The Air Force Gunship Program--Successes And Lessons To Be Learned B-176702

Department of Defense

UNITED STATES
GENERAL ACCOUNTING OFFICE

AUG.31,1972

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

LOGISTICS AND COMMUNICATIONS
DIVISION

B-176702

Dear Mr. Secretary:

This is our report on the successes and lessons to be learned in an Air Force major modification program to convert cargo aircraft to gunships.

The report contains recommendations for improved coordination of interservice programs and suggests resolution of open questions concerning the applicability of certain radar equipment being procured for these aircraft.

We believe this report should serve as a guide to program managers in avoiding similar problems in the future, and you may want to disseminate it to various activities and offices having program management responsibilities throughout the Department of Defense.

Copies of this report are being sent to the Senate and House Committees on Appropriations, Government Operations, and Armed Services; the Director, Office of Management and Budget; and the Secretaries of the Air Force and Army.

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Sincerely yours,

J. K. Fasick

Director, Logistics and
Communications Division

The Honorable
The Secretary of Defense

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ABBREVIATIONS

FLIR	forward-looking infrared set
GAO	General Accounting Office
PACAF	Pacific Air Forces

GENERAL ACCOUNTING OFFICE
REPORT TO THE
SECRETARY OF DEFENSE

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D I G E S T

WHY THE REVIEW WAS MADE

Cost growth and other problems in developing and producing new weapon systems have been discussed extensively in the Congress, General Accounting Office (GAO) reports, and the news media. Little has been said, however, about similar problems as they relate to major modification programs which, in effect, create new or improved systems.

From 1968 through 1971, the Air Force programed an estimated $5 billion for what it calls class V modifications--those which add to or change original characteristics of the equipment. This report discusses one of these programs, the conversion of two cargo aircraft into complex, highly sophisticated and effective armored-attack aircraft called gunships.

FINDINGS AND CONCLUSIONS

The Air Force spent about $317 million to convert C-130 and C-119 aircraft to gunships from 1968 to 1971. The program was highly successful in producing effective combat systems. Gunships have been used extensively in Southeast Asia for various purposes, including base and hamlet defense, close support of ground troops, and interdiction of enemy supply lines. Battle damage assessments confirm that they have performed well. On the basis of these successes, C-130 gunships are expected to remain in the Air Force inventory through the 1970s.

The program was well managed generally, in that an effective weapon was produced in a relatively short time. However, some costs were incurred which might have been avoided through more thorough planning of program requirements and through better coordination between the Air Force and the Army. For example:

--The Air Force developed a new concept to enhance close support of Army ground forces and spent at least $6.9 million for airborne equipment without having a commitment from the Army that it would participate in the program. The Army subsequently decided not to buy corresponding ground components necessary to make the concept work. Some of the airborne equipment became virtually useless, was removed, and is being disposed of. Other equipment--the beacon tracking radar--was used sparingly and not as originally intended. Despite the limited use and without assurance of future utilization, the Air Force spent another $7 million for an improved radar to replace the old one.

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--Some equipment was still being developed and was known not to be functioning when the Air Force had it produced and installed on the early gunships. The equipment did not perform all its intended functions, and it limited gunship capabilities for extended periods. Redesign and replacement of some of the equipment cost about $6.9 million.

--C-119 modification was started before performance characteristics and mission requirements were established. When these finally were established and incorporated into the program, the gunships became so heavy that they could not carry sufficient fuel for their missions. Recycling gunships through contractor facilities to reduce their weights cost about $0.7 million.

--Despite known limitations on how fast C-119 gunships could be deployed--such as a manpower ceiling, late delivery of equipment, and inadequate facilities in Southeast Asia--modification continued on an accelerated basis. The limitations continued after modification was completed, and deployment was delayed from 4 to 11 months.

These experiences in the gunship program should provide valuable lessons for managing future modification programs.

--In interservice programs the Air Force should obtain definite commitments to program concepts before committing its individual resources to procuring and installing expensive equipment.

