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THE ENHANCED GUNSHIP FIRING CAPABILITY

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THE ENHANCED GUNSHIP FIRING CAPABILITY

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During the Vietnam conflict, the United States conceived, developed, and implemented the combat rendezvous program. The two essential elements of this program, the fixed wing gunship and the x-band ground transponder (beacon), enabled the USAF to deliver safe, sustained, and effective aerial fire on enemy ground forces in close proximity to friendly forces even when both forces were invisible from the air. This essay is a summary of the combat rendezvous program specifically addressing the utility and effectiveness of the gunship beacon off-set firing techniques, the problems associated with this technique,

Block 20 continued
and recommended solutions to these problems.

The objectives of this essay are: to provide interested parties information about the combat rendezvous program, to evaluate the tactical utility of this program, and to examine the USAF RDT&E program associated with the combat rendezvous concept. The essay first explains the revolutionary all-weather support capability associated with the combat rendezvous program, and provides sufficient technical information for the reader to compare the merits and shortcomings of this program to those of other close air support systems. Second, the essay examines the ability of gunships to meet the requirements of counterinsurgency and close air support missions in a low intensity environment, and investigates how they will be used in future conflicts. Prominent factors in this analysis are the gunship's quick reaction time, long loiter, ability to locate friendly troops and targets, accuracy, firepower, reliability, and capability to attack day or night under all weather conditions. Finally, the essay examines the process by which the USAF developed, tested, introduced, and finally implemented the combat rendezvous program. In doing so, it derives lessons and recommendations which will aid in future planning concerning the close air support mission and which may facilitate more systematic management of future weapons systems.

LIST OF ILLUSTRATIONS

THE ENHANCED GUNSHIP FIRING CAPABILITY

INTRODUCTION

The counterinsurgency and unconventional warfare environment of Southeast Asia has resulted in employing USAF air power to meet a variety of combat requirements. In this essay some of those USAF experiences are documented and analyzed for current and future impact upon policies, concepts and doctrine. The specific systems examined are the AC-119K and AC-130 gunships utilized in the Combat Rendezvous (C/R) role.[1]

This paper will examine these gunships and determine their application in improving the capability of the military to counter the threat of counterinsurgency and unconventional warfare in a low intensity environment.

PURPOSE

This essay will attempt to isolate those elements or concepts of the gunship weapon system that are responsible for its remarkable success, and to derive lessons and concepts from this system which can be used in the future.[2]

The history, configuration, and the all-weather capability of the gunship will first be presented briefly. This will be followed by an analysis of five principle lessons and concepts of the gunship program:

1. Combat Rendezvous.

2. Integrated Weapon System.

3. Terminal Effectiveness.

4. Interdiction Role.

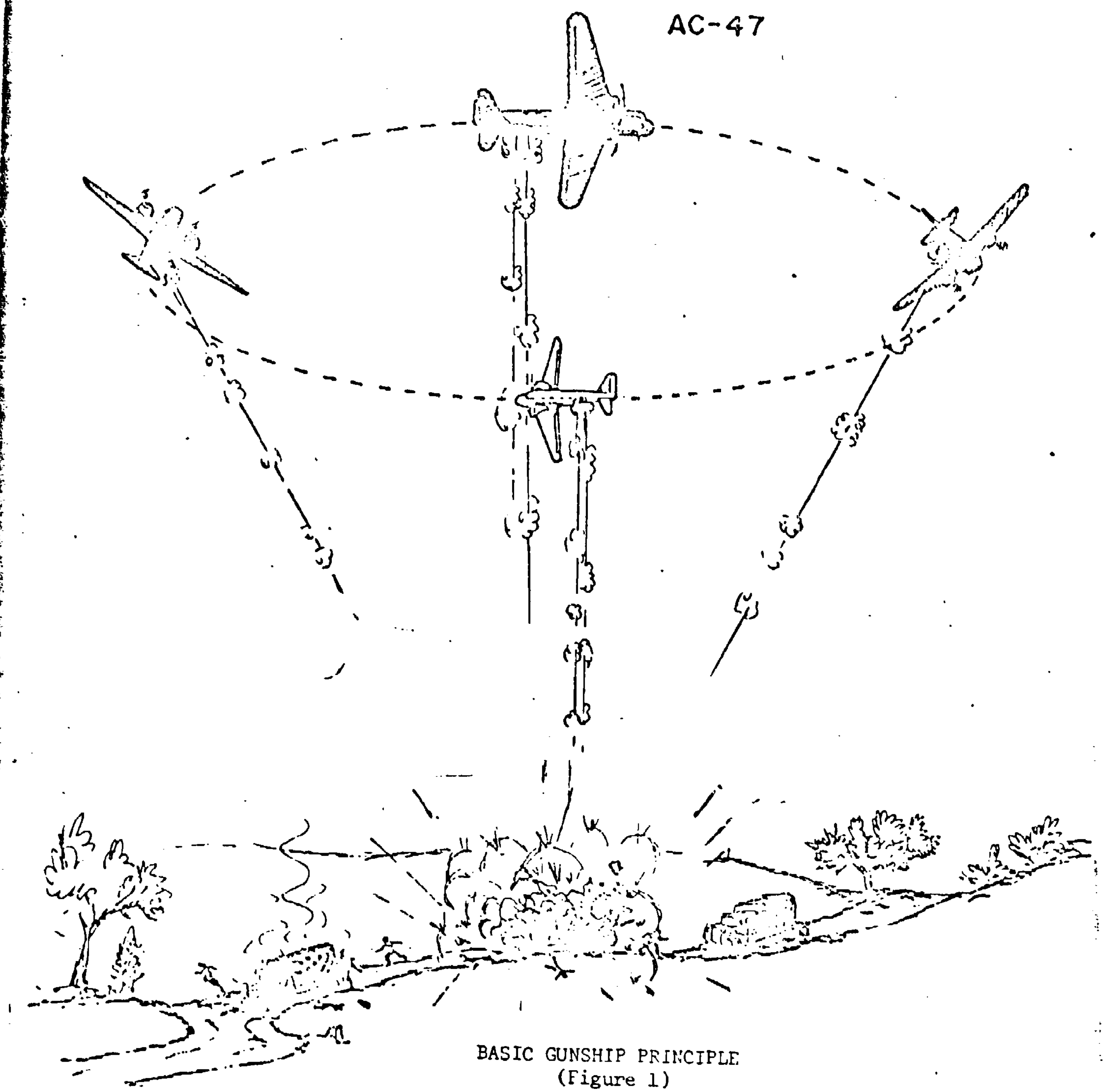
5. Research and Development Technology.

