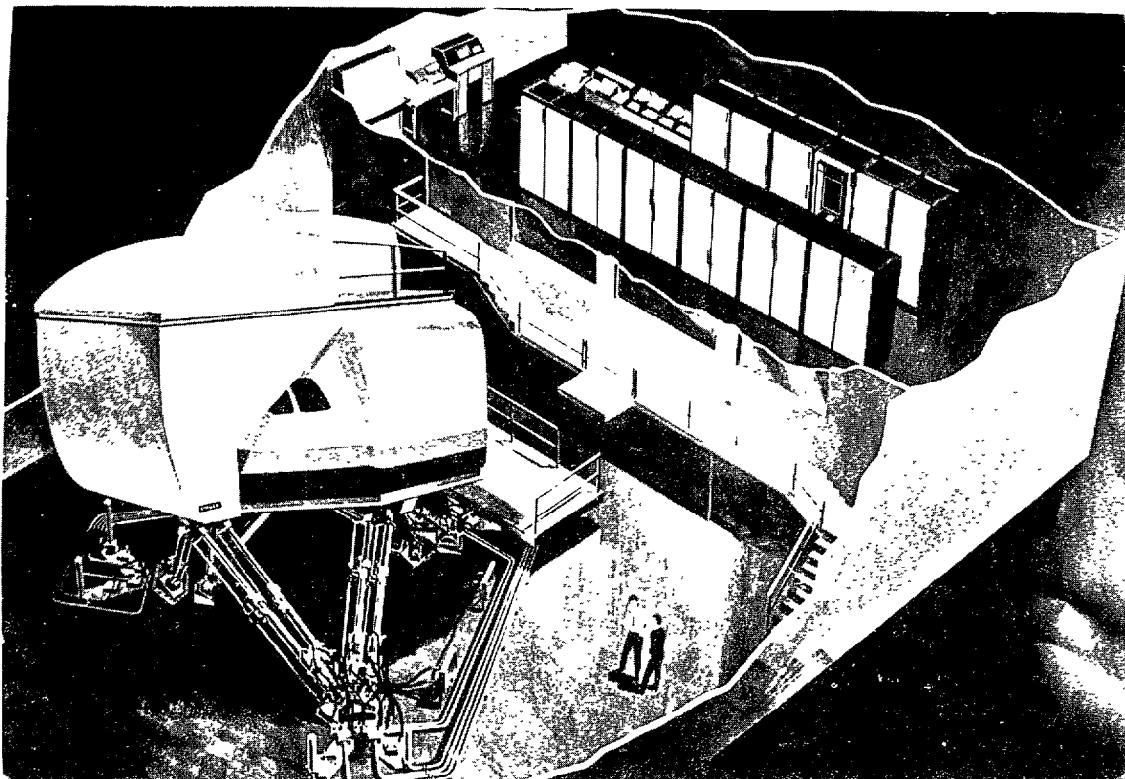
#### WHAT A FLIGHT SIMULATOR IS

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The term "flight simulator" usually refers to a device which depicts in varying degrees the flight and/or operational characteristics of a particular airplane configuration. It is used primarily for training pilots and copilots. In the military, such devices may also be known as operational flight trainers or weapons systems trainers or by other special terminology.

These devices vary considerably in design, complexity, realism, and training purposes. In the late 1940s, analog computers were used to try to simulate certain cockpit and flight characteristics of a particular airplane. More

sophisticated simulators have since been developed which use digital computers and modern electronics technology to produce more realistic flight dynamics--motion, visual, and instrumentation. A commercial airline's L-1011 simulator, shown below, is one example of the current state of the art in simulator technology.



ARTIST'S CONCEPTION OF L-1011.

Simulators, such as navigational trainers and electronic warfare simulators used by the Air Force and various tactics trainers used by the Navy, also have been developed for training other military flight crew members. Simulators, such as the Navy's S-3A Weapons System Trainer shown on page 5, can be used for individual crew station training or for integrated training exercises for an entire flight crew.

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One of the major attributes of a simulator is that it can provide valid training without the use of an actual aircraft. The operating costs for the Navy and Air Force aircraft included in our review range from \$530 to \$2,752 an hour. The cost of operating simulators for Navy aircraft range from \$44 to \$90 an hour, depending on the complexity and sophistication of the device. Operating and support costs for Air Force simulators are not currently available; however, the Air Force is preparing a directive which will require the collection of these costs for all simulators in use. A report is due in the first quarter of fiscal year 1976.

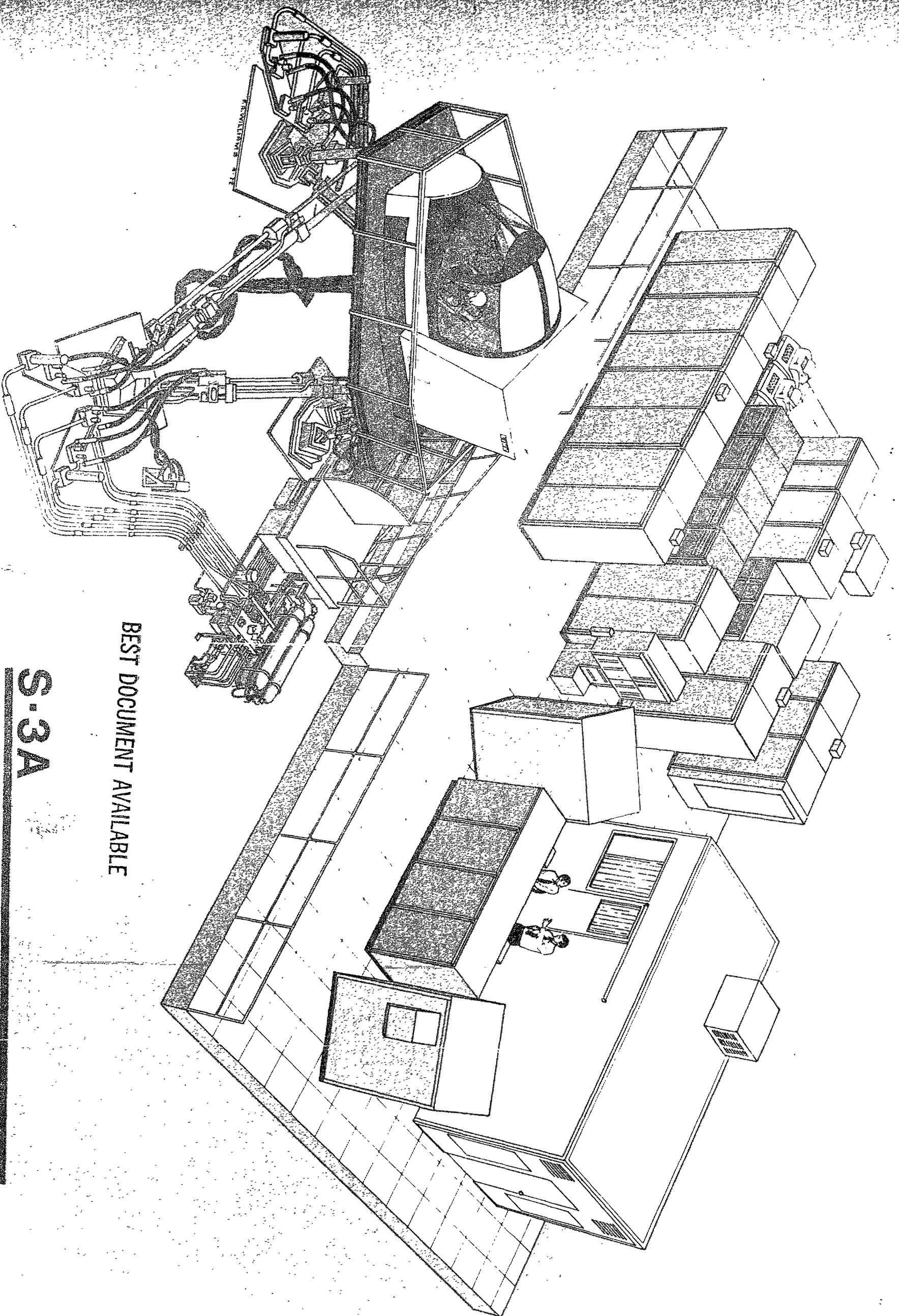
#### SCOPE OF REVIEW

We selected Air Force and Navy training programs and requirements for initially qualifying, upgrading, and maintaining proficiency of pilots and crews for cargo, bomber, and patrol types of aircraft. Our review was limited generally to large, multiengine aircraft because certain of their operations are comparable to those of the commercial airlines and because suitable simulators were more likely to be available for such aircraft and their missions.

The DOD and military organizations and commands covered in our review are shown in appendix I. A summary of the aircraft cockpit simulators included in our review are shown in appendix II. We obtained information from a number of commercial airline companies and from representatives of the Airline Pilots Association and the Air Transport Association.

The specific findings and deficiencies identified in our review may not be representative of all military flying commands and operations. For example, basic pilot training and fighter-type aircraft were not covered. However, the basic issues addressed and improvements needed should be considered as potentially applicable to all military flying operations.