--The concept of concurrent development and production, although prompted by a desire to expedite delivery, contains risks of resulting instead in high-cost equipment which is not fully useful.

--Operational concepts and mission requirements should be defined before equipment is modified, and, whenever possible, prototype models should be developed to fully test equipment within those concepts and requirements.

--Accelerated modification programs do not necessarily result in equally accelerated deployment of modified equipment. They can be more costly than conventional modification programs and should be used only when no practicable alternative is available.

Although this report illustrates that high costs and problems in making major modifications are somewhat analogous to those in developing new weapon systems, the most serious problem, in GAO's view, is the ability of one military department to develop unilaterally new concepts or programs intended to involve other military departments.

The Air Force proceeded unilaterally with a concept and program of its own design without agreement from the Army, even though Army participation was essential. The Army did not approve the ground equipment needed to correlate with the airborne equipment purchased by the Air Force but instead is proceeding to develop a program of its own for this mission.

RECOMMENDATIONS OR SUGGESTIONS

GAO suggests that:

--The Air Force obtain definite agreements on planned interservice use of equipment before the equipment is bought and installed in its aircraft.

--The Secretary of Defense and the Joint Chiefs of Staff evaluate the gunship program specifically to determine whether the beacon tracking radar capability can satisfy any of the Army's close air support needs.

CHAPTER 1

INTRODUCTION

In 1964 the Air Force began arming old, relatively slow transport aircraft with side-firing weapons for combat in South Vietnam. These modified gunships proved to be more effective for certain missions than fast fighter aircraft because they were better able to find targets and hold continuous suppressive fire on them.

The first gunships were modified C-47 aircraft. Subsequently C-130s and C-119s were added to the gunship force. They have been used in Southeast Asia for various combat roles, including base and hamlet defense, close support of ground troops, and interdiction of enemy supply lines. Total program costs are estimated at about $317 million.

Success of the first side-firing AC-47 gunship in 1964 led to modification of 52 additional C-47s by late 1967. They were armed with 7.62-mm. miniguns and equipped with flares. The program cost about $5.2 million.

The original mission of the AC-47 was to support Army Special Forces camps and isolated outposts under Vietcong attack. The mission was then broadened to include close support of ground troops and night reconnaissance. AC-47s were used primarily at night because they were vulnerable to ground fire in the daytime.

Although AC-47s were effective, they had limited capability; they could carry relatively small amounts of ammunition and could locate targets only under certain light and weather conditions. The Air Force decided that a gunship with increased capabilities was needed for expanded missions. Accordingly, in 1967, the Air Force produced a prototype C-130 gunship, called AC-130, with increased firepower and equipped with new devices for target detection and fire control.

Successful combat tests of the prototype in late 1967 led to the conversion of seven additional C-130 aircraft under a contract awarded in December 1967. Total cost of initial modification work on the seven aircraft was about $34 million.

AC-130s were armed with four 7.62-mm. miniguns and four 20-mm. cannons and were equipped with sensors and other equipment for locating targets, including a forward-looking infrared set and a beacon tracking radar.

Because of increased enemy action and successful combat performance of both AC-47s and the AC-130 prototype, the Secretary of the Air Force approved a plan in early 1968 to further expand and exploit the use of gunships. He decided, however, that conversion of additional C-130s at that time would have a serious impact on the airlift mission. Therefore he selected C-119 aircraft from reserve units for the expanded gunship role. He directed the Air Force to proceed with a program to insure the earliest possible deployment of a highly optimized and fully configured gunship to Southeast Asia.

On the basis of this decision, the Air Force began a program to modify and deploy C-119 gunships on a highly accelerated or crash basis. The C-119 gunship program manager awarded a contract in February 1968 to modify 52 C-119s--26 AC-119Gs and 26 AC-119Ks.