The significance of each concept will be derived from the history of the development and deployment of the gunship. Following the discussions of these five concepts will be suggestions for future use.

BACKGROUND

In the early 1960's, a new concept in air-to-ground weapon systems was introduced. This system, the AC-47, more commonly referred to as "Puff, the Magic Dragon," employed a fixed, side-firing gun with the tactic of circling the target to deliver intense fire power. This mode of attack, approximating a pylon turn, proved to have certain noteworthy advantages. The extended time in the firing circle would pin down enemy troops as they attempted to overrun a hamlet. In addition, the aircraft could loiter in an area for several hours. Initially, there was a problem of finding targets at night which was solved by dropping flares from the aircraft (see Figure 1).[3]

While the AC-47 was an extremely effective weapon system, it still had some difficulty in locating targets at night. Also, the pilot had to be very skilled to correct his fire for the effects



BASIC GUNSHIP PRINCIPLE
(Figure 1)

of winds and gun misalignments. In addition, the ammunition-carrying capacity of the AC-47 was limited. Recognizing the potential of side-firing aircraft, the Air Force proposed modifications to C-119 and C-130 aircraft to build AC-119K and AC-130 gunships.

As armament, prototype systems had four 20-mm Vulcan cannons and four 7.62mm miniguns, all fixed mounted to fire out the left side of the aircraft.[4]

The new aircraft had two principal advantages over the AC-47. First, the reliance on visual search and acquisition was removed by the addition of two sensors: a Night Optical Device (NOD) and a prototype infrared sensor. These sensor systems were applicable to interdiction or close air support. Still, the gunship had to "see" the target or a suitable ground reference point with one of its sensors. Thus, the gunship possessed only limited all-weather capability. In the search for ways to increase the all-weather capability, a Beacon-Tracking Radar (BTR), which was a modified Bomarc guidance radar was added. The BTR employed a ground beacon to provide a fixed reference point for the gunship regardless of weather. Range and bearing to the target could be passed to the gunship and set into the fire control computer which would determine an off-set aiming point for the pilot. By using this technique, the gunship could remain above the clouds and still direct its fire on the enemy position. This represented a revolutionary breakthrough in all-weather close air support which added an entirely new dimension to USAF fixed wing gunship capability The all-weather capability could be used to provide close air support to front-line troops or long-range clandestine patrols.[5]

The improved ability to acquire targets was coupled with another new development--an improved fire-control system. A prototype analog computer used the sensor gimbal angles, as measured by resolvers, to calculate the desired attitude of the aircraft to hit the target. This was displayed to the pilot as a moving circle on his side-mounted gunsight, which he had to align with the fixed reticle representing his gun position. An important additional feature of the analog computer was an approach guidance calculation which gave the pilot the information required to smoothly enter the firing orbit.[6]

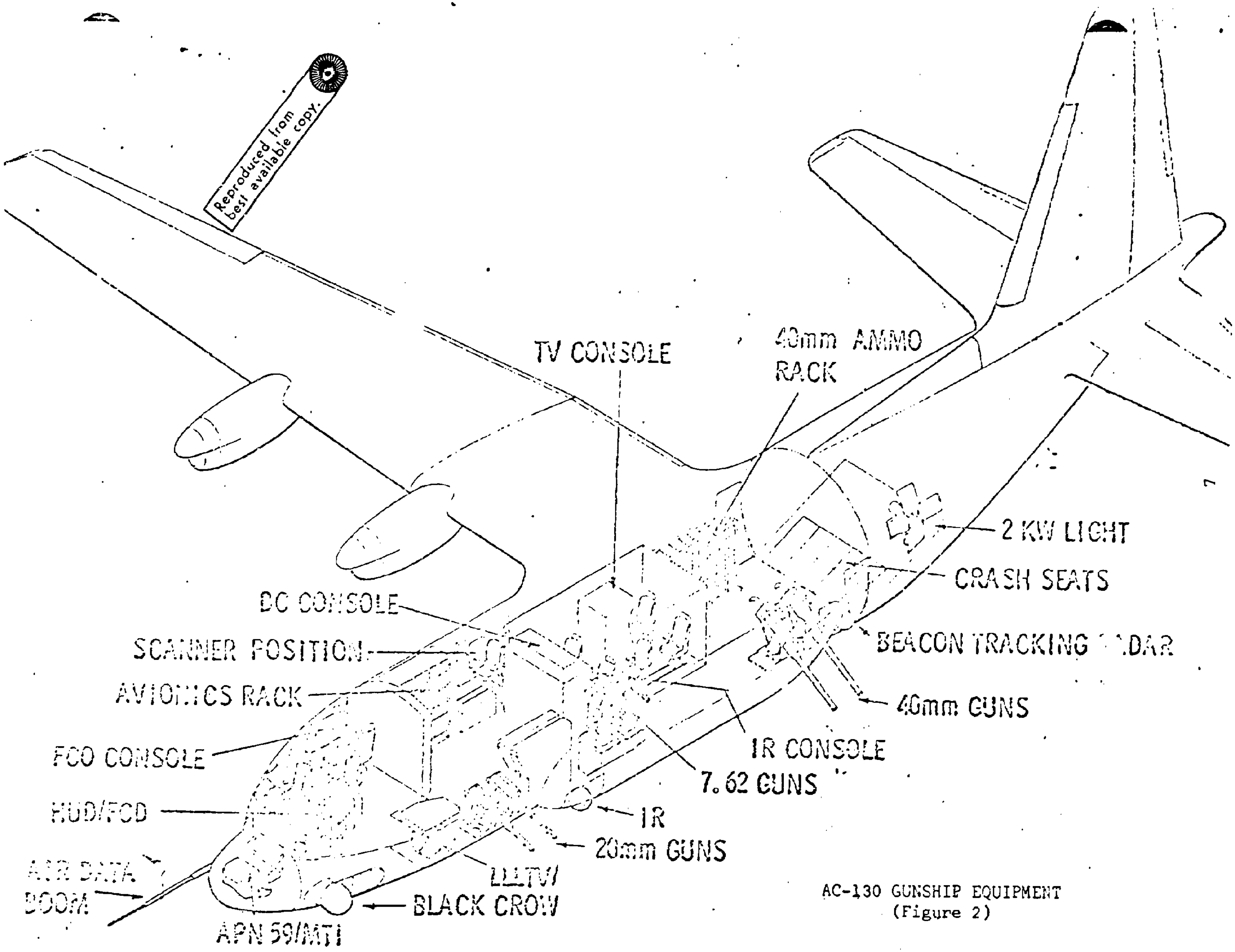
Another equipment feature which was of great value for close air support was the fire safety display. This display consisted of a cathode-ray-tube picture showing the position of a friendly force as the center of a circle of adjustable radius. The territory outside this circle represented the area where fire could safely be directed. This gave a complete picture of the ground situation and was the basis for cease fire in case of equipment malfunctions.