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## CHAPTER 2

### STRONGER MANDATES NEEDED

#### TO SAVE FLYING TIME

Although the military services have taken some steps to increase simulator development and use, there continues to be resistance to substitution of simulators for flying time. More emphasis on the use of simulators is required if flying time is to be reduced and if the services are to effectively use simulator technology. Particular emphasis is needed to change

- management and attitudinal constraints which inhibit reduction of flying and
- policies and regulations in the Office of the Secretary of Defense (OSD), the Air Force, and the Navy which discourage using simulators instead of flying.

#### MANAGEMENT AND ATTITUDINAL CONSTRAINTS

Commercial air carriers seeking to reduce costs and maximize profits are strongly motivated to accomplish as much training as possible in simulators rather than on nonrevenue-producing training flights. The military flying commands have no comparable profit motive to use simulators to reduce aircraft flying time. The military commander is allocated a certain amount of flying hours, funds, and other resources each quarter, or fiscal year, to accomplish his training and other assigned missions. Within these budgetary constraints, the commands are motivated to use all allocated flying hours.

Most flight training and upgrade requirements are stated only as minimums. Except for proficiency flyers, the maximum number of exercises and hours an individual can fly to train or upgrade is generally left to the discretion of the local commander, who makes his decision largely on the basis of the number of aircraft and flying hours allocation available and the relative priorities of planned or requested flight missions.

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The effects of the "use 'em or lose 'em" incentives referred to above are illustrated in the following examples:

--Officials at a Military Airlift Command (MAC) base told us that they try to fly within plus or minus 2 percent of the allotted hours. Even though unneeded flying hours could be returned to MAC headquarters for use elsewhere, this does not always happen. We were told that flights were sometimes initiated to use up allotted hours. Analysis of flying performed at this base during calendar years 1972 and 1973 showed that C-5 and C-141 aircraft flew 97.8 and 100.1 percent, respectively, of their allotted flying hours.

--In discussing the use of sonobuoys used in anti-submarine warfare training, a Navy officer said that "at present \$70 million are budgeted annually for this program. While it is emphasized that we must continue to use up our stocks to justify their existence, we must effect overall savings." (See p. 12.)

Another major obstacle is that flying personnel, particularly pilots, enjoy flying and are reluctant to give it up or have it reduced by simulator time. Nearly all the flyers we interviewed spoke highly of the value of simulators for certain types of training, such as emergency and weather condition procedures. However, their attitudes about using simulators to substitute for rather than supplement flight training changed somewhat. Reduction in individual flying time was cited as one drawback to increased use of simulators. One pilot put it more forcefully when he said, "I didn't join the Air Force to drive a truck."

#### BASIC POLICY AND REGULATION CONSTRAINTS

Basic Air Force and Navy flight policies and regulations do not encourage maximum effective use of flight simulators. Since little, if any, credit is allowed for simulator time, flying personnel are encouraged to fly as much as possible to meet proficiency and currency requirements, to qualify for advanced aeronautical ratings, and to further their military careers. In effect, existing flight policies and

regulations are hindering progress in achieving the cost savings and training benefits available through increased use of simulators.<sup>1</sup>

Air Force Manual 60-1, which establishes minimum annual flying hours for aircrew members, generally does not allow substitution of simulator time for any of these requirements. This policy appears to be contrary to one of the basic purposes for acquiring simulators--providing valid training without the use of an actual aircraft.

Navy flight instructions (OPNAVINST 3710.7G) give limited recognition to simulator time by allowing aviators not assigned to operational flying billets to substitute time in simulators for up to 10 percent of their 100-hour annual minimum flying requirement. The Navy instructions also state that requirements for instrument ratings and aircraft qualification must be met in actual aircraft. By contrast, the Federal Aviation Administration (FAA) now allows airlines to accomplish most of their aircrew proficiency flight checks in simulators--particularly checks for instrument ratings.

Many subordinate commands have also established minimum aircrew training and proficiency requirements. Although these requirements call for more flying hours than the annual minimum required by headquarters instructions, little, if any, substitution with simulator time is permitted. MAC, for example, allows credit for only 20 hours simulator time toward its annual currency requirements of 180 flight hours. The simulator hours substituted are not recognized as meeting basic Air Force Manual 60-1 flying requirements. Centralized records were not available to show the extent to which simulators may have been substituted in meeting MAC requirements. However, according to MAC officials, simulator time has actually been substituted only to a limited extent because of various management and attitudinal constraints and because of problems in maintaining the equipment so that it realistically simulates flight conditions.

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<sup>1</sup>As indicated in the agency comments (app. V, p. 46), the flight policies and regulations are being reevaluated as the result of our review.

In both the Navy and the Air Force, there is a prevailing attitude that flyers' opportunities for career advancement and command positions are enhanced by having recorded large numbers of flying hours. Simulator training time is not credited toward satisfying the minimum flying hours required for advanced aeronautical ratings. As a result, flyers are motivated to accomplish as many of their training and proficiency requirements as possible in actual flight rather than in flight simulators.

The DOD policies that lead to this attitude are not in consonance with current fuel shortages, high aircraft operating costs, and the acknowledged training and safety benefits available with effective simulator use. The policies and regulations should encourage the maximum use of simulators by recognizing simulator time in satisfying aviators' training, proficiency, and career advancement needs.

#### DOD comments on policies and regulations

Our views on the impact of basic service policies and regulations on the effective use of flight simulators were addressed in a report (B-157905) to the Secretary of Defense on May 29, 1974. In response, DOD acknowledged that current policies and regulations in the areas identified above would be reviewed and that provisions for revisions as appropriate would be made. (See app. IV.) However, DOD added:

"\* \* \* we must caution you that the present generation of simulators is limited in its ability to serve as a substitute for actual flying. While there is a promise that a considerably greater degree of substitution will be provided through future generations of simulators, regulations and policies governing current flight management must be geared to simulators which are on hand. We will review these policies within this framework."

Our review shows that the problem may not be so much with the limitations of present simulators as with the ways they are managed, used, and maintained.

## CHAPTER 3

### SIMULATOR USE

Flying personnel and officials in both services frequently said that more sophisticated simulators are required before flying time can be further reduced through substitution of simulator training. Military flight crews must be trained in tactical mission skills--such as air-to-air combat, bombing, patrol, and reconnaissance flights--in addition to the more routine flight skills required of airline crews. Some of the flying conditions and missions flown by military pilots and crews are difficult to simulate. However, in January 1973 the United States Air Force Scientific Advisory Board reported the following concerning the Air Force's use of flight simulators:

"\* \* \* Expanded use of flight simulators appears less limited by insufficiencies in hardware technology than by management constraints, budget problems, and long-established negative attitudes.\* \* \*"

Commercial airlines are continuing to get quality training--instead of actual flying--in simulators of the same vintage as many of the military simulators that are considered too old. (See p. 19.) Most of the military simulators covered in our review are being used for supplemental training and for less sophisticated types of training than designed into the equipment. The instructors are not being systematically trained to use the equipment and, as a result, may not be completely aware of the equipment's capabilities.

Additionally, we noted that the proficiency flying programs--required flying for those pilots not assigned to flying positions--have not adequately provided for simulator use to increase proficiency and/or reduce flying hours.

#### A SUPPLEMENT TO FLYING

The increased use of certain Navy P-3 (patrol aircraft) tactics trainers did not result in the reduction of crew training flight hours. The trainers were approved for use instead of the actual aircraft flights to complete certain antisubmarine warfare qualification exercises. The training officer of one squadron confirmed that they were, in

fact, completing required exercises in the training devices and using the flight hours "saved" for additional in-flight training.

The tactics trainers also have potential for reducing expenditures of sonobuoys used in antisubmarine warfare training flights. A Navy study completed in March 1973 concluded that using trainers instead of actual flying for operational crew training could save an estimated \$13.6 million annually in sonobuoys used by the Pacific P-3 aircraft fleet.

At a MAC base, C-5 and C-141 aircraft were flown to accomplish certain pilot upgrade training that could have been, and in some cases actually had already been, performed in flight simulators. For example, the C-5 and C-141 pilot upgrade programs were planned for 6 and 8 hours of pilot time, respectively; 4 hours of which could be done in the simulator. Analysis of flying by several pilots recently participating in upgrade training showed that simulators had not been used in some cases and that in all other cases the simulator did not replace any flight hours. Average first pilot upgrade flight time was 9.35 hours for the C-5 pilots and 11.3 hours for the C-141 pilots. MAC officials told us that the main reasons the upgrading pilots flew more than the allowed minimums were that they currently were not getting much flying time and needed more flying experience.

#### SIMULATOR CAPABILITIES NOT FULLY USED

In many instances, military simulators are not being used to their full capabilities. An example of this was the Navy's use of the weapon system trainers for the P-3 antisubmarine patrol aircraft. These simulators, which consist of an operational flight trainer for pilots and flight engineers and a tactics trainer for the other crew members, can be used together to perform complete simulated missions or separately to accomplish individual training. We found that the P-3 training squadron used the components separately, but seldom as a complete system to perform crew-coordinated training missions. The coordinated crew training in antisubmarine warfare was generally being provided through in-flight training.

In most instances the operational flight trainer portions of the P-3 weapon system trainers were being used at



less sophisticated levels than they were designed for. For example, the motion systems and radio-navigation aids were not being used.