AC-119Ks, which were more advanced, were equipped with sensors and other equipment not installed in AC-119Gs, such as terrain avoidance radar, forward-looking infrared (FLIR) set, and beacon tracking radar. Both versions of the AC-119 were outfitted with four 7.62-mm. miniguns, and AC-119Ks were also outfitted with two 20-mm. cannons. Both versions had two reciprocating engines. Two jet booster engines were added on each AC-119K to provide better operating performance. About $146 million has been programed for AC-119 modifications.

Both AC-130 and AC-119 programs were given high priority and had compressed schedules for delivery and deployment. The two programs involved similar or identical subsystems.

After the first eight C-130s and 52 C-119s had been converted, 18 additional C-130s were modified. Also some AC-130s were subsequently updated by the addition of new equipment that was not available at the time of initial modification. Updating and modifying additional aircraft cost about $131 million.

We made our review, which was limited generally to the modification of 52 C-119s and the first eight C-130s from 1968 to 1971, at the following activities and locations.

Headquarters, United States Air Force

Aeronautical Systems Division,
Wright-Patterson Air Force Base, Ohio

Warner Robins Air Materiel Area,
Robins Air Force Base, Georgia

Phan Rang, Vietnam

Tan Son Nhut, Vietnam

Nakhon Phanom, Thailand

Ubon, Thailand

U.S. Army Land Warfare Laboratory,
Aberdeen Proving Ground, Maryland

Headquarters, Department of the Army

Fairchild Hiller Corporation
St. Augustine, Florida

CHAPTER 2

EFFECTIVE COMBAT SYSTEMS PRODUCED

The Air Force considers the gunship modification program highly successful because effective combat systems have been produced and delivered to users in a relatively short time. Information on accomplishments in combat shows that gunships have made significant contributions to the air war effort in Southeast Asia.

According to the Air Force, gunships have inflicted considerable damage on enemy operations. For example, a study of the AC-130 shows that the prototype:

> "*** had unprecedented success in identifying and destroying enemy targets, and far exceeded fighter aircraft kill ratios on trucks and other equipment. The slower, larger, and more stable 'gun platform' that was provided by the C-130 easily exceeded the smaller and faster fighter aircraft."

Each year, during the October to April dry season, the Air Force accumulates battle damage assessments on interdiction missions flown against enemy supply routes in Southeast Asia. For campaigns ended in 1970 and 1971, these assessments show that AC-130s and AC-119Ks contributed significantly to the total damage inflicted on enemy logistics.

Selected Air Force reports on gunships in close support missions showed that the gunships were indispensable on certain occasions. During important combat action, gunships were credited with killing many enemy troops, destroying vehicles, and creating fires and explosions.

The Air Force has determined that the latest gunship version, the AC-130E, will be the force structure gunship for the 1970-80 time period.

FAVORABLE COMMENTS BY GUNSHIP AIRCREWS

During June 1971 we interviewed Air Force personnel assigned to AC-130 and AC-119 activities in Southeast Asia

concerning the suitability of gunships and equipment for assigned missions. Aircrew members told us that generally gunships were well suited for the missions being flown at that time and that most of the seven subsystems included in our review were performing satisfactorily. These interviews were made more than 2 years after the first gunships were deployed, during which time many of the problems experienced had been resolved or improvements had been made.

CHAPTER 3

LESSONS TO BE LEARNED FROM GUNSHIP PROGRAM

The Air Force gunship program was generally well managed in that a complex, sophisticated, and effective weapon was produced in a relatively short time. However, some costs were incurred which might have been avoided if the Air Force and the Army had coordinated their efforts, if program requirements had been more thoroughly planned, and if the equipment had been developed in a more deliberate fashion. Following are examples of problems which we found.

--Some equipment installed received only limited use because the Air Force did not obtain a commitment from the Army to procure compatible ground equipment. Some of the equipment was removed from the gunships and is being disposed of.

--Some equipment installed was still under development and would not perform all planned functions, which necessitated costly redesign or replacement.

--Failure to communicate firm mission needs for the AC-119 resulted in the aircraft's being overweight and necessitated a costly weight reduction program.