The above developments contributed to the basic gunship configuration. The pilot flies the aircraft to eliminate the attitude errors derived by the fire-control computer and displayed on the side-mounted gunsight. The computer corrects for winds and minor misalignments of the fixed guns, based on the gimbal angles of the active sensor, which is pointed at the target by a sensor operator. Thus, control is effected by a closed loop running from the sensor to the computer to the pilot, who in turn flies the aircraft into the firing orbit, correcting the gimbal angles so as to hit the target.[7]

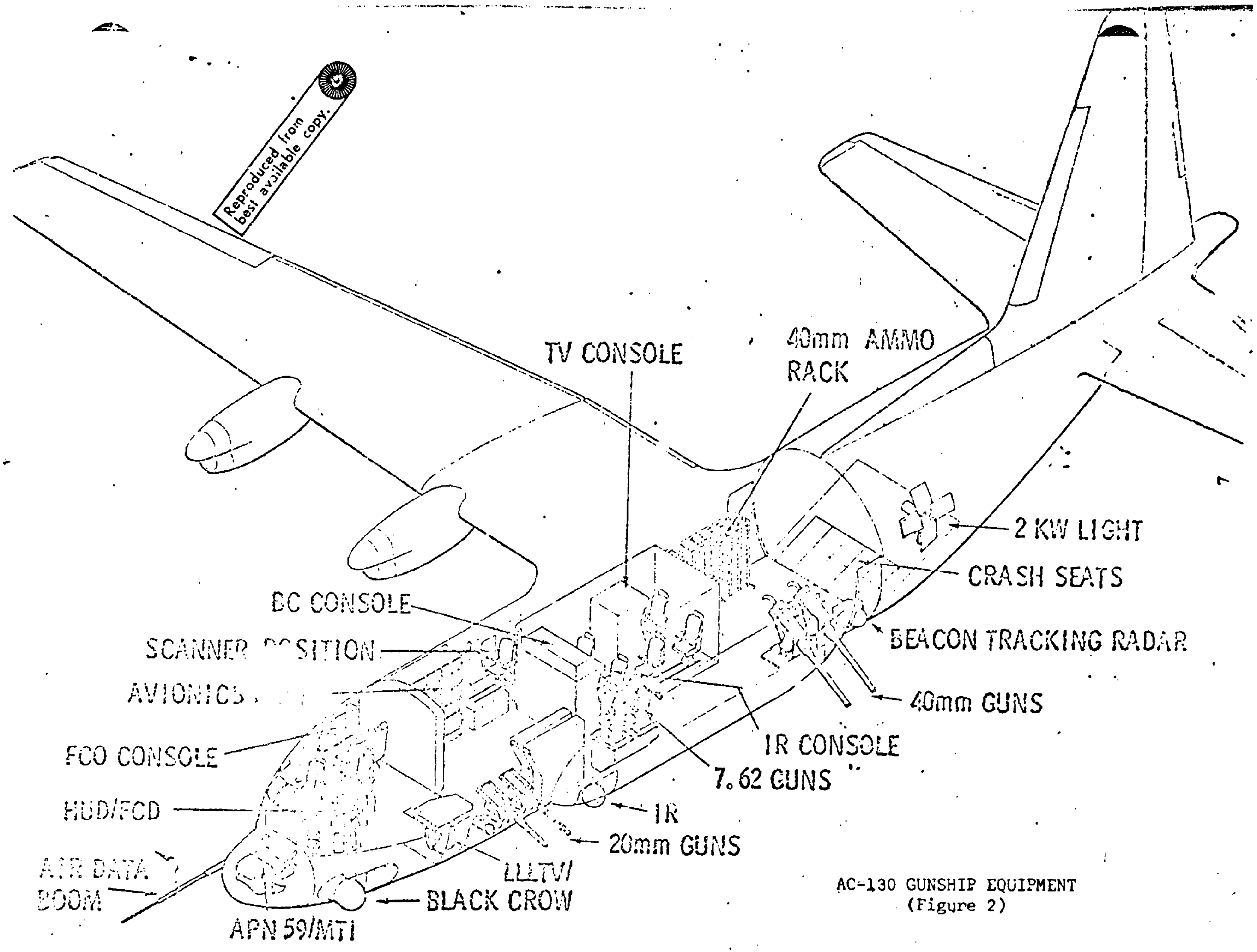
On the basis of experiences in Southeast Asia, the developers proposed a new configuration for the AC-130. The principal advances were a pair of 40-mm guns to replace one pair of 20-mm Vulcans, a digital instead of analog fire-control system, an x-band ignition detector (Black Crow), a low light level TV (LLLTV) which replaced the night optical device, an inertial navigation system, a LORAN set, and a Ground Moving Target Indicator (MTI) (see Figures 2 and 3).[8]