In 1972 and 1973 a Naval Training Equipment Center (NTEC) team analyzed the training of P-3 replacement pilots and concluded that the training devices had been misused. Their report, issued in December 1973, stated that more efficient use of the simulators could reduce flight training for initial qualification of P-3 pilots by at least 7.5 hours a trainee; that is, the students could achieve in five flights totaling 11.75 hours the same level of proficiency that normally required seven flights totaling 19.25 hours.

The Air Force frequently relegated the simulators to less important training roles. For example, the C-5A simulator at one base was being used extensively to teach techniques for starting engines and taxiing aircraft.

Commercial airline representatives told us they attempt to make maximum use of their simulator capabilities and give priority to reducing or eliminating in-flight training. Cockpit familiarization and procedures training, as well as ground crew training in the simulators, are kept to a minimum. Regarding the Air Force's use of simulators to train personnel to start engines and taxi aircraft, officials of one airline said that such uses of simulators were not cost effective and should be done in the simulator only on a spare-time-available basis. They said that their company conducts similar types of training on the job in the aircraft with the aid of qualified instructors.

#### INSTRUCTORS NOT WELL TRAINED

The December 1973 NTEC report cited the lack of instructor training as one of the principal causes of ineffective uses of the equipment. It stated that instructors were not fully aware of the capabilities of the simulators and had never received formal instruction in how they should be used.

We found that, with few exceptions, the Air Force and Navy simulator instructors learned about the capabilities and limitations of their simulator equipment solely through on-the-job training. This training usually consisted of watching and helping experienced instructors conduct several training exercises with the simulator. It also consisted of instructors conducting training sessions themselves under the supervision of an experienced instructor, before going ahead

on their own. Some of the instructors told us that when they began teaching they weren't fully aware of the equipment's capabilities and limitations and that they could have done a better job if their training had been more comprehensive.

Another problem noted was the high turnover rate of qualified simulator instructors because of military rotation policies, reassignments, and separations. Also, the formal training syllabuses used by the instructors have not been developed to make maximum use of the available simulators and other training aids.

#### MAINTAINING BASIC SKILLS

Both the Air Force and the Navy have large numbers of pilots and other aeronautically rated personnel who are not in assignments requiring flying. Public law and military regulations generally provide that these rated personnel may fly 100 to 110 hours a year to maintain basic flying skills, if it is likely that they may be reassigned to flying duties in the future.

Most of the flying by pilots authorized to maintain proficiency is performed in aircraft which usually are not the types the pilots would fly if returned to active flying duties. Further, in most cases Air Force and Navy policies require pilots to complete refresher flight training courses before being reassigned to operational flying, regardless of whether basic flying skills are maintained while in a nonflying assignment. Based on these facts, the value of proficiency flying seems questionable. It appears that the pilots' basic skills could be better and more economically maintained in simulators, particularly if the simulator is for the aircraft that the individual might be expected to fly when reassigned to active flying.

Commercial airlines do not have any comparable proficiency flying programs for pilots and crewmen temporarily removed from flying duties. Generally, commercial pilots are required to attend refresher training and to requalify for their former positions if they have been out of flying for 90 days or more. Some industry representatives and commercial pilots said that they considered the 100 to 110 hours a year flown in the military proficiency flying programs to be a

waste of time because pilot proficiency cannot be adequately maintained with so few hours. They also said that such flying just adds congestion to already crowded areas of air space and creates a potential safety hazard to other aircraft.

In May 1974, a report on the DOD interservice audit of support aircraft utilization noted that the Army requires only 80 hours flying a year to maintain proficiency, as compared to the 100 to 110 hours the Navy and the Air Force require. The report concluded that enough differences in practices for proficiency flying existed among the services for OSD to consider establishing more specific criteria for proficiency flying. The report also noted that potential savings may be possible by eliminating proficiency flying for pilots in nonflying positions or by establishing lower proficiency flying limits for all services. The report said that eliminating proficiency flying for pilots in nonflying positions might be possible since (1) pilots in these positions receive refresher training before being assigned to a flying position and (2) increased usage of simulators to maintain flying skills may be more cost effective. It was estimated that eliminating such flying DOD-wide could reduce fuel use by about 58 million gallons and operating costs by about \$78 million a year.

We found that MAC had taken a progressive stand in trying to promote greater use of simulators to meet proficiency and other annual flying requirements. In its input to an Air Force master plan for use of simulators, MAC recommended that pilots in nonflying positions be allowed to maintain proficiency in simulators to (1) reduce proficiency flying and associated costs, (2) increase the pool of qualified crew members for emergencies, and (3) make available more actual flying time for younger crew members since this would reduce flying by those who are normally more experienced.

The major obstacles to increased use of simulators for proficiency flying are restrictions imposed by existing military policies and regulations. MAC recognized and pointed out these obstacles. The need for revising the policies and regulations was discussed in chapter 2.

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## CHAPTER 4

### MAINTENANCE AND MODIFICATION OF SIMULATORS

The December 1973 NTEC report said that since the equipment reviewed was not used to the full extent of its designed capabilities many of the simulated systems were not maintained. The report also said that poor maintenance practices were one of the principal causes for ineffective use of the equipment.

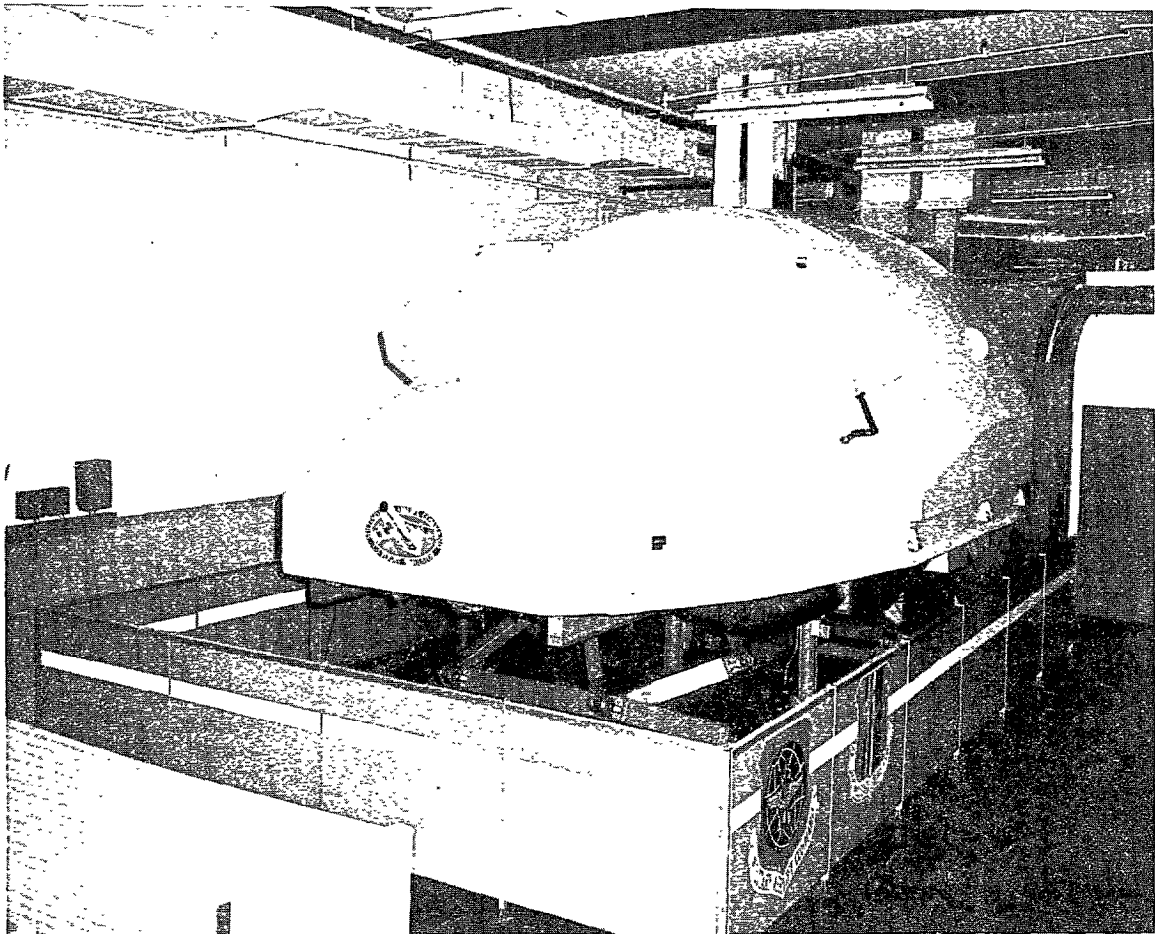
Overall, the maintenance and readiness status of most of the Air Force and Navy simulators examined during our review was notably inferior to that for the commercial airline equipment observed. Existing simulators generally could not be used effectively because the equipment was not maintained in fully operational condition or it was not up to date with the current aircraft configuration. In effect, flight simulators were sometimes made obsolete and reduced to procedural or part-task trainers through insufficient maintenance, modifications, and logistic support.