--Although there were restrictions on deploying AC-119s that were known to the program managers, modification continued on an accelerated basis. The restrictions continued after modification was completed, and deployment was delayed from 4 to 11 months.

Experiences in these programs, we believe, should provide the Air Force with valuable lessons for improving management and for avoiding similar problems on future modification programs.

NEED FOR AGREEMENT ON EQUIPMENT UTILIZATION

The Air Force spent at least $6.9 million for two items of airborne electronic equipment installed in some gunships for use with compatible ground equipment, without having a commitment by the Army that ground equipment would be bought

and used. After the equipment was installed, the Army informed the Air Force that compatible ground equipment, needed to make the airborne items fully usable, would not be procured. As a result, one of the items, an interrogator set, was useless to the gunship and will be disposed of. The other item, a beacon tracking radar set, has received only limited use. Despite limited use of the radar, the Air Force contracted for an improved version costing about $7 million to replace the original radar.

Interrogator set

The Air Force installed an interrogator set in the AC-130 prototype and demonstrated it to the Army in Southeast Asia in late 1967. The interrogator set and a ground transponder, called a beacon, form a direction finding and ranging system intended to be used to locate friendly ground forces needing fire support. The Air Force planned to install interrogators in all gunships, but it expected the Army to procure beacons for its field units. The interrogator sets were useless without the ground beacons.

The Air Force considered its demonstration of the interrogator set and preproduction model beacons successful and proceeded to buy interrogators for all gunships. The Army, however, thought the tests were inconclusive. Attempts to use the beacon at that time were unsuccessful because either the airborne or the ground components were inoperable, and the Army decided the beacons were "not sufficiently rugged for field use by an infantry unit." The Army deferred procurement pending further development and testing of a limited number of prototypes by the Air Force.

The Air Force learned in March 1968 that interrogator set performance would be limited by signal interference when more than two gunships or beacons operated simultaneously within 50 miles of each other. It decided not to install interrogators in the AC-130 and AC-119K as originally planned but did install interrogator sets in AC-119Gs, despite the interference problem. The Air Force thought the interference problem would be overcome because the beacons and AC-119Gs would be widely dispersed and because the AC-119Gs would not have some of the sophisticated equipment installed on the AC-130s and AC-119Ks.

As the planned deployment date for the first AC-119G neared, the Air Force and the Army had not resolved the interrogator-beacon problem. An Air Force staff study dated May 14, 1968, showed the predicament the Air Force faced at that time.

> "*** The Air Force has proceeded with the Gunship aircraft modification program (including the development of peculiar airborne equipment) but has not adequately coordinated with the Army those phases requiring Army coordination. Specifically we are installing*** [interrogators] on our gunship aircraft yet we have not placed on contract compatible ground equipment*** [beacons]."

The study also revealed that prototypes of the beacon had been tested in Southeast Asia and that the Army found they "didn't work" and were "not rugged enough for field use."

The Army subsequently agreed to conduct joint tests with the Air Force and said that:

> "*** it is considered essential that a comprehensive, objective evaluation of the systems be made prior to a decision on procurement and fielding of operational quantities."

AC-119Gs equipped with interrogators were deployed, although the beacon problem had not been resolved. About 9 months after deployment was completed, the Army decided to cancel its program to test the beacon. By letter dated September 26, 1969, the Army Acting Chief of Research and Development, Southeast Asia Division, said that, as a result of a meeting held September 11, 1969:

> "*** it was determined that the UHF beacon had certain definition drawbacks, including a limited operational capability, excessive weight, a marginally acceptable time schedule and high cost. *** This program is cancelled and no more funds will be expended for UHF beacons under this task."

Thus, the interrogator sets installed in AC-119Gs were completely useless and in early 1970 were removed and placed

in storage. The Air Force planned extensive modification of selected interrogator parts, valued at about $550,000, in a research project. The remaining interrogators and support equipment, which cost about $2 million, will be disposed of.