COMBAT RENDEZVOUS

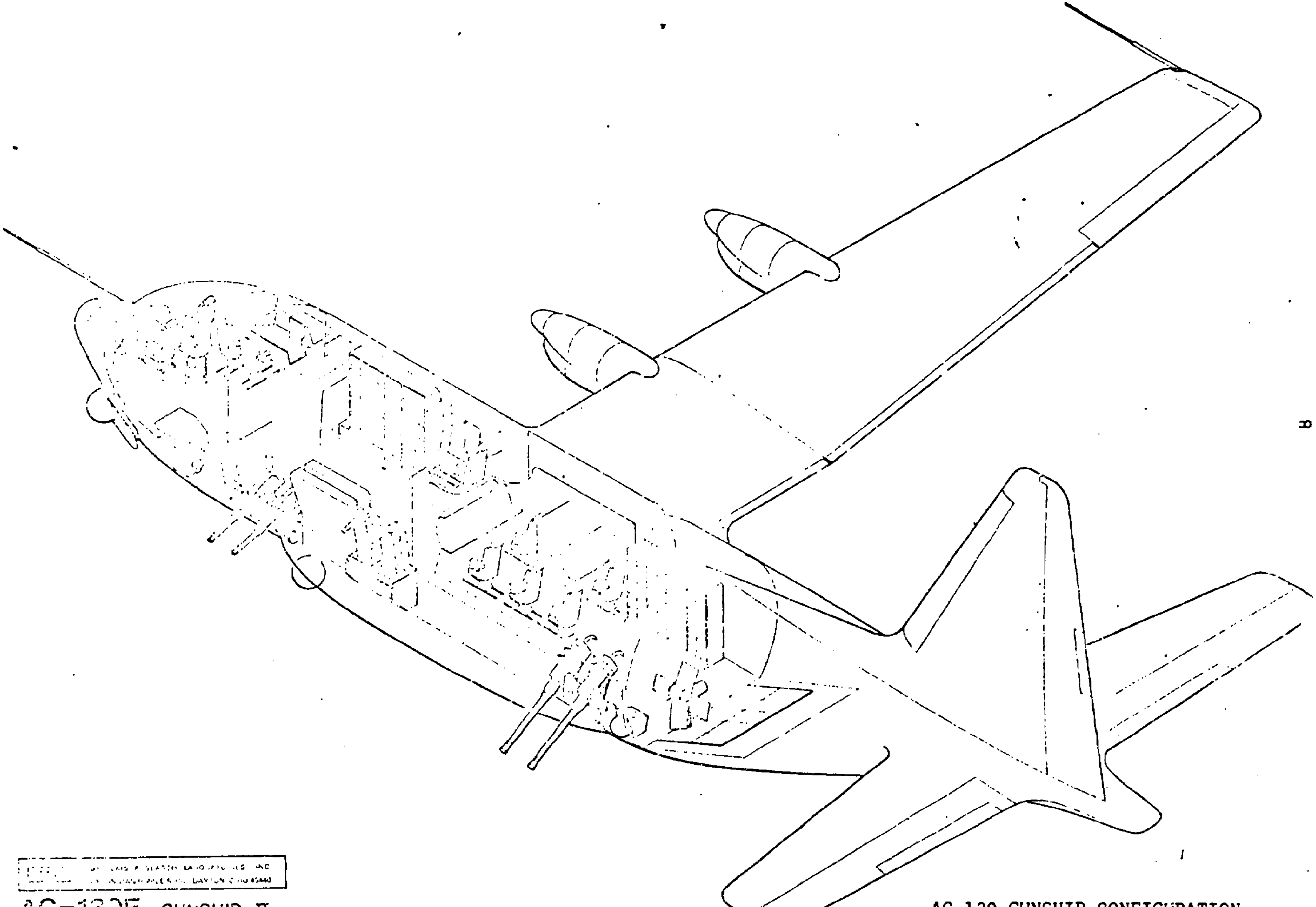
Combat Rendezvous is the name assigned to the all-weather operational concept which utilizes the x-band ground transponder (beacon) in conjunction with the AC-119K or the AC-130 gunship beacon tracking radar and computerized off-set firing capability (see Figure 4). The gunship's side-looking radar tracks the ground beacon signal, usually located at a friendly position, and gives the gunship's fire-control computer a reference point.



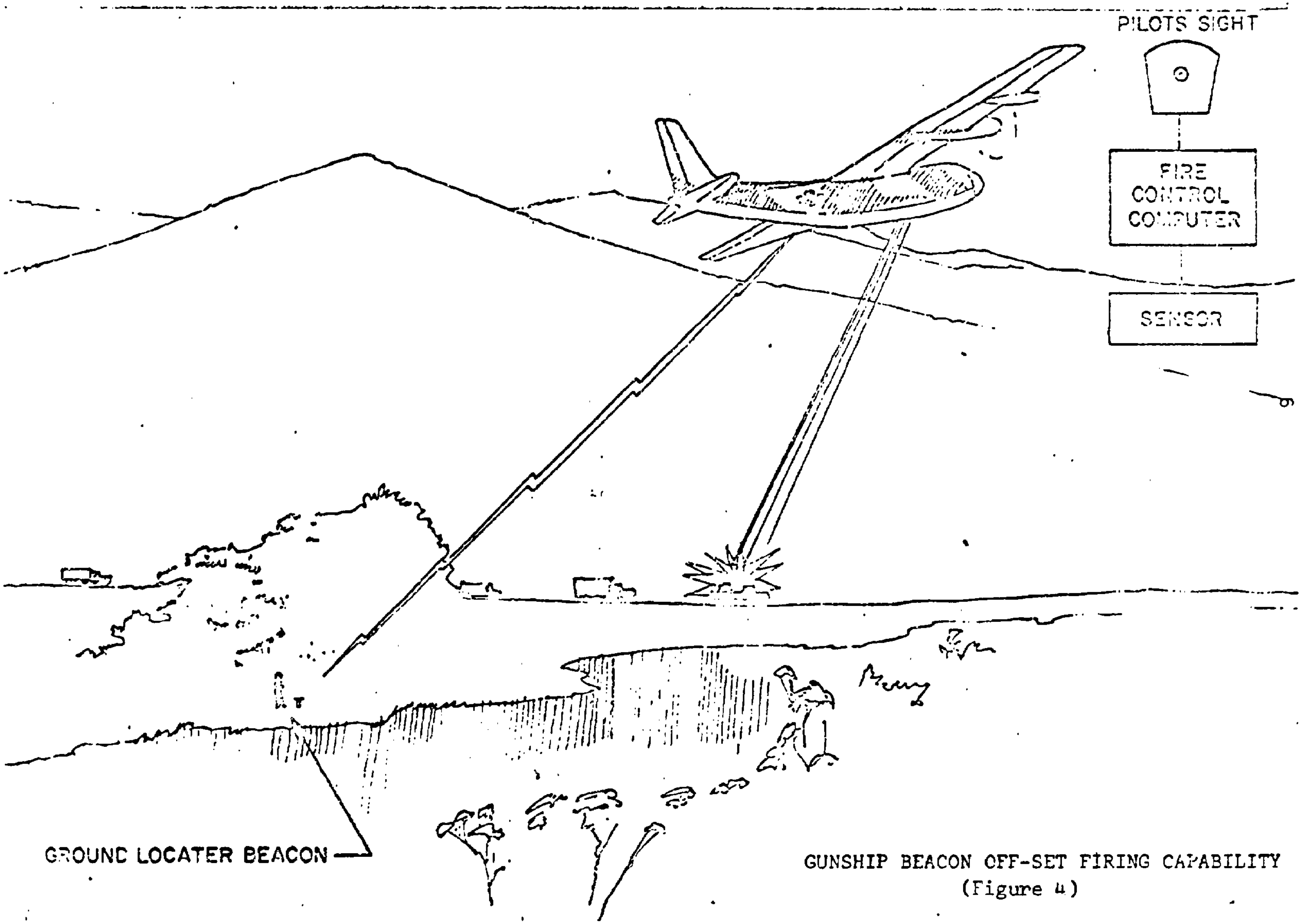
AC-130 GUNSHIP EQUIPMENT
(Figure 2)



AC-130 GUNSHIP EQUIPMENT
(Figure 2)



AC-130 GUNSHIP CONFIGURATION
(Figure 3)



GUNSHIP BEACON OFF-SET FIRING CAPABILITY
(Figure 4)

The ground commander then gives the gunship a bearing and distance from the beacon to the desired target. When this information is input into the aircraft's computer, the pilot is given target guidance information to direct the gunship's fire power at the desired target. Line-of-sight must be maintained between the aircraft and the beacon, but there is no requirement to have visual contact with the beacon. Therefore, combat rendezvous gives the gunship an all-weather close air support capability.[9]

Combat rendezvous required two new pieces of hardware. The first of these was the ground beacon system. Since this system was introduced into SEA it has been plagued with problems and setbacks. There was a lack of ground personnel knowledgeable and trained in utilizing the gunship/beacon concept in a close air support role.