A lack of spare parts plagues most of the military simulators manufactured before 1970. As a result, most of these simulators were being operated with certain parts missing or with functionally inoperative systems which degraded their effectiveness. In other instances, modifications to the simulator had been delayed in the approval, funding, or implementation processes. Also, there was no program for rating and certifying simulators for use within and between the services.

#### AIR FORCE SIMULATORS

The Air Force C-5A simulators were the only ones examined which appeared to be maintained in a readiness condition approaching comparability to the commercial airline equipment. The simulators were also kept up to date with the current aircraft configuration. The C-5A simulator shown below was being used at Travis Air Force Base, California, for recurrent training of MAC pilots and crews.

Other Air Force simulators examined, such as those for the C-130, B-52, and KC-135 aircraft, often were poorly maintained (dirty, cluttered, and in need of repairs and painting) and were consistently operated in a degraded



condition. Due to the age of these simulators, some spare parts were not available or they were difficult to obtain. Even though some of the simulators were found to be up to date with the related aircraft configuration, instructors and maintenance personnel told us that they did not realistically simulate the actual aircraft flight characteristics. This lack of realism appeared to be due to inadequacies in the maintenance program. (See p. 19.)

The Air Force has had some problems in promptly modifying the C-141 simulators. MAC personnel attributed this problem to coordination difficulties between the C-141 weapon system program office and the Air Force Logistics Command (AFLC), which is responsible for developing simulator modifications when required.

The Strategic Air Command (SAC) has avoided some coordination difficulties and delays with a "Quick Mod Program," which

was instituted in conjunction with AFLC in January 1967. The SAC Quick Mod Unit manages configuration control on simulator equipment within the command and overcomes the funding constraints and time delays previously encountered when procedures required AFLC to process all training device modification actions.

The foregoing types of problems are discussed in the Air Force Master Plan for simulators, which states that:

"\* \* \* technology is not all together (sic) responsible for the lack of simulator modification. Management support is often the cause. When an aircraft is reconfigured or modified in some way, the commensurate modification or update is often deferred in the simulator for a long period of time and in some cases never incorporated at all. In many cases, this is due to the fact that the simulator is in the field operation and being supported by the AFLC organizations but the engineering responsibility may still be with an AFSC (Air Force Systems Command) organization."

#### NAVY SIMULATORS

Most of the Navy simulators reviewed were poorly maintained and were not in an up-to-date, operable condition. The most serious degradation involved the tactics section of a P-3 aircraft simulator which had been cannibalized for parts to the extent that it no longer existed. The remaining pilot and copilot section of this simulator no longer functioned as an operational flight trainer; it was being used as a cockpit procedural trainer.

At most Naval Air Stations visited, spare parts for the simulators were generally not readily available and, as a result, the maintenance personnel had to improvise or fabricate spare parts to substitute until orders could be filled. One technique being used to support the simulators was to cannibalize parts from grounded aircraft.

A majority of the Navy simulators reviewed were not promptly modified. Lengthy approval processes and funding problems were cited as the main obstacles in getting simulators modified. According to Chief of Naval Operations (CNO) representatives, NTEC, at the time of our inquiry, had a backlog

of about \$20 million in unapproved and unfunded simulator equipment modifications. The Navy has requested \$18 million in its fiscal years 1974 and 1975 budget submissions to eliminate most of the backlog. Some of the requested modifications were over 3 years old. CNO and NTEC officials agreed that completing modifications often takes 1 to 2 years from the contract award date.

#### AIRLINE SIMULATORS

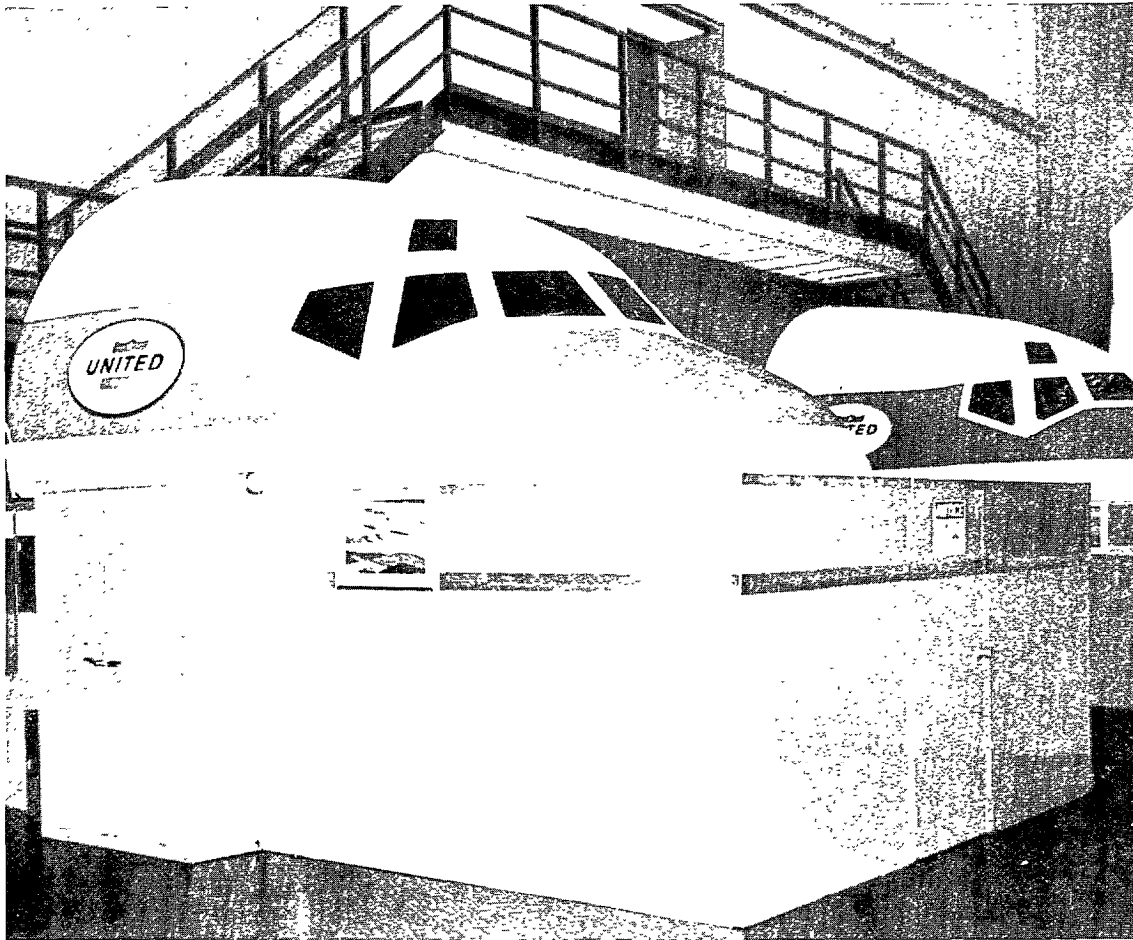
All airline simulator equipment which we observed was maintained in excellent condition in clean, well-kept facilities. Even the oldest simulators, built in the late 1950s, were in good condition. Of particular note was the fact that the maintenance included painting, so that the equipment all looked to be new.

Airline representatives maintain that the simulators have to be treated and maintained the same as any of their aircraft.

The equipment requires periodic tune-ups to keep it functioning in a realistic manner. Updating of the equipment must also be done promptly to keep up with the appropriate aircraft configuration.

The oldest airline simulators, one type of which is shown below, were comparable in age to the oldest military simulators but were fully functional and, except for certain limitations due to their lack of visual systems, have been accepted by FAA for use instead of in-flight training. Their acceptance and certification was the same as that for the new equipment without the visuals. Airline officials explained that the reason these old simulators could still provide valid training was that they had been well maintained and used properly in their training programs.

Airline representatives said they considered maintenance fine tuning essential--especially in the area of fidelity--to prevent the equipment from losing its comparability to the aircraft. The military's greatest objection to their current simulator equipment is the lack of fidelity; poor maintenance first shows up in this area. One airline's representatives said that certain military simulators, which they considered comparable to airline equipment, became



obsolete because of insufficient maintenance to retain fidelity and/or to stay up to date with the aircraft.

#### TRAINING AND RETENTION OF MAINTENANCE PERSONNEL

Military personnel responsible for maintaining simulators are normally enlisted men who have taken courses in basic electronics subjects or simulator maintenance. Like the simulator instructors, they usually learn about the specific simulator equipment they are working with through on-the-job training.

Navy officials cited training and retention of qualified maintenance personnel as a serious problem. One maintenance officer pointed out certain inefficiencies with on-the-job training of maintenance personnel. For example, although



the more experienced personnel provide the instruction, they have not had any formalized training and, as a result, can only pass on a portion of what they have learned through their own on-the-job training and experience. Thus, the quality of on-the-job training can vary considerably and the strengths and weaknesses of different instructors are perpetuated.

Rotation policies also aggravate the problem of retaining qualified maintenance personnel. Navy training and maintenance personnel said that by the time a technician has had 2 or 3 years experience with a simulator and is becoming reasonably competent and proficient in his job, he is ready to get out of the service or to be reassigned to another location, and often a different job.

Civilian technicians were used in addition to military personnel for operating and maintaining simulator equipment at some of the bases visited. This approach adds some stability to the maintenance staff, but it does little to improve shortcomings in the training process for maintenance personnel.