Beacon tracking radar

In a situation somewhat paralleling that of the interrogators discussed above, the Air Force spent about $4.3 million for beacon tracking radars installed in gunships under a concept it had devised for close support of Army ground forces. The Army, however, did not buy the necessary beacons required to make the system usable. The radars were used, but only for limited purposes which were outside the original plans. Despite the limited use of the radars, the Air Force has remained adamant that they are essential gunship equipment for close air support. It has contracted, at a cost of about $7 million, for improved radars to replace the old ones, without having adequate assurance from the Army of their complete usefulness.

The beacon tracking radars, modified missile radars, were tested in the AC-130 in Southeast Asia in the fall of 1967. The Air Force offered to provide them on AC-119Ks and AC-130s if the Army would procure necessary ground beacons. The Air Force proceeded to install radars and requested an early decision on the beacons from the Army. Subsequently, the Army stated that a comprehensive evaluation of the radars was essential before it would decide whether to buy and use the beacons.

Noncombat demonstrations of the gunship close support equipment, including the radars, did not satisfy the Army.

Additional tests completed in August 1969 showed that offset firing (see p. 17) was unacceptable at any distance using the radars and other equipment in the gunships. By that time, however, AC-130s had been deployed, and AC-119Ks were scheduled to be deployed about 2 months later. The radar had been installed in both.

In March 1970 the Army requested that the safety of gunship close air support be certified before testing under

combat conditions. The Army was concerned with the safety of its ground forces using the system during periods of reduced or no air-to-ground visibility. In June 1970 the Army decided to hold in abeyance operational evaluation until safety parameters were established.

In October 1970, about 2 years after deploying gunships with beacon tracking radars, the Army informed the Air Force that it did not support the use of beacons under conditions then existing in Southeast Asia and that there was no need to maintain radars in the gunships to support the Army. The Army stated that the beacon tracking radars were unsuitable because they did not meet required Army criteria for approving new items introduced into Vietnam. These criteria, in part, required that the radars significantly improve mission capability, apply to the Vietnamization program, and result in saving lives. The Army also was concerned with troop safety because of a lack of validated safety criteria.

The Army said that it did not take exception to the basic concept of a beacon system and that such a system might be applied to other aerial weapon systems. It then began determining Army needs for this type of system and developing specifications which could be used by all services.

Air Force personnel informed us that the radars had been used very little--mostly for highly classified missions. Although the Army declined to buy beacons and although the radars received only limited use, the Air Force decided it needed new radars because (1) it still believes the radars are essential gunship equipment for close air support, (2) old missile radars were not available for new gunship production, and (3) new radars would be more reliable and easier to maintain. The Air Force has procured new radars for about $7 million. The new radars and supporting items will replace those in the original AC-130s and will be installed as basic equipment in later AC-130s.

We believe there are lessons to be learned from this experience. Definite commitments and agreements on planned interservice use of equipment must be made by each service involved before equipment is bought and installed by an individual service.

PROBLEMS WITH ATTEMPTS TO USE NEW, UNPROVEN EQUIPMENT ON GUNSHIPS

Some equipment on the early gunships exceeded state-of-the-art technology and was still being developed when the Air Force had it produced and installed. Attempts to use it were unsatisfactory because it would not perform all intended functions and limited certain capabilities for extended periods of time. The Air Force later spent about $6.9 million to redesign or replace this equipment.

FLIR

The AN/AAD-4 FLIR is a target detection device which, through electronic circuitry, converts heat energy emitted by objects on the ground into visual presentations on a screen in the aircraft. The FLIR and supporting items were procured for all AC-119Ks and AC-130s for about $33 million.

A forerunner to the AAD-4, the FL-2B, had been installed in the AC-130 prototype and, according to the Air Force, was an effective sensor for altitudes and tactics in use at that time. However, the Air Force approved procurement of the AAD-4 because it felt that enemy defenses would be improved, which would require FLIR performance at higher altitudes, and that the AAD-4 could be developed, manufactured, and delivered to meet gunship schedules. The Air Force recognized that a risk was involved in concurrent development and production of the AAD-4.