Service personnel management problems contributing to this dilemma began on 6 August 1972. Selected U. S. Army personnel and USAF instructors were to assemble at a Florida Air Force Base for training as beacon/gunship instructors. Training was to include academic and practical applications of procedures as deemed necessary by USAF personnel. Three Air Force personnel and twenty-five members of the United States Army representing four different Army posts, (Ft. Ord, Ft. Lewis, Ft. Bragg, and Ft. Devens) reported to the Air Force Base.[10] Because each service had a different conception of the mission of the detachment, the following problems arose immediately:

a. The Air Force was under the impression that the Army was sending a well-trained Special Forces detachment that would need a minimum of training and be capable of sustaining the mission of combat controllers in a hostile environment with a minimum of guidance.

b. The Army was under the impression that the personnel that it sent from the various posts would be utilized as instructors only and would not be required to operate on the front lines.

(1) Fort Bragg was led to understand that twelve well-qualified Special Forces troopers from the 10th Special Forces Group would accompany the ten inexperienced lieutenants that it was levied to send.

(2) Fort Devens understood that its only commitment was a well qualified commander to head up the project.

(3) Fort Lewis and Fort Ord understood that they had a commitment to fulfill and did not ask for volunteers. They simply levied troops that were available at that time. This is commonly referred to in layman's terms as a gross lack of systematic management.

Nevertheless, by the end of August the 25 man Army contingent along with the three man USAF Advisory Team arrived in Southeast Asia.[11]

Maintenance, supply of repair parts, and training surfaced as problem areas related to the introduction of the x-band ground transponder (beacon) system into Southeast Asia. The beacons introduced into SEA were funded as a test project and were not available through normal supply channels. There was limited maintenance capability for the beacons, and no firm procedures were established for repair and replacement of beacons. These factors resulted in the following specific problem areas impacting on an all-weather combat rendezvous:

(1) Lack of operator training in the interface between the ground beacon and the aircraft radar.

(2) Lack of adequate supply of beacons and beacon repair parts.

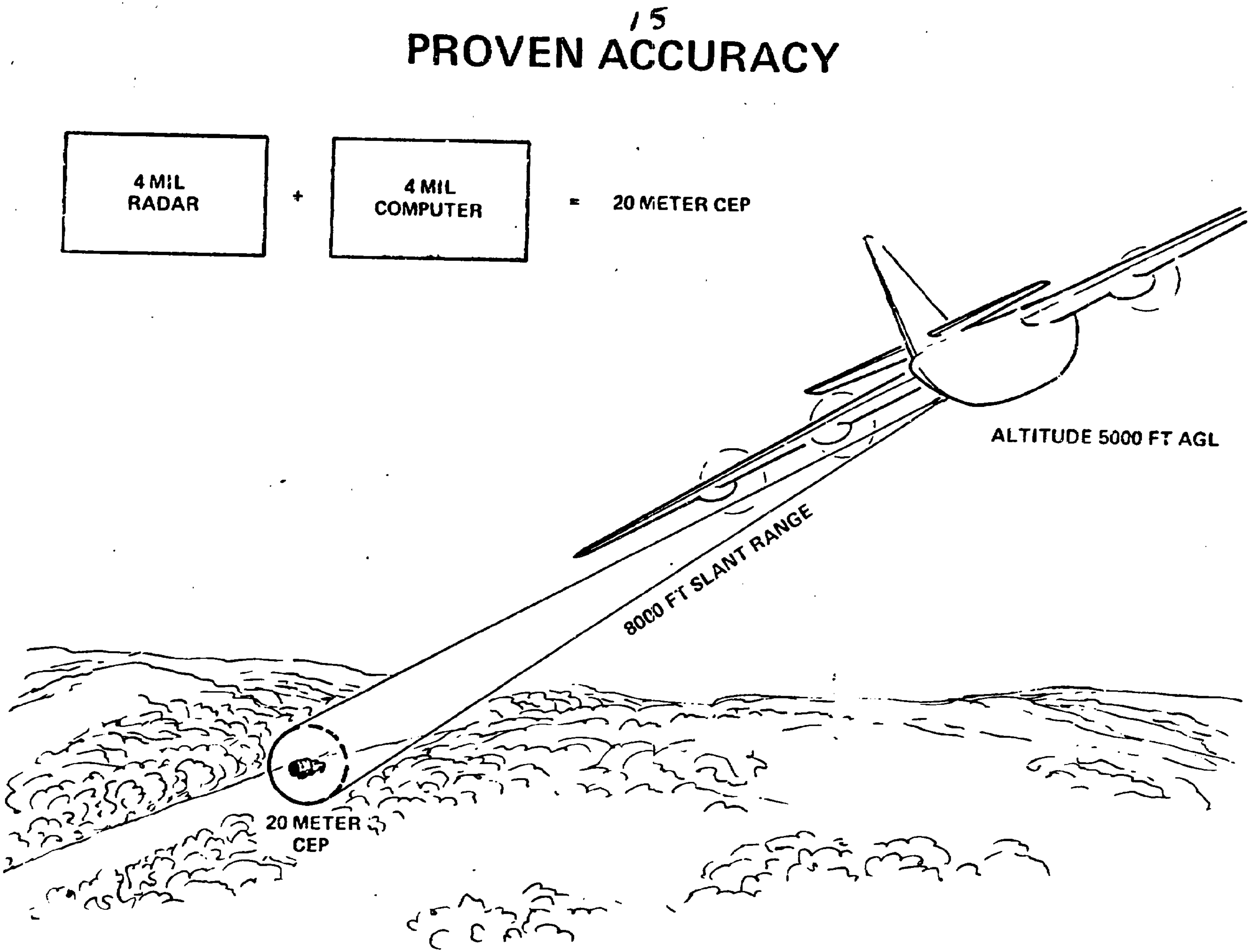
Contributing to the first problem area was the fact that the only way most ground users could tell if their equipment was operating was to have a gunship check their beacons. This was a time consuming process at best, and detracted from the gunship's primary mission. Gunships did however perform regular checks of all beacons in their operating areas. The check was to consist of acquisition, lock on, and tracking of the beacon. To save ammunition for the gunship's primary mission, practice firing was not conducted. While this procedure helped to insure that all beacons were operating properly and that inoperative units were being replaced, it did not afford either the air or ground forces an opportunity to develop experience and confidence in actual air/ground control procedures and fire adjustment. At first these checks were performed nightly, but when it developed that this was consuming too much of the gunship's orbit time it was changed to every three to five nights.