With the trend toward acquiring and using more sophisticated, complex, and expensive simulators in the military services, the effects of the foregoing problems in training and retaining qualified maintenance personnel are likely to continue and increase constraints on the potential utility of simulators. Accordingly, we believe DOD should consider converting more maintenance support from military to civilian billets and increasing the quality and priority of training to insure that simulator equipment is properly maintained. Good maintenance appears to be essential to achieving user acceptance of the simulators.

#### RATING AND CERTIFYING MILITARY SIMULATORS

DOD, the Air Force, and the Navy have no broad-based program comparable to FAA's regulations for rating and certifying airlines' training courses, flight simulators, and other training devices. FAA requires that each airplane simulator or other training device used in an approved training course be specifically approved for, among other things, the type of airplane concerned and the particular maneuver, procedure, or crew member function involved in

its operation. Further, the air carriers must see to it that the equipment retains the performance, functional, and other characteristics required for approval. They must also insure that the simulator is modified to conform to any modifications to the aircraft which affect the simulated flight characteristics.

FAA certifies air carrier simulators at least annually; those with sophisticated motion and visual systems may require formal inspections more frequently. FAA representatives continually make informal inspections and partial checks of the simulators while monitoring the airlines' training programs.

Procedures for inspecting and approving military simulators for use varied between, and even within, the services reviewed. There was no system of interservice certification for equipment or training courses which would permit cross-service support of training and proficiency.

Navy simulators are subject to yearly Quality Assurance and Revalidation Reviews. It appears that these reviews have had no success in insuring that the simulators are maintained at even an acceptable level of operational efficiency and effectiveness. Most of the Navy simulators we examined were either not current with the line aircraft, only partially operational, or a combination of both.

In the Air Force, three groups within SAC--Quality Control, Quick Mod, and Standardization Evaluation--evaluate the maintenance and readiness status of the simulator. In MAC, the instructor pilots and simulator maintenance personnel are responsible for insuring that the simulator is functioning properly. MAC officials said they knew of no requirements for certification or approval of their simulators by any Air Force group or by FAA.

As with the Navy, the Air Force was having little success in controlling the quality and readiness of the equipment.

In summary, the military has no required inspection and certification procedures comparable to those FAA requires of commercial air carriers. We found no procedures for insuring that deficiencies are corrected.

FAA's independent inspection and certification of commercial airline flight simulators appears to be an important and necessary means of insuring that the equipment is maintained adequately to provide acceptable training. Segments of the military have recognized the need for developing similar controls. A Tactical Air Command official told us that a suggestion to rate their simulators and provide a substitution/supplementation formula was being studied. In its portion of the Air Force Master Plan for simulators, MAC stated:

"A procedure must be established for the certification of simulators. If credit is to be given for simulator time, the fidelity, flight dynamics and configuration of these devices must be evaluated on a regular basis to insure adequate representation of flight in the simulated aircraft."

In the plan, MAC recommends that:

"Relationships between design capabilities of equipment and maneuvers for which training credit would be allowed should be detailed. Standards of configuration and fidelity for simulators should be determined."

These MAC observations and recommendations appear to be logical steps toward improved Air Force control over maintaining simulator performance and should contribute to better training and more cost effective use of the equipment. A DOD-wide program should be established to provide standards and requirements for the rating and continuing certification of flight training programs, flight simulators, and other training devices used by each of the military branches to train and maintain the proficiency of pilots and aircrews.

## CHAPTER 5

### NEED FOR INTRASERVICE AND INTERSERVICE COORDINATION

#### IN PLANNING FOR AND ACQUIRING SIMULATORS

The military services and commands have differed widely in the emphasis given and efforts devoted to acquiring needed flight simulators and associated facilities and equipment. At some of the bases visited, the simulators in use were quite old and poorly equipped, representing technology of the 1950s and early 1960s. At other bases, the equipment was more modern and comparable to newer simulators being used by commercial airlines. Overall, the simulator equipment used by the military organizations did not compare--either in quality or condition--to the equipment observed at the airline companies.

Within the past year, however, the services and individual commands have taken more interest in updating existing equipment and in acquiring additional simulators. The result is that they are now planning large expenditures to upgrade their flight simulation capabilities. With this increased activity, it is essential that the equipment acquired is justified in terms of potential cost savings, reduced flying, and/or improved training benefits. Improvements are needed in procedures and controls for funding simulator programs and coordinating the services' efforts to develop and acquire simulators.

#### IMPROVING EXISTING SIMULATORS AND ACQUIRING NEW ONES

In late 1973, OSD established a special task force to work with the military services to determine their plans and needs for simulators. The military services met with representatives of the task force and the Office of Management and Budget in November 1973 to discuss their flight simulation programs and to identify unfunded simulator requirements. As a result, funding to update and modify existing training devices and initiate acquisition programs for other systems has increased from \$88.5 million for fiscal year 1974 to \$283 million for fiscal year 1975. The fiscal year 1976 request is for \$247.5 million. OSD also established a planning goal to achieve an overall reduction

of 25 percent in total military flying hours by 1980 through increased use of simulators and other improvements in training methods.

The services see the development of improved visual simulation systems as a key element to achieving the OSD flight reduction goals. The Air Force accepted its first visual system in 1973 for use with the C-5 and C-141 simulators in transition training of aircrews at Altus Air Force Base, Oklahoma. The Navy and the Air Force have additional requirements for available visual systems, but they believe that improved, wide-angle visual systems will be needed to extend the use of flight simulators to training in certain military tactical missions. The Navy requested \$1 million for development of a wide-angle visual system. The Air Force already has programs underway involving development of improved visual systems, such as the Simulator for Air-to-Air Combat, scheduled to be operational at Wright-Patterson Air Force Base, Ohio, in December 1975, and the Advanced Simulator for Undergraduate Pilot Training, which became available for research at Williams Air Force Base, Arizona, in the summer of 1974.

Some of the other major simulator acquisitions and projects which will affect training for the aircraft included in our review are summarized in appendix III.

With major improvements and acquisitions planned to upgrade their flight simulation capabilities, the services and OSD must insure themselves and the Congress that the expenditures are justified. Many training experts point out that often there is a tendency to try to obtain more realism and sophistication in simulators than is required for some training tasks. Past experience has shown that the services have not always developed training programs which make maximum use of simulator capabilities. (See p. 9.)

#### FUNDING PROCEDURES AND CONTROLS

Many DOD officials believe that funding problems have hindered progress in improving simulator technology and application in the services. A problem frequently cited was combining the funding of simulators (support facilities excluded) with aircraft procurement costs. These funds are

controlled by an aircraft project manager (Navy) or program manager (Air Force) who is responsible for overseeing the development and procurement of a total aircraft system, including related flight simulators.

The advantages in having acquisition of simulators an integral part of the aircraft procurement program are that it facilitates total program planning, making trade-off analyses, and coordinating program adjustments when necessary because of various system changes. However, simulator acquisitions suffer when the aircraft have priority when competing for available funds. According to one military official, simulators may be given equal priority when initial trade-offs are made, but the project manager is likely to transfer funds from the simulator to the aircraft part of the program if problems arise in the latter. He explained that project managers tend to emphasize developing and producing the aircraft because that portion of the total program will be reflected most in their career record. Air Force officials said that the Air Force will probably change its system in the near future so that aircraft and simulator funds cannot be interchanged.

While an aircraft remains in production, the modification and updating of the simulators and aircraft continue to be funded at the project or program management level. When the aircraft is no longer being procured, funding of these activities shifts to logistic support groups, such as the Navy's Logistics and Fleet Support Group and AFLC. Here again simulators compete, often with a lesser priority, for available support funds. Problems in modifying and maintaining simulators were discussed in chapter 4.

Another major problem is that support facilities for simulators are requested and financed separately through military construction fund projects. In some instances, installation of simulators was delayed because construction funds were not available to provide proper facilities for housing the equipment. Facilities were not available for several high-fidelity simulators scheduled for delivery in 1974 because the Congress did not approve the Navy's request for the required construction funds. This problem was cited at several of the military bases visited.

We believe the separate financing of support facilities and simulators leads to a disjointed and ineffective presentation of requirements to the Congress. Procedures and controls should be improved to provide better visibility of all pertinent elements of program requirements and costs to project and program managers and appropriate higher military and DOD management levels. These elements include additional supporting facilities needed, research and development efforts, and simulator requirements for both out-of-production aircraft and those still being procured.

NEED FOR IMPROVED COORDINATION  
IN ACQUIRING SIMULATORS

Military officials said that there is some limited coordination and interchange of information between the services concerning simulator research and development efforts. However, they said there is very little real coordination in simulator contract and procurement phases.

Although there are differences in many of their respective operational missions and equipment, greater coordination could be achieved. For example, the Air Force and the Navy have contracted separately with the same commercial source for simulator training of C-9 flight crews. Also, MAC is seeking approval to buy a C-9 simulator solely for their own training requirements. It appears that evaluating the need for a C-9 simulator and for training support should consider both Air Force and Navy requirements, as well as continuing to use commercial sources for this training.