In May 1968 the manufacturer experienced development problems with the AAD-4. In June 1968, delivery began but the first two units were unacceptable. However, the Air Force accepted five FLIRs for installation in AC-130s scheduled for deployment to Southeast Asia on the condition that the manufacturer would later correct all problems at no additional cost.

About October 1968, after several test flights, the Air Force was certain that the equipment needed redesign but deployed the AC-130s equipped with the AAD-4 FLIRs anyway, expecting to correct the problems later.

In December 1968 Pacific Air Forces (PACAF), the command using the AC-130s in Southeast Asia, reported that its aircrews were of the unanimous opinion that the AAD-4 did not have an effective combat capability at that time. PACAF also said that performance was substantially less than that achieved with the FL-2Bs installed as an interim measure in two AC-130 aircraft used for training. In January 1969 PACAF said that none of the AAD-4s on hand were considered operational.

In February 1969 the manufacturer stopped production to develop and implement design improvements for correcting performance, reliability, and design deficiencies discovered as a result of operational use. Although no FLIRs had been delivered to the AC-119K program, work was in progress. The extensive redesign changes negated much of the effort already expended on the AC-119K units.

Redesign cost charged to the AC-119K program amounted to about $3.5 million, primarily for production parts and labor. We were unable to determine the cost charged to the AC-130 program for spares made obsolete by redesign.

Deliveries of suitable AAD-4 units were delayed by the redesign. The first unit delivered to the AC-119K program in May 1969 was about 8 months late and contributed to delays in AC-119K deployment. In addition, late deliveries and diversion of redesigned FLIRs from AC-119Ks to AC-130s resulted in deploying three AC-119Ks without FLIRs. Although performance of the first FLIRs later improved, they were only partially successful until redesigned units were delivered beginning in April 1969.

According to Air Force personnel, redesigned AAD-4 FLIRs have been satisfactory and have provided a significant percentage of gunship target detection. The redesigned AAD-4 was subsequently replaced by later versions in the AC-130s.

At the conclusion of our review, the Air Force, after a lengthy delay, was trying to determine if any of the $2.6 million of obsolete AAD-4 production parts were usable for other requirements.

Fire control computer

Fire control computers and supporting items were procured for about $4.2 million and were installed in AC-130s and AC-119s although the Air Force had information that the computers had unsolved, basic design limitations which could affect firing accuracy under certain conditions. Unsatisfactory performance of the computers in certain instances under test and actual combat conditions led to their removal and the installation of a new type of computer in AC-119Ks and AC-130s at a cost of about $3.4 million.

Fire control computers determine the flight pattern for release of firepower on a target. The computers were designed to provide gunships with the capability for both direct firing at targets and offset firing for close support of ground forces. Offset firing was intended to provide a capability of firing at enemy targets located at estimated distances and directions, or offset, from friendly positions.

According to the Air Force, the original computer was installed, despite its limitations, because (1) it was the best computer available, (2) it was essential gunship equipment, and (3) the gunship program was very urgent.

Significant offset-firing inaccuracies were noted in June 1968 during testing of the computer and related equipment on the AC-119G and from November 1968 to April 1969 during testing of the AC-119K. After additional testing, the Air Force concluded in July 1969 that offset firing was "not acceptable at any distance" using the fire control equipment in the gunships at that time. PACAF advised the Air Force Chief of Staff that it wanted the offset-firing deficiency corrected.

During 1969 tests the Air Force also tested a recently developed computer and a different type of aircraft attitude indicator system which gave the desired accuracy in offset firing. The Air Force concluded that both the aircraft compasses and the computers installed in the gunships had contributed to offset-firing inaccuracy. To improve firing accuracy, the Air Force contracted for new position indicator systems and new computers in September and October 1969, respectively.