The second problem area was a result of the Army's initial lack of support, inadequate maintenance, and an insufficient supply of ground beacons. Because of these factors, the ground forces had not received extensive training in the use and care of the beacons with the result that the beacons were subject to rough handling and improper emplacement. Consequently, the beacons frequently failed in combat situations. This problem was aggravated by failures to introduce the beacons into normal supply channels and to provide for routine preventive maintenance. Instead, the beacons were maintained on an ad hoc basis by various Air Force and Army units.[12]

Reports from the field on the evaluation of the beacon and requests for additional beacons indicated that the fighting personnel saw the merit of the system. While there were a number of beacons in the field that were not utilized, many successful combat rendezvous missions were flown. An interesting observation in reviewing the combat rendezvous missions is that where ground units effectively used the system, the beacon was used frequently and with good results. Confidence and proficiency in controlling the gunship and using the beacon were prerequisites to an effective combat rendezvous program. There is no doubt that the concept is capable of enhancing the gunship's close air support capability in weather conditions which would otherwise preclude gunship operations. In addition, aircrew statements attest to the effectiveness of the system in locating the friendly position and reducing target acquisition time.

The firing geometry of the gunship required a continuous left turn and, since the navigation radar on the gunship was not capable of angular tracking, a side looking beacon tracking radar (BTR) was required. This beacon tracking radar is the second new piece of hardware required for combat rendezvous missions.

Two different radars, the AN/APQ-133 and the AN/APQ-150 were employed in combat rendezvous. Both were pulsed x-band BTRs capable of search, acquisition, and angular tracking of ground located beacons. Each system was composed of a receiver-transmitter unit (RTU) and a control indicator unit (CIU). The receiver-transmitter unit consisted of an antenna, transmitter, receiver, and signal processor mounted in a fiberglass radome on the left side of the aircraft. The control-indicator unit was located inside the gunship and consisted of a scope and operator controls. The weight of the entire system was approximately 400 lbs. When everything was working properly and the gunship was locked on the beacon, the range and bearing to the target could be passed to the gunship and set into the fire-control computer. From a nominal altitude of 5,000 feet above ground level (AGL), the four mil accuracy of the APQ-133 combined with the four mil accuracy of the fire-control computer produced a circular error probable (CEP) of only 20 meters (see Figure 5). The APQ-150 with its



GUNSHIP ACCURACY
(Figure 5)

two mil accuracy was able to significantly improve even this level of performance! When any one element of the system was not operating properly, it was recognized as a "no fire" situation.[13]

The APQ-133, installed on the AC-119K and early models of the AC-130 had a power output of 300 watts, a range of 8 NM, and a tracking accuracy of four mils. The APQ-150, with an improved antenna and receiver-transmitter unit, featured greater power (5000 watts), increased sensitivity, and finer tuning than the older BTR. These refinements gave the APQ-150 a range of 10 NM and an accuracy of two mils. The APQ-150 was mechanically more reliable than the APQ-133, and it could acquire and track beacons too weak for the older BTR to detect.[14]

Beginning in July 1971, the APQ-150 replaced the APQ-133 in the AC-130 gunships while the AC-119K gunships continued to use the older model radar.

INTEGRATED WEAPON SYSTEM

An integrated weapon system is a self-contained system which contains all the elements necessary to carry out a given task of tactical warfare. Since its infancy the idea of the gunship was to insure that the system was self-contained. It was to have the ability to locate and attack a target, assess the damage done to the targets and reattack the target if necessary. There were times when the gunship was used to locate targets for other aircraft, in particular for the fighter/bomber escorts which were used as flak suppressors. This activity improved the effectiveness of the other aircraft, but for point targets it was generally not as effective as the use of the gunship itself to deliver the munitions.[15]

The desirability of a self-contained weapon system is almost self-evident, since it obviously eliminates many of the communications, coordination, and command-and-control problems that are inherent in systems involving more than a single aircraft. The question is not whether a system is self-contained or not, but rather its effectiveness as a self-contained system. In the case of the gunship, its effectiveness against trucks in Laos attests to how well it performed as in this role.[16] This effectiveness is based on accomplishing three tasks: rapidly locating the target, minimizing the probability of losing the target once it has been acquired, and providing sustained fires on the target to include reattacking it if necessary.[17] When these three tasks are accomplished, the result is an integrated weapon system optimized to achieve target destruction.

In the case of the gunship, the first two tasks are accomplished by using multiple interdiction sensors. These sensors, by covering different portions of the electromagnetic spectrum provide a level of redundancy that dramatically reduces the time required to locate a target and makes it almost impossible for the target to evade the attack once it has been acquired. It accomplishes the third task through a combination of system accuracy, weapon lethality, and the circular attack mode, in short by achieving a high degree of terminal effectiveness.

TERMINAL EFFECTIVENESS

System accuracy is the first component of terminal effectiveness. This accuracy is a natural consequence of the flying geometry of the fixed side-firing gun that fires out the side of the aircraft. It is depressed from the aircraft's horizontal plan by an amount called the depression angle (typically 6 to 28 deg) and is pointed slightly aft to compensate for the forward airspeed. The gunship's circling attack is extremely confusing to a ground gunner, who has a much simpler prediction problem with the straight-ahead, nearly constant-velocity attack that is normally used by close-air-support, interdiction, and strategic aircraft.[18] As the aircraft flies around the target, all ballistic corrections remain within a few mils of being constant, and the wind effects appear as target motion in the air-mass coordinate frame. While the wind may be initially unknown, the measured error after the first few shots allows the effective wind to be calculated. The estimator that calculates this is a part of the digital fire-control system. The insertion of miss data automatically refines the estimate of the wind, as well as the fixed-gun misalignment.