Efforts to achieve compatibility and some degree of standardization of simulator systems being used should be coordinated. In particular, an Air Force official said that coordinating requirements for peripheral simulation equipment (computers and certain software program technology) might be practical and that it would be explored. We noted instances within the same service where incompatibility of airborne tactical and simulator data systems and equipment limited the training possible with the simulator.

An Air Force Systems Command official cited standardization as a problem in using simulators. He pointed out that three visual systems, three motion systems, and four

simulator software systems are currently available and that the services and commands do not agree on which systems and combinations are best.

The need for more extensive coordination in developing and applying simulation technology to training programs is particularly important at this time because of the current plans for increased expenditures in this area. As the services' investments in simulators increase, it will become more difficult and costly to change systems and approaches to try to obtain the desired compatibility and standardization.



## CHAPTER 6

### CONCLUSIONS AND RECOMMENDATIONS

#### CONCLUSIONS

Air Force and Navy commands flying large, multiengine aircraft have lagged far behind commercial air carriers in adopting available simulator technology to support their flight training needs. The military services claim that new and more sophisticated equipment is needed before any substantial progress can be made in using the technology to reduce in-flight training. However, the military has been getting less effective training than the airlines with comparable equipment.

Although the services have recently acted to upgrade their simulator capabilities, greater top management emphasis will be necessary to achieve the possible training benefits and OSD-established goals for reduction of flying.

Because of various constraints and problems, existing simulator equipment has not been used to its full potential to enhance training and reduce flying. It is apparent, therefore, that acquiring new modern simulators offers no assurance that the desired cost savings and training benefits will be realized. We believe that strong mandates and incentives are needed to insure that maximum effective use is made of the simulators and that unnecessary flying is eliminated.

Flight simulators offer great potential in maintaining basic skills of military pilots and aeronautically rated personnel assigned to nonflying duties.

With large expenditures now being planned for developing and acquiring improved flight simulators, sound justifications should be provided to the Congress to show how planned reductions in flying time and cost savings will be realized. Also, improvements should be made in the procedures and controls for funding simulator programs and for coordinating the services' efforts to develop and acquire simulators.

## RECOMMENDATIONS

To help achieve potential training and safety benefits, cost savings, and conservation of assets (fuel and aircraft), we recommend that the Secretary of Defense:

- Revise basic policies, regulations, and management procedures governing flight training and the use of simulators to encourage maximum effective use of simulators instead of flying.
- Improve procedures and controls for maintaining simulators in an up-to-date and fully operable condition including:
  1. Establishing standards for certifying and periodically recertifying simulators and the related training program as to their suitability for use in training pilots and aircrews for specific models of aircraft.
  2. Establishing policies to preclude progressive downgrading of the simulators resulting from inadequate maintenance and/or relegating them to less sophisticated levels of training.
  3. Requiring more training of maintenance personnel.
- Provide for improved training and retention for instructors and design training syllabuses to insure that the simulators are used to their full potential.
- Reevaluate the need for proficiency flying to maintain basic flying skills and consider the potential substitution of simulator training for this purpose.
- Increase coordination between the services and commands in developing and acquiring simulators.
- Streamline procedures for funding simulator programs to improve their priority and insure coverage of all program elements.
- Justify simulator acquisitions in terms of reduced flying, cost savings, and training benefits.

## AGENCY ACTIONS AND UNRESOLVED ISSUES

The Assistant Secretary of Defense for Manpower and Reserve Affairs commented on this report on behalf of the Secretary of Defense (see app. V). DOD agreed that a number of the problems identified have adversely affected the utilization of simulators. Both in this response and in subsequent discussions DOD stated that it had recently initiated corrective actions. DOD also agreed that further improvement is needed and said that it would continue to seek improvement.

DOD emphasized that regulations and policies governing current flight management must be geared to the capability of the simulators now on hand for satisfying military training requirements. We were told that the sophistication of military weapon systems and tactical requirements pose challenges beyond the relatively straightforward airline application.

Although we recognize there are differences in military training requirements, our review generally included those military aircraft with mission profiles similar to commercial aircraft and with relatively advanced simulator technology. We found that the problems were not so much with the limitations of simulators but with the way they are managed, used, and maintained.

In commenting on our recommendations, DOD stated that:

--Navy regulations are being considered for revision to allow flight personnel to substitute up to 50 hours of the annual minimum flying requirements in high fidelity simulators. The Air Force is revising its regulations to develop a sortie-event oriented approach to continuation training, rather than the current minimum requirement for 100 hours to be flown annually. This approach will provide for specific tasks to be performed in the simulator and the aircraft.

--Increased funding emphasis for device upgrade and modification programs are expected to continue until a more favorable relationship exists between the operational capability of the aircraft and its

associated training devices. Additional direction is anticipated to supplement current service procedures for simulator maintenance and possible periodic device evaluation, if that is feasible and desirable. The Air Force is staffing a revised regulation which includes greater emphasis on configuration control and life cycle management.

- Civilians are currently used in many of the simulator support positions. Unduly extended tours for instructor, operator, and maintenance personnel could conflict with the goal of providing students with the expertise of qualified crew members. A program to determine possible use of civilians is currently underway throughout the Air Force.
- Navy and support personnel initially receive formal factory training. Replacement training is conducted when required by personnel rotation. The Air Force has recently reviewed its simulator technician career field and has taken action to realign Air Force Specialty Codes to more accurately reflect job requirements. New training programs are tentatively scheduled to begin in October 1975.
- The Navy is reevaluating its proficiency flying program and the Air Force is applying the sortie-event oriented approach to its proficiency flying program.
- The Navy and Air Force have executed a joint letter of agreement to exchange personnel between the Naval Training Equipment Center and the Air Force Special Project Office for Simulation. A naval officer has been assigned to the Air Force's Human Resources Laboratory to coordinate research and development efforts and information exchange on simulation.
- Improved planning, programing, and budgeting procedures will provide a means for streamlining procedures for funding simulator programs. The Navy has increased its management capability at the Chief of Naval Operations level and is studying a reorganization that would establish a group functionally oriented to provide management support of simulator programs. The Air Force is considering the designa-

tion of one agency to be responsible for flight simulation in the Air Staff. A Simulator System Program Office has been established for developing and procuring simulation devices.

--The acquisition and use of synthetic flight training devices have been given additional emphasis and visibility in the DOD planning, programing, and budgeting system. Decisions on procurement and modification of flight simulators are to be based on training benefits, cost savings, and reduced flying hours.

These actions and improvements, if properly implemented, will help to realize potential training, safety, and cost benefits available from the use of simulators and they will correct many of the problems noted during our review. However, GAO believes that more management emphasis is needed in improving basic policies and regulations, improving maintenance and instructor training, developing an evaluation or certification program for simulators, and evaluating the alternative of using simulators instead of proficiency flying for pilots and other aeronautically rated personnel assigned to nonflying duties.

The Navy regulations will continue to leave simulator training as an option rather than establishing any mandatory minimum requirements for simulator use. The Air Force's sortie-event approach, if properly implemented and adopted DOD-wide, could go a long way toward achieving the desired cost effective application of simulators within DOD.

The necessary skills to support the latest and future generations of simulator equipment will be far more demanding than in the past. Since GAO and service studies have shown that insufficient instructor and maintenance personnel training has contributed to the ineffective use of the equipment, more attention and efforts than those planned are needed in training these personnel.

DOD questioned the validity of our comparison of the oldest commercial simulators to the oldest military simulators. It stated that the example of the DC-8 simulator used on page 20 is based on mid-1960 technology with motion capability and that some of the DC-8 devices used by the airlines have digital computation capability. The Air Force stated

that 88 percent of the simulators in its inventory are analog devices and that it was not practical to upgrade these to digital systems.

We believe that the comparison remains valid since some of the airline simulators referred to had analog computer systems and used late 1950 technology. The picture of the DC-8 simulator in the report is shown only as an example to demonstrate the condition of older devices used by the airlines. (See p. 20.) The important point to be gained from the comparison is that the comparatively old airline simulators were still providing valid training because they were kept current, tuned-up, and well maintained. The military equipment was deficient even when current with the aircraft because it usually was not properly tuned-up and was poorly maintained. Airline and simulator equipment suppliers said that some valid training could be gained from analog simulators and that state-of-the-art visual systems could be added to them.

In discussions subsequent to the written response, DOD officials said that before a certification program could be considered the existing simulator maintenance and modification problems must be solved. We believe that a certification program would help provide quality control over the maintenance and readiness of simulators.

The Navy stated that it was reevaluating its proficiency flying program and the Air Force said it was instituting the sortie-event oriented approach to its proficiency flying program. DOD should consider reducing or eliminating proficiency flying since most of the flying done by pilots authorized to maintain proficiency is not performed in the types of aircraft they would be assigned to if returned to active flying duties. In most cases, refresher courses are required before reassignment to operational units.

#### MATTERS FOR CONSIDERATION BY THE CONGRESS

The appropriations and other committees of the Congress may wish to consider the matters discussed in this report in connection with the military departments' requests for funding simulator development, acquisitions, and related support facilities. The focus of this consideration should be to determine how the acquisition of advanced simulators will

affect flight training operations, manpower requirements,  
and aircraft acquisitions in terms of potential cost savings  
and reduced flying.