The second component of terminal/effectiveness is weapon lethality. The "old" AC-47 gunship was forced to fly between 3,000 and 5,000 ft altitude because of the lethality of its weapons which, in turn, depended on their effective range: the 7.62mm minigun had an effective range of only 3800 ft. This range limitation was one of the major factors in upgrading the aircraft to the AC-119K and replacing the 7.62mm miniguns with 20-mm guns. Shortly thereafter some of the 20-mm guns were replaced with 40-mm guns. This change allowed the gunship to work effectively out to slant ranges of 20,000 ft. A newer and larger caliber gun offered the ability to fire at ranges out to 40,000 ft which also increased the gunship's invulnerability to ground fire.[19] Furthermore, the wide variety of warheads associated with the larger caliber gun enhanced the value of this weapon: high explosive, white phosphorous, and beehive-type flechette packages were available.

The third component of terminal effectiveness is the circular attack path. This path ensures that the gunship is continuously on target, and that in the pilot's frame of reference the target is practically stationary and continuously under attack. It naturally leads to an ability to attack, assess the effect with the sensors, and reattack very rapidly, an advantage which is particularly important for close air support missions. Finally, the fact that the target is under virtually continuous scrutiny makes it extremely difficult for an enemy to evade the attack.[20] The defensive advantages associated with the turning flight increase with higher altitudes. From the ground gunner's standpoint, the gunship motion is viewed as perpendicular to the gunner's line of sight. A small percentage error in velocity estimation can result in a sizable miss distance. This is a more difficult lead problem that the straight-ahead delivery, where the lead angle for the incoming aircraft is virtually eliminated because the target is flying straight at him.

Finally, and equally important, the gunship is in a continuous turn; that is, from the gunners point of view it is in accelerating flight. Since most antiaircraft fire-control computers predict position on the basis of an assumed constant velocity, this continuous acceleration will cause them to be in error.[21]

It must be clearly understood that this miss occurs for a perfect fire-control system of the constant-velocity-prediction type. In particular, the use of radar will not eliminate the error. It is theoretically possible to construct an antiaircraft artillery system which would include a constant acceleration correction, but this would involve making unacceptably complex and bulky modifications to current systems.[22] The defensive advantages associated with the turning flight increase with higher altitudes. The low-flying AC-47s experienced a higher attrition rate, partly because they were not able to use higher altitudes.

Accuracy, weapon lethality, and the circular attack mode determine the amount of fire that can be delivered on a given target. As important as the physical fire impacting on the target is the target's view of that fire and the system delivering it. Thus, the gunship is as powerful a psychological weapon as it is a physical weapon. To capitalize on its psychological impact, a gunship must be seen and must be heard. The tactics used by a gunship must be unpredictable in order to make full use of its psychological advantage. For example, one time the gunship may orbit, drop a flare, then fire. The next time it may orbit and just drop flares. Or it may drop a flare in one spot, then fly to another spot and strike instantly. Most important, the gunship must be aggressive; it must demonstrate that it is hunting and must expend ordnance. The concept of orbiting and waiting to be called upon, and perhaps eventually landing without expending, is passe.

THE INTERDICTION ROLE

The initial successes of the gunship concept had little to do with the interdiction role. Instead, its close air support of friendly troops and hamlets gave the AC-47 its well-deserved initial reputation for effectiveness. The shift to the interdiction of enemy logistics did not occur until the AC-130 was introduced.

The interdiction role varied considerably, according to the mission.[23] Although the AC-130 is an integrated weapon system, it lacks the capability to destroy all targets efficiently. It is best at finding and destroying point targets, such as trucks. Larger or harder targets can be found by the AC-130, but they are more appropriate for attack by other aircraft and aircraft systems. Thus, the interdiction task force, which used the AC-130 to locate targets for other aircraft, was developed. Typical targets for the interdiction task force are gun sites, oil pumping stations, and area targets such as truck parks and troop concentrations.[24] Most of these are more vulnerable to ordnance such as general purpose bombs and napalm delivered by other than gunship aircraft.

The interdiction role is a natural outgrowth of the gunship's ability to see a class of targets, such as fortifications and antiaircraft artillery sites, that it cannot effectively attack. This use of the AC-130's detection capability with the destructive interdiction potential of other systems is a very promising marriage.[25]

RESEARCH AND DEVELOPMENT TECHNOLOGY

Since its inception the gunship concept employed the current philosophy of prototyping, including the idea of continuous prototyping of the total weapon system. While this concept was not clearly enunciated during the gunship research and development process, it was essentially followed since the early days of the AC-47. The managers viewed gradual evolutionary research and development as the natural way to achieve the best state-of-the-art design. The process can be termed as buy, fly and try with specific reference to new or modified subsystems of the gunship.

A single organization, the Gunship System Program Office at Wright Patterson AFB, was responsible for all the production aircraft. The research and development was jointly handled by the System Program Office and the Deputy for Tactical Warfare at Wright Patterson AFB. This joint relationship was at times under the general direction of the System Program Office, but still, it was an example of management to achieve an objective rather than management to achieve control. The Chief of the System Program Office, evidenced a great deal of trust in his subordinates and was not subjected to an excessive number of outside constraints on the configuration of the experimental prototypes. Other Air Force research and development elements including the U. S. Air Force Academy furnished key personnel. All groups interacted smoothly, bringing few organizational prejudices with them in their endeavors.[26]

As an important aspect of creating teams to fly the operational systems, the individuals selected for training as gunship crews were involved in the conception, experimental prototyping, production testing, and combat deployment of these systems. The strong sense of personal identification created the spirit needed to overcome the difficulties involved in research, development, testing, and deployment.

An example of how this spirit affected the work accomplished consider the production time associated with the installation of twelve new major subsystems. The new subsystems were two 40-mm guns, a digital computer, an inertial navigation system, a helmet sight, a LORAN system, a low light level TV sensor, a laser ranger/designator, a 2-kw illuminator, a TV and IR video recorders, a Black Crow sensor, an air data computer, and a moving target indicator processor.[27] Forty-five days after receiving the hardware, this system had been flight tested and combat evaluation was initiated in Southeast Asia! This remarkably short production and deployment time was due to a unusually well-balanced group of managers and engineers. The small group of officers had more than 500 combat missions in gunships. They worked in concert because they believed in the gunship concept and felt that they were partially in control of the destiny of the program. They had two stated rules during prototyping. The first was to never look back or blame anyone, because everyone was doing his best. Second, the installation of any proposed fix had to be overseen by the proposer; and if the fix failed he also had to oversee the removal. This latter rule circumvented "sharp shooters" from interfering with the work at hand.[28]

During the production phase, the Gunship System Program Office was extremely small, consisting of 14 technical and support positions. Headquarters Department of the Air Force had directed that the initial series of aircraft be completed in 5 1/2 months. Despite the short production schedule, all aircraft were delivered either on time or ahead of schedule. Additionally, the program used only 90 percent of the dollars originally allocated.