MILITARY COMMANDS AND OTHER

ORGANIZATIONS CONTACTED

DEPARTMENT OF THE AIR FORCE:

Air Force Systems Command  
Simulator System Program Office, Wright-Patterson  
Air Force Base, Ohio

Air Training Command  
Mather Air Force Base, California

Strategic Air Command:  
Castle Air Force Base, California  
Offutt Air Force Base, Nebraska

Military Airlift Command:  
Altus Air Force Base, Oklahoma  
Dover Air Force Base, Delaware  
Travis Air Force Base, California  
Scott Air Force Base, Illinois

Tactical Air Command  
Little Rock Air Force Base, Arkansas

DEPARTMENT OF THE NAVY:

Naval Training Equipment Center, Orlando, Florida

Commander Naval Air Forces, Atlantic:  
Naval Air Station, Norfolk, Virginia  
Naval Air Station, Patuxent River, Maryland

Commander Naval Air Forces, Pacific:  
Naval Air Station, Alameda, California  
Naval Air Station, Moffett Field, California  
Naval Air Station, North Island, California

FEDERAL AVIATION ADMINISTRATION



COMMERCIAL AIRLINES:

Continental Airlines  
National Airlines  
Pacific Southwest Airlines  
Pan American World Airways  
Trans World Airlines  
United Airlines  
Western Airlines

AIRLINE PILOTS ASSOCIATION

AIR TRANSPORT ASSOCIATION

SUMMARY OFAIRCRAFT COCKPIT SIMULATORS REVIEWED

	<u>Navy</u>	<u>Air Force</u>	<u>Commercial</u>
Number of pilot/copilot simulators reviewed	8	28	42
Simulators with:			
Visual systems	0	2	22
Motion systems:			
2° (note a)	0	0	9
3° (note b)	4	13	26
6° (note c)	1	0	7
Types of aircraft simulated	E-2	C-5	707
	P-3	C-130	720
	S-2	KC-135	727
	S-3A	C-141	737
		B-52	747
			CV-880
			DC-8
			DC-9
			DC-10
			L-1011

<sup>a</sup>2° of motion includes roll and pitch.

<sup>b</sup>3° of motion includes roll, pitch, and either yaw or vertical movement.

<sup>c</sup>6° of motion includes the three motions described in note b, plus lateral, longitudinal, and either vertical or yaw movements.

SOME MAJOR SIMULATOR PROJECTSAFFECTING LARGE MULTIENGINE AIRCRAFT

- MAC is requesting funds for incorporating visual systems, similar to the one used in transition training at Altus Air Force Base, on all of its C-5 and C-141 aircraft simulators.
- SAC has formalized requirements for a B-52 refueling part-task trainer and a related KC-135 boom operator trainer with visual attachment.
- SAC is developing plans and requirements for current state-of-the-art simulators with visual systems and 6° of motion for both the B-52 and KC-135 aircraft.
- Tactical Air Command has established requirements for 10 new C-130 flight simulators with 6° of motion and a flexible visual system having a wide enough field of view to perform take-off, enroute, approach, and landing tasks.
- Air Training Command is constructing a navigation simulator (designated the T-45) complex at an estimated cost of \$21 million for use in Undergraduate Navigator Training at Mather Air Force Base, California. A simulator (designated the T-5) for electronic warfare training was accepted by Air Force at Mather in November 1973.
- The Navy is purchasing two OFTs 1/ and five tactics trainers for operational training of crews for P-3C patrol aircraft. The OFTs are to have pilot and copilot stations simulated on a motion base with a full color visual system. The tactics trainers are not on the motion base and have no visual simulation. However, the OFT and tactics trainers can be operated together as a weapons system trainer to conduct integrated full crew training.
- Cockpit and tactics trainers for the Navy's E-2C aircraft are being installed at Naval Air Station, Norfolk, for use in operational training programs.

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--Two OFTs and a visual system for the Navy's S-3A anti-submarine warfare aircraft are scheduled to be procured in fiscal years 1975 and 1976 for use at Naval Air Station, North Island. The equipment will supplement the S-3A simulator equipment installed at North Island in fiscal year 1974.

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1/Operational flight trainers.



ASSISTANT SECRETARY OF DEFENSE  
WASHINGTON, D. C. 20301

BEST DOCUMENT AVAILABLE

MANPOWER AND  
RESERVE AFFAIRS

8 SEP 1974

Mr. R. W. Gutmann  
Director, Procurement and  
Systems Acquisition Division  
U. S. General Accounting Office  
Washington, D. C. 20548

Dear Mr. Gutmann:

This responds on behalf of the Secretary of Defense to your Letter Report, dated May 29, 1974, "Application of Simulator Technology in the Management of Military Flight Operations" (Code 952050) (OSD Case #3844).

Your report finds that basic Service policies and regulations governing flying do not encourage maximum effective use of flight simulators. The report cites the following deficiencies:

Little, if any, credit is allowed for simulator time as a substitute for flying time;

Policies controlling proficiency and flight currency requirements and qualification for career advancement unduly emphasize accumulating the maximum amount of flying time.

The report concludes that existing policies and regulations are hindering progress toward achieving the cost savings and training benefits available through simulation, and recommends that the DoD Study Group give attention to this matter with the objective of developing appropriate changes.

The Department of Defense shares your objective of making the most effective use of flight simulators. We also agree that flight policies and regulations should be structured to achieve this objective, both at the present, with available simulators, and in the future, as new simulation technology is developed. We will therefore review current policies and regulations in the areas you have identified and provide for revisions as appropriate.

While we agree with the objective of your Letter Report and with the appropriateness of a review of policies and regulations to assure that they support this objective, we must caution you that the present generation of simulators is limited in its ability to serve as a substitute for actual flying. While there is promise that a considerably greater degree of substitutability will be provided through future generations of simulators, regulations and policies governing current flight management must be geared to simulators which are on hand. We will review these policies and regulations within this framework. Additionally, we will seek to assure that these policies and regulations are revised to adapt to new simulators as they become available and that Service policies do not discourage or impede the appropriate development and use of more advanced simulators.

We appreciate your concern for this important matter and await with interest the report of your continuing review of the application of simulator technology in the management of military flight operations.

Sincerely,

  
William K. Brennan

BEST DOCUMENT AVAILABLE



ASSISTANT SECRETARY OF DEFENSE  
WASHINGTON, D. C. 20301

MANPOWER AND  
RESERVE AFFAIRS

25 FEB 1975

Mr. R. W. Gutmann  
Director, Procurement and  
Systems Acquisition Division  
U.S. General Accounting Office  
Washington, D.C. 20548

Dear Mr. Gutmann:

This responds on behalf of the Secretary of Defense to your request for comments on a draft report entitled "Department of Defense Use of Flight Simulators--Accomplishments, Problems, and Ways to Improve" (Code 952050) (OSD Case #3844-A).

We have reviewed the report and agree that a number of the problems identified have adversely affected the utilization of flight simulators. However, since collection of the data and information used in the report, corrective action has been started in many of these problem areas. The attachment to this letter contains comments regarding those actions initiated, or under consideration, to make it possible to realize greater training benefits from synthetic flight training devices.

We agree with GAO that still further improvement is needed, particularly in training device maintenance and modification, to keep the devices current and effective. Emphasis must also be given to the early identification of flight training device requirements as an integral part of weapon system development, acquisition, and program management.

The Department of Defense shares your objective of making the most effective use of its flight training assets. We will seek continuous improvement in the utilization and management of those resources to achieve cost effective training programs which are consistent with the requirements of military readiness and operational flight safety. Your report, suitably modified to give appropriate recognition to recently initiated corrective actions, is a valuable contribution to this objective. We appreciate the opportunity to comment on the report.

Sincerely,

*William H. ...*  
William H. ...



## COMMENTS ON CAO DRAFT REPORT, DEPARTMENT OF DEFENSE USE OF FLIGHT SIMULATORS -- ACCOMPLISHMENT, PROBLEMS, AND WAYS TO IMPROVE.

The Department of Defense (DoD) strives to make use of all technological advances which promise to improve the efficiency or effectiveness of its training mission. Particular emphasis has been given to the recent advances in flight simulation technology as they apply to military aviation. Adaption of such a rapidly advancing technology has given rise to problems. The subject report identifies and makes recommendations regarding these problems. The following comments are directed toward those recommendations.

## DEVELOP UNIFORM AND CONSISTENT METHODS FOR ASSURING REQUESTED SIMULATORS ARE JUSTIFIED.

The report recommends that uniform and consistent methods be developed for assuring that requested simulators are justified in terms of reduced flying, cost savings, and training benefits. Since the gathering of information and data used in the report, several management actions have been initiated to resolve these problems. The acquisition and use of synthetic flight training devices have been given additional emphasis and visibility in the DoD planning, programming and budgeting system. Decisions on procurement and modification of flight simulators are to be based on improved training benefits, cost savings, and reduced flying hours. This additional emphasis and visibility given to flight simulators will



provide for greater control and better management of Service programs without imposing constraints which would unrealistically reduce needed management flexibility.