During the more than seven years of gunship evolution, the developers would invariably concentrate their efforts on high-payoff improvements, using existing technology. This is closly related to the concept of an integrated weapon system, since it was the overall system improvement that formed the basis for the many alternative choices that were made. The identification of the correctable deficiencies in the existing system is a prerequisite to successful evolution, and this identification can only come from realistic operational test and evaluation in an environment as nearly identical to combat as possible.

Realistic gunship testing was achieved because the developers had actually used the system in combat in Southeast Asia. The test programs tended to be informal and flexible, basing each day's test on previous results. This empirical approach was in contrast to the theoretical analysis that is sometimes substituted for testing. Another pertinent example is the fire-control system. A new digital fire-control system had been developed for use in an Air Force aircraft. Rather than develop an entirely new system for the AC-130's, the System Program Office wisely decided to modify the digital system which was already in inventory. Maintenance, training, spares, and technical manual costs all were tremendously reduced as a result.[29]

AC-130A airframe improvements were mainly limited to those items that would improve the survivability of the gunship. For example, foam was added to the fuel tanks, hydraulic lines were armored, and armor was placed around each crew station. The upgrading from Model A (AC-130A) to Model E (AC-130E) was motivated by the requirements of airframe and engine maintenance as much as anything else. This is because the Model A has rapidly lost its world-wide logistic support system in the past few years.[30]

CONCLUSIONS AND RECOMMENDATIONS

The results of the gunship experience have a distinct use in a number of possible low-level conflicts. Good use could be made of the all-weather gunship close air support system in counter-insurgency operations, both in this hemisphere and elsewhere in the world. In these operations, the night reconnaissance capability offered by the gunship gains additional importance because it supplies field commanders with the timely intelligence they require about truck movements, the relocation of supply storage areas and other insurgent movements, most of which take place during the hours of darkness.[31] Since gunships are equipped with both infrared and LORAN sets, they have the precise navigation capability required to effectively pinpoint targets discovered during their infrared reconnaissance. Moreover, the gunship may have application in border or coastline patrol operations, and increased use of this type of aircraft may be worthwhile in search and rescue systems.[32]

As an integrated weapon system, the gunship strives for a certain element of complexity. In armed forces that are rapidly reducing their manpower, increases in individual effectiveness can be obtained by using the modular "black box" approach. Two lessons involving this approach can be drawn from the gunship experience. First, if the purpose of a given weapon system is analyzed in detail, aid to the human operator usually is called for, and, second, the sophisticated techniques involved in this approach must evolve slowly or reliability and maintainability will suffer.

Many of the black marks given to sophisticated weaponry are directly refuted by the gunship experience. Instead, unnecessary, unrealistic, and undeveloped technical approaches are often the real causes of the problems encountered in fielding and using such systems. We cannot disregard technology that is already on hand because of the false notion that it cannot be made to work or is not "cost effective." Closer analysis will reveal that a moderate degree of technological advance is necessary if we are to produce systems materially better than those of 25 years ago.[33]

The x-band off-set beacon used in conjunction with the side-firing aircraft, represents far more than just another ancillary system. Rather, when it is coupled with a gunship, the result is a complete air/ground system which constitutes a revolutionary breakthrough in the all-weather employment of air power for direct support of ground forces.[34] It is now operational and able to direct fire through clouds in support of friendly positions. The potential of this system should be fully understood and utilized by the Army and Marine Corps ground units it is designed to support.

The fixed side-firing gun offers a wide range of very appealing advantages. Its accuracy and relative invulnerability were important factors in the success of the AC-130 gunships. In particular, the fixed side-firing gun provides the firing ability and allows mode of flight, which have been key ingredients in the gunship achieving its remarkable record of success.[35]

The history of the gunship development program shows that the developers paid merciless attention to the purpose of their weapon system. Any component that did not improve the accuracy or lethality and any system which could not be maintained was ruthlessly discarded. By the same token, temporarily ineffective systems were retained if it was known that they could be improved in the near future. A prerequisite to the flexibility shown in this development program was the courage and confidence in the developers that was shown by the Air Force leaders.[36]

As evidence by the development of the gunship, there seem to be some major prerequisites for successful research and development:

1. The basic weapon-system concept must be sound.[37]

2. The managers of the system must have relative freedom of action.

3. Top and middle management should be committed to the program over an extended time.[38]

4. Before any massive production buys, research and development items should be brought to the point where major deficiencies cannot go unnoticed. In this respect, Assistant Secretary of Defense Packard stated that research and development programs were in trouble because production had been started before engineering development was finished.[39]

5. The weapon system should be managed by a small, competent group made up of people who understand the problem. The creation of small, highly motivated teams offers promise for relatively inexpensive, long-term weapon system development. In the case of the gunship, a competent in-house, rather than contractor, group showed that a combination of engineer, combat operations, and research personnel is the desired mix.[40]

6. More than anything else, realistic operational test and evaluation is absolutely necessary.

It is recommended that a comprehensive Department of the Army study be initiated to further examine the considerations brought forth in this essay for the purpose of strengthening the ground armed forces. In particular, this study should address the feasibility and utility of a small task force comprised of gunships, gunship crews and off-set beacon teams. The beacon teams would be airdropped as paratroopers into a threatened area and used to establish ground beacon sites. Once these sites were established, these teams would have the firepower of the gunships available to neutralize almost any target. Trained and deployed as a unit, such a task force would be an organization with the flexibility and strength to handle any reasonable threat in a low to mid intensity enviroment where the US maintained air superiority.

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FOOTNOTES

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6. Ibid., p. 9.

7. Ibid., p. 10.

8. Ibid., p. 15.

9. Interview with Riddle, 22 December 1972.

10. Interview with Riddle, 24 December 1972.

11. Interview with Riddle, 25 December 1972.

12. Interview with Riddle, 29 January 1973.

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14. Ibid., p. 19.

15. Richard J. Toner, "The Total Force Concept," Air University Review, November-December 1972, p. 5.

16. "Darkness Dies Screaming," Airman, October 1972, p. 37.

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23. John L. Frisbee, "USAF's Changing Role in Vietnam," Air Force Magazine, September 1971, p. 45.

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31. Robert L. Gleason, "Quo Vadis? - The Nixon Doctrine and Air Power," Air University Review, July-August 1972, pp. 45-56.

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33. Ibid.

34. US Air Force, "Gunship Off-Set Firing Capability," Department of the Air Force Presentation Outline, August 1972, p. 21.

35. Interview with Riddle, 25 December 1972.

36. Ibid.

37. Ibid.

38. Ibid.

39. D. Packard, DOD/NSIA Industry Briefing, Washington, D. C., 11 August 1971.

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