#### STREAMLINE MANAGEMENT AND FUNDING PROCEDURES.

The report recommends that funding procedures for simulator programs be streamlined to improve their priority and assure that all programs are covered. The improved planning, programming and budgeting procedures mentioned in the preceding paragraph will provide a means for accomplishing this objective. It is true, as the report notes, that simulator acquisition programs have lagged in the past because of funding difficulties and the priority given to simulators vs aircraft. However, with advances in the state of the art of simulation technology, and spurred on by the energy crisis, procurement expenditures for simulation have increased significantly since 1973. It should be noted that the \$59 million requested as a supplement to the fiscal year 1974 budget, as cited in the report (p. 2 and p. 37), did not receive Congressional approval. The \$377 million reportedly requested for fiscal year 1975 is incorrect. Procurement appropriation requests for fiscal year 1975 totaled \$283 million. It is anticipated that substantial funds for simulators will be included in the FY 1976 and subsequent Defense budgets.

**BEST DOCUMENT AVAILABLE**

Navy Actions To Improve. The Navy increased its management capability at the Chief of Naval Operations level and initiated a reorganization study that would establish a group functionally oriented to provide management support of simulation programs. This action would centralize simulator management responsibility. Specific actions taken previously have resulted in procurement programs for all known flight simulator requirements in support of the P3, S3, and E2 weapon system programs. This initiative includes the acquisition of visual systems for the training devices.

Navy Programs. Four Operational Flight trainers have been procured for the P3 weapon system since 1973. These trainers, complete with airline-type visual systems, are just now being delivered. Without these simulators, a flight training syllabus would require 52 hours per student. With this equipment, only 25 hours will be flown. Without this reduction, ten additional P3 aircraft would have been required for training. The S3 weapon system training program was designed to achieve a balance between flight and simulation requirements. A syllabus requirement of 107 flight hours per student is being reduced to 52.5 hours. This is being accomplished with highly sophisticated simulators using airline-type visual systems.

Air Force Actions To Improve. The Air Force is also taking action to improve its flight simulator management capability. Consideration is being given to the designation of one agency to be responsible

for flight simulation in the Air Staff, and action has been taken to establish a Simulator System Program Office with the responsibility for developing and procuring simulation devices. This office will manage the acquisition of simulators for major weapon systems. It will insure that the various weapon system changes are incorporated into the simulation devices and that the devices will be available as the weapon system becomes operational.

Air Force Programs. The Air Force currently has two simulators with visual capability in its inventory for training in support of the heavy multi-engine C-5 and C-141 aircraft. Two additional visual display systems are currently being installed and are scheduled to be operational for C-5 and C-141 transition training in March 1975. Visual systems are scheduled for C-5 and C-141 devices at the operational units beginning FY 1977. Emphasis is also being given to acquiring improved simulators for aircraft that utilize large quantities of fuel (B-52 and KC-135). When these new devices enter the inventory, the projected reduction in flying activity will significantly contribute both to fuel conservation and dollar savings.

## APPENDIX V

### INCREASE COORDINATION BETWEEN THE SERVICES.

The report recommended increased coordination among the Services and commands in the development and acquisition of simulators. The Navy and Air Force have executed a joint letter of agreement to exchange personnel between the Naval Training Equipment Center (NTEC) at Orlando, Florida, and the Special Project Office - Simulation (SPO) at Wright-Patterson Air Force Base (AFB), Ohio. This exchange will permit mutual interservice benefits through increasing program coordination and reducing redundancy in simulation development and procurement programs. A Naval officer has also been assigned to the Air Force's Human Resources Laboratory at Williams AFB, Arizona, to coordinate research and development efforts and information exchange on simulation.

### REVISION OF BASIC POLICIES, REGULATIONS, AND MANAGEMENT PROCEDURES.

To encourage maximum effective use of simulators in lieu of flying, the report recommends that basic policies, regulations, and management procedures governing flight training and the use of simulators be revised.

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Revision of basic policies, regulations, and management procedures.

As directed, by the Office of the Secretary of Defense, the Services are currently conducting a detailed review of directives with a view toward restructuring them to encourage the maximum effective use of simulators in lieu of flying. The Navy reports that its policy and directive with respect to annual minimum flight time are being revised to provide for an evaluation of a change in the mix of flight and simulation hours. The revision would allow flight personnel to substitute time in high fidelity simulators under proper supervision for up to 50 hours of the annual minimum flying requirement. If this change proves successful, the Marine Corps is expected to institute a similar change.

The Air Force has developed a new sortie/event oriented continuation training concept as opposed to the previous fixed annual minimum flight hour requirement. Those tasks or events needed to accomplish a specific mission are identified and converted into required simulator and aircraft sorties using the least-cost approach to training. Events that may be accomplished in a simulator are identified along with the resultant flying sortie tradeoffs. The number of continuation training events or sorties that can be accomplished in a simulator is a function of the type of aircraft, its mission profile, and the capability of the device.

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Use of simulators. The changes in policies and directives cited above are an indication of efforts to improve the use of existing simulators and encourage the development of more advanced devices. However, as previously pointed out in response to GAO's Letter Report, dated May 29, 1974, regarding the application of simulator technology, regulations and policies governing current flight management must be geared to the capability that the simulators now on hand have for satisfying military training requirements. It must be remembered that the sophistication of military weapon systems and tactical requirements, both in weapon system employment and in training, pose challenges far beyond the relatively straightforward airline application.

For example, the draft GAO Report uses the DC-8 simulator as an example of the oldest airline training devices and states that these devices are comparable in age to the oldest simulators possessed by the military. Air Force investigations and coordination with the Federal Aviation Agency (FAA) reveal that these DC-8 devices are based on mid-1960 technology with motion capability (one device has visual capability). Of the five DC-8 simulators currently in use by commercial airlines, three contain the more sophisticated digital computation capability. As a matter of comparison, the Air Force reports that 88 percent of the simulators in its inventory are analog devices; it is not practical to upgrade these to digital systems. None in this group has a visual capability and few have

motion. Consequently, the vast majority of the simulators in the Air Force inventory are limited in training capability. This condition is complicated by the diverse and complex nature of the military mission, compared with that of the commercial air carriers, and consequently training devices with greater capability are required by the military than those currently used in airline training programs.

Finally, attitudes developed over a period of years with respect to use of simulation create, as the report notes, an emotional issue. Changes in attitudes dealing with simulation acceptability cannot be legislated. However, as a well-managed simulator program which employs high fidelity equipment and an optimum balance between simulation and flight time matures, it will enlist increased acceptability among aviators. Although the attitude among some aviators that people do not enter into aviation to fly simulators is correctly identified, it is incorrectly addressed as an obstacle to increased simulator use rather than a problem of incentive and personnel retention. As simulators become an accepted, integrated segment of an overall training program and demonstrate their worth, as has been the airline experience, attitudes are expected to change.

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## IMPROVE PROCEDURES AND CONTROLS FOR MAINTAINING SIMULATORS.

The report recommends that improvements be made in the procedures and controls for maintaining simulators in a fully operable condition and up to date with the aircraft and that requirements be established to certify simulators and preclude progressive downgrading through reduced maintenance. It is also suggested that longer tenure and better training of maintenance and operator personnel be provided, perhaps using more civilians in lieu of military personnel.

Maintenance of Simulators. The report notes that many of the simulators examined were not maintained in fully operational condition or up to date with the current aircraft configuration. Service budgets for flight simulators since 1973 have contained increased amounts for device upgrade and modification programs. It is expected that this increased funding emphasis will continue as necessary until a more favorable relationship exists between the operational capability of the aircraft and its associated training devices. There are occasional aircraft modifications that have no impact on training and therefore would not require modification of the simulator. All modifications which are needed to make the simulator an efficient device for training, however, should be applied when the aircraft are modified. As a result of the findings of the report and a DoD internal management review, it is anticipated that additional direction will be necessary to supplement current Service procedures for

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simulator maintenance and modification and possible periodic device evaluation, if that is feasible and desirable. Some actions have already been initiated to correct the deficiencies noted. In this regard, the Air Force is staffing a revised regulation which includes greater emphasis on configuration control and life cycle management. It must be recognized, however, that certain devices may be reduced to procedural or part-task use when their continued modification or overhaul is no longer worth the cost, or when training requirements dictate that new equipment be acquired.

Tenure and training of simulator support personnel. With regard to the tenure and training of simulator support personnel and the recommendation for using more civilians in lieu of military, it should be noted that civilians are currently used in many of these positions. Fifty percent of the operator and maintenance personnel under the Commander, Naval Air Forces, Pacific, are civilians, and significant civilianization is occurring in Naval undergraduate pilot training simulation positions. The Marine Corps is presently over 95 percent civilianized with complete conversion expected by mid-1975. Navy and Marine Corps support personnel initially receive formal factory training. Replacement training is conducted when required by personnel rotation. Presently, military instructor, operator, and maintenance personnel are rotated in concert with career demands and overall needs of the Service. Unduly extended

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tours for instructors could conflict with the desirable goal of providing students with the expertise of qualified aircrew members who are current in tactical and operational procedures.

The Air Force has recently reviewed its simulator technician career field. As a result, action has been initiated to realign Air Force Speciality Codes to more accurately reflect job requirements. New training programs are tentatively scheduled to begin in October 1975. A program to determine military essentiality and possible use of civilians is currently underway throughout the Air Force.

GAO note: Page number references in this appendix may not correspond to pages of this report.